Switched on Homes final report

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Contents

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Executive Summary

This report provides an analysis and evaluation of the current results of the Switched on Homes trial. The trial engaged 240 households in the City of Gosnells, City of Armadale and Shire of Serpentine Jarrahdale in piloting energy efficiency approaches. The trial was funded through the Department of Industry, Innovation and Science's Low Income Energy Efficiency Program and a consortium including local governments (Gosnells, Armadale and Serpentine Jarrahdale), energy efficiency technology specialists (Power Intelligence), land developers (Stockland), non-government organisations (Anglicare) and not for profits (Environment House) was assembled.

Participation in the trial was voluntary and a core of "volunteers" was established. The average Switched on Homes participant was 65.5 years old, lived in their own home, had completed high school and had an annual income between $20,800 and $31,200. Prior to starting the trial, Switched on Homes participants had an average electricity consumption of 10.6kWh per day while the Perth metro-average was 15.23 kWh per day.

Trial volunteers sought to be involved for a number of reasons, including a desire to trial new technology, to be part of a study, to help more disadvantaged members of the community through their participation as well as a to try and save electricity in their own homes.

Three energy efficiency approaches were trialled during 2015: generic energy efficiency tips sent by SMS, personalised feedback sent by SMS and voltage optimisation. In addition, "peak load SMS" were dispatched three times when electricity demand was extremely high to measure how the community responded to requests to shift their use. Volunteer households had their electricity consumption recorded every half hour to evaluate how effective different trial approaches were. Electricity consumption in the trial year (2015) was compared to the baseline of the previous year (2014).

Key findings of the trial include:

- Voltage optimisation resulted in a 8% reduction in electricity use
- SMS tips helped 43% of households make a meaningful reduction in their electricity use. In a household with average electricity use this resulted in a 5.8% electricity reduction
- Personalised feedback had mixed results. Households increased wellbeing, including financial control, control over their electricity use and attitudes towards energy efficiency. Despite this, personalised feedback did not result in meaningful electricity reductions and showed signs of being slightly demotivating
- The community pulled together in response to peak load SMS and turned off their appliances. Households without rooftop solar-PV played a large part in this, with 45-51% of these households reducing electricity consumption after receiving an SMS
- Households built since minimum energy efficiency standards were enacted (post-year 2000) have a lower electricity demand than older households, and consume less electricity year round.

Voltage Optimisation

Voltage optimisation units, designed and manufactured by consortium members Power Intelligence, were fitted to 80 trial homes. This was the first trial of residential voltage optimisation in Australia. The voltage optimisation unit tailors voltage supply to an ideal level, resulting in electricity savings

and prolonged life of appliances. The average change in the voltage optimisation group was a 14.5% decrease in electricity consumption. Some participants have provided feedback that the voltage optimisation unit made their appliances function better; however the vast majority didn't notice its operation at all. Although the overall response to voltage optimisation was a significant electricity reduction (8% reduction in the trial year), it is clear a targeted approach is needed in future. Under half of all houses with voltage optimisation units had a significant reduction in electricity consumption (45% of households experienced a reduction of greater than 5% per annum). This is marginally higher than the percentage of households that benefited from SMS tips.

SMS tips

SMS tips were a popular approach and 96% of households said they found them convenient. Performance of the automated service was highly reliable (235/240 participants received their SMS regularly during the trial) and cost effective (7 cents per SMS). Receiving energy efficiency tips via SMS proved more popular with the senior citizen demographic recruited to Switched on Homes than the general population. Despite the near universal popularity of this approach, it appears there is a need to target the delivery. A total of 43% of households that received SMS tips were able to reduce their annual electricity consumption by over 5%. However, when analysing all households, the approach was not statistically significant. Further investigation revealed that two demographics specifically benefit from receiving SMS tips: households without rooftop solar-PV (average reduction of 4.7% per annum) and households with average electricity use (5.8% reduction in electricity use). Since the average Switched on Homes household had below average electricity use, it appears that widespread SMS tips would perform better in a real world application than they did in the Switched on Homes trial.

Personalised feedback was a popular approach, with 80% of participants reporting it helped to reduce their electricity bills. These households increased their financial control (from 72% to 81%) and control over their electricity use (from 74% to 81%) and reduced barriers (after receiving personalised feedback there was a 20% increase in households reporting no barrier to energy efficiency). There was however, no reduction in electricity consumption from households receiving personalised feedback. Unlike SMS tips, there was no subset of households identified through the trial that responded to personalised feedback by reducing electricity consumption. There was also a slight decrease in motivation (lack of motivation increased from 1.3% to 2.9% during the trial) while motivation in groups not receiving personalised feedback improved. This seemingly conflicting set of results leads to the conclusion that personalised feedback is a powerful informative tool which consumers value highly, but in the Switched on Homes format does not motivate energy efficient behaviour.

Peak load SMS

Three times during 2015 households involved in the trial were asked to reduce their power consumption for the next four hours as the grid was nearing peak capacity. There was no incentive for households to do this, other than the benefit to the wider community. The response from participants was powerful, particularly from households without rooftop solar-PV. 45% of households without rooftop solar-PV responded by decreasing their electricity consumption following the first two messages, and then 51% decreased consumption in response to the third message. A consistently smaller number of households with solar-PV participated, and this suggests

there may be some confusion in households with solar-PV about contributing to peak demand. Although households were very compliant in the first hour following an SMS, only a small proportion was able to maintain this over a four hour period. Future programs should work to harness the goodwill of the community by asking them to switch off for brief periods of peak demand, instead of long blocks of time.

New housing stock

A subset of homes built since minimum energy efficiency standards were introduced was included in the trial. Built age had no impact on the ability of households to respond to Switched on Homes approaches, indicating that behaviour change and technology based approaches are suitable in most houses and do not require further tailoring. However, homes built since minimum standards were introduced consumed 26% less electricity than their older counterparts. This was of particular importance in summer, as none of the approaches trialled by Switched on Homes reduced summer electricity demand, but new homes had much lower electricity demand. While this is a wonderful endorsement for energy smart buildings, it is important that older housing stock isn't left behind.

Based on the findings of this report, the Switched on Homes team recommend the following information be considered by future programs and policies:

- Use SMS as a communication channel for behaviour change, but tailor to the audience
- Support Australian households to invest in energy efficiency hardware
- Support the community to shift their use outside of peak demand through tailored programs. Focus on programs and policies that improve thermal resilience and comfort in the home.

Switched on Homes

What is Switched on Homes?

Part of the Low Income Energy Efficiency Program – a national program investigating innovative energy efficiency ideas.

Switched on Homes was an energy efficiency trial to test ways of helping households to save electricity.

2015 RESULTS

Households that had a Voltage Optimisation Unit installed **reduced** their electricity use by an average of 14.5% in 2015.

14.5%

Energy efficiency tips delivered by SMS proved very popular and helped

43%

of households save electricity

Participants that received personalised feedback about their electricity use by SMS reported increased wellbeing, including financial control, control over their electricity use and attitudes towards energy efficiency, but did not save electricity.

WHAT ARE VOLTAGE OPTIMISATION UNITS?

Voltage Optimisation Units smooth the voltage delivered from the grid to your home. The reduction in voltage can save electricity and money.

Voltage Optimisation Units will work better for some homes than others, depending on the voltage being delivered to your home and your mix of appliances.

HOUSEHOLD CHARACTERISTICS

The **average** daily electricity use for households enrolled in the trial was

11 units per day

240 households

in the south east of Perth participated in the trial

The **average** Switched on Home had

1.9 residents

The **average** age of participants was 65.5 years

OUTCOMES

SMS was found to be a popular and convenient communication method. If you would like to receive a free monthly energy-smart tip by SMS, text your name and postcode to 0428 917 898

Find out more at **switchyourthinking.com**

Figure 1 Draft Switched on Homes infographic of results

Figures

Tables

Glossary of terms

Ad hoc SMS:	SMS that does not contain an Energysmart tip and sent outside of the scheduled 7pm, Monday evening timeframe.
Baseline:	Electricity consumption data collected in 2014 for comparative purposes.
Bi-monthly data:	Collected from Western Power billing records
Community control:	Data provided by Western Power on the electricity consumption of the general population in the trial area.
Consortium:	The collection of organisations that contributed to Switched on Homes.
Control group:	Group of participants that received no treatments.
Data loggers:	Device installed in Low Intervention, Test 1 and Test 2 households to collect electricity consumption data (Millennium Electronics 100A energy monitor, aka intelligy GPRS module and PMD.
Energy efficiency:	Using less energy while providing the same service.
Energysmart SMS:	Energy efficiency tips sent to participants by SMS
Greensense:	Western Australian company that provided the Information Management System
Group site:	Residential facility where participants share central management and resources (for examples, a common area, club house and bowling green).
Half hourly data:	Electricity consumption data collected by the data loggers at participant dwelling.
IMS:	Information Management System used to collate electricity consumption data and provide personalised feedback for participants.
Interquartile range:	A measure of variability, based on dividing a data set into quartiles.
Intervention:	An activity that is intended to influence a participant's electricity consumption behaviour.
Köppen classification:	The most widely used system for classifying the world's climates. Its categories are based on the annual and monthly averages of temperature and precipitation.

kWh:	Kilowatt hour
Linear mixed effect models:	Extensions of linear regression models for data that are collected and summarized in groups. These models describe the relationship between a response variable and independent variables, with coefficients that can vary with respect to one or more grouping variables. A mixed-effects model consists of two parts, fixed effects and random effects
Low-income households:	Household eligible for a health care card or proof of household income under $51,000
Low intervention:	Group of participants that received the Energysmart SMS only.
Mean:	The average value, calculated by adding all the observations and dividing by the number of observations.
Median:	A value lying at the midpoint of a frequency distribution of observed values, such that there is an equal probability of falling above or below it.
N:	The number of households included in a sample or test
NEM 13:	Billing data from retailer. Data format for interchange of 'accumulation' (usually 60–100 days) electricity consumption data
NEM 12:	Half hourly electricity consumption data collected from data loggers. Data format for interchange of 'interval' (30 minute) electricity consumption data.
Outlier:	A value that "lies outside" (is much smaller or larger than) most of the other values in a set of data.
p-value test:	Level of marginal significance within a statistical hypothesis test, representing the probability of the occurrence of a given event.
Peak demand:	Peak demand refers to the times of day when our electricity consumption is at its highest.
Personalised feedback:	Feedback on household electricity consumption generated by the Information Management System.
Rebound effect:	The reduction in expected gains from new technologies that increase the efficiency of resource use, because of behavioural or other systemic responses

Standard deviation (Std Dev, SD):	A quantity expressing by how much the members of a group differ from the mean value for the group.
Standard error (SE):	The standard deviation of a statistic. This expresses how much the statistic (for example mean) differs from the sampled population.
SoHo:	Switched on Homes
Solar-PV:	Household solar photovoltaic energy system.
Time of use tariff:	Electricity costs different prices at different times of the day.
Test 1:	Treatment group that received Energysmart SMS tips and personalised feedback only.
Test 2:	Treatment group that received Energysmart SMS tips, personalised feedback and a Voltage Optimisation Unit.
Test groups:	Low Intervention, Test 1 and Test 2 groups.
Voltage optimisation unit (VOU):	Power Intelligence Voltage Optimisation units (VOU) create a tap change from the utility supplied voltage to 220-222 volts

Introduction

Overview of Switched on Homes

Switched on Homes trialled technology and communication based approaches to reduce household electricity consumption through behaviour change. Trial approaches were tested in 240 low-income households in 2015, compared to a 2014 baseline in the same households. The trial was delivered at no cost to participants and objectives focused on behaviour change with no financial investment.

Each household received a combination of the three approaches detailed in Table 1.

Table 1 Switched on Homes approaches

Approach	Number of households involved
SMS tip weekly	240
Personalised advice via SMS weekly	160
Receive a voltage optimisation unit	80

The target demographic for inclusion was households with a health care card and/or households with low levels of educational or occupational obtainment. A subset of new households or new homeowners was sought. Among the recruited demographic, seniors, retirees and home owners were strongly represented.

Switched on Homes approaches addressed the following barriers:

1. Time poor
2. Low levels of educational and occupational obtainment resulting in:
    a. poor research skills and
    b. difficulty in adapting generalised advice to their circumstances
3. Financially unable to participate in past government initiatives which offered rebates for investing in energy efficient measures (e.g. insulation, upgrading appliances or installing renewable energy systems).

Table 2 Switched on Homes barriers

Approach	Barrier Addressed
SMS tip weekly	1 and 2a
Personalised advice via SMS weekly	2b only
Receive a voltage optimisation unit	3 only

Funding for the program was received through the second round of the Low Income Energy Efficiency Program, funded and administered by the Department of Industry, Innovation and Science. The program was developed and delivered by a consortium formed specifically for the trial, who contributed additional funds and in-kind contributions (see The consortium).

Switched on Homes objectives

Switched on Homes program objectives

1. Assess if trial approaches (treatments) are able to change participant's electricity use
2. Assist participants to reduce their household electricity use
3. Influence future public policy and program design relating to low-income household energy efficiency

Switched on Homes experimental objectives

1. To assess the efficacy of SMS as a tool for driving electricity conservation behaviour change
2. To measure the effect of personalised feedback in helping households reduce their electricity use
3. To measure the effect of voltage optimisation units in a residential home
4. To measure if low-income households can respond to requests to reduce electricity consumption during times of peak demand
5. To summarise energy use patterns over a 24 hour period for summer, autumn, winter and spring
6. To identify trends between climatic data and electricity use within trial participants

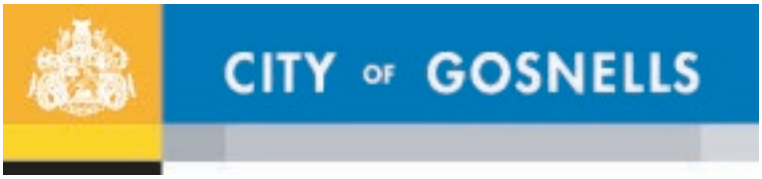
The LIEEP and objectives

The Department of Industry, Innovation and Science administered the LIEEP to trial new and innovative approaches to assist low-income households overcome barriers to energy efficiency and to better manage their energy costs and use.

LIEEP funding was assigned through competitive merit-based grants to projects which could fulfil the LIEEP objectives and benefits.

Table 3 The LIEEP objective and Benefits

Low Income Energy Efficiency Program	
Objectives	**Benefits**
• 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	• 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


CITY OF GOSNELLS


CITY OF
Armadale


power intelligence
Voltage Optimisation


Shire of
Serpentine
Jarrahdale


Stockland


AnglicareWA
FOR TODAY FOR TOMORROW


Environment House

The consortium

Switch your thinking

The City of Gosnells, City of Armadale and Shire of Serpentine Jarrahdale are three contiguous Local Governments in the South East of Perth, WA. The councils have worked collectively on the award winning *Switch your thinking* program since 2001. Through the program, the councils aim to create positive environmental action and reduce greenhouse gas emissions in their community and corporate practices. *Switch your thinking* has a fifteen year history of partnering with the corporate sector and government agencies to deliver successful and innovative energy efficiency projects within the local community.

As the administrative base of *Switch your thinking*, the City of Gosnells acted as the grant recipient and lead consortium member.

Power Intelligence

Working from their headquarters in Western Australia, Power Intelligence design and manufacture voltage optimisation units. Power Intelligence have installed voltage optimisation units at numerous industrial sites and entered the residential market in 2014. Power Intelligence focus on providing energy smart hardware solutions for the business, industry and residential sectors.

Stockland

Australia's largest property group, Stockland is actively engaged in developing new, liveable and sustainable communities in *Switch your thinking* councils and across Australia.

Anglicare WA

A not for profit working together with people, families and their community to enhance their abilities to cope with the challenges of life and relationships. Anglicare WA provides services to help low-income households with the cost of living and develop skills to manage household finances.

Environment House

A dedicated sustainability community association operating in Perth since 2001, Environment House is committed to protecting and restoring the natural environment of Western Australia through community education and involvement.

Consortium roles

The City of Gosnells, City of Armadale and the Shire of Serpentine Jarrahdale aided in recruitment and contributed the time and expertise of *Switch your thinking* staff for the duration of Switched on Homes. Access to the resident database in each council was a crucial turning point for recruiting households to the program. In addition to these contributions the following unique contributions are recognised:

- The City of Gosnells, as the lead consortium member, also provided an administrative base for Switched on Homes and a financial structure. The City of Gosnells contributed $114,180 in-kind and $10,000 cash.
- The City of Armadale collected building records, provided administrative support, IT guidance and IT review for the program. In completing their activities, the City of Armadale provided $14,220 in-kind support.
- The Shire of Serpentine Jarrahdale contributed $2,091 in-kind, retrieving building records.

Power Intelligence developed and installed customised voltage optimisation units, sourced and installed data loggers and sourced a file transfer system (from data loggers to the information management system). In 2015 Power Intelligence also prepared an analysis of the first six months of the trial. Power Intelligence contributed $35,000 in-kind delivering the above.

Stockland spearheaded the marketing and communications campaign for Switched on Homes. Stockland developed and coordinated flyer drops and randomised mail outs for recruitment as well as creating media opportunities for promotion of the trial. Stockland provided a contribution of $10,021 cash to printing and distributing marketing materials and $10,000 in kind producing materials and marketing.

Anglicare WA revised and improved the Switched on Homes advertising materials and survey to ensure inclusiveness, relevance, cultural sensitivity and accessibility. Through their experience rolling out the Home Energy Saver Scheme, they helped create energy efficiency tips that would generate the best results for participants. Anglicare WA contributed $1,350 in kind completing these activities.

Environment House assisted in participant recruitment and engagement as well as developing and delivering personalised reports for each household at the end of the trial. Environment House contributed $1,350 in kind completing these activities.

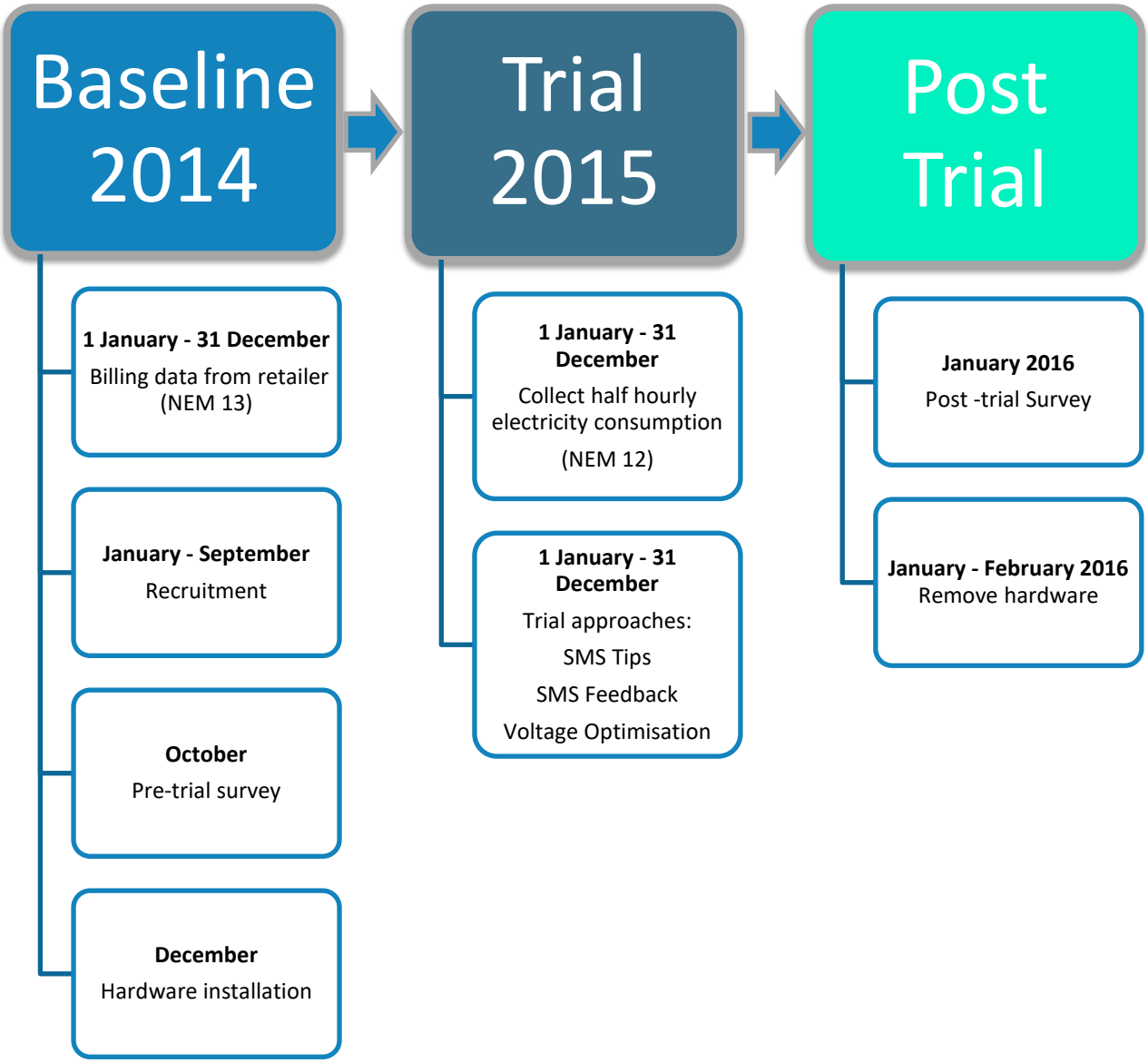
Although not part of the official consortium, Switched on Homes gratefully acknowledges the support of Western Power. Western Power is the electricity transmission and distribution utility in the south west of Western Australia. Western Power provided electricity consumption data for consenting participant households and also provided de-identified data from the South West Interconnected System to add context to the results of Switched on Homes.

Methodology

Trial Characteristics

Trial period

The study period was 1 January 2014 – 31 December 2015. One full calendar year was used for both the baseline (2014) and trial (2015) period. The design provided data suitable for robust statistical testing and allowed the trial to examine the effect of seasonality on electricity consumption. This reasoning precluded a post-trial period, as the LIEEP Program concluded in June 2016.



Trial area

The trial area is the South-East corridor of the Perth Metropolitan region. The trial boundaries were the City of Armadale, the City of Gosnells and the Shire of Serpentine Jarrahdale. These three local government areas are adjacently located and include medium and low density residential housing as well as semi-rural properties.

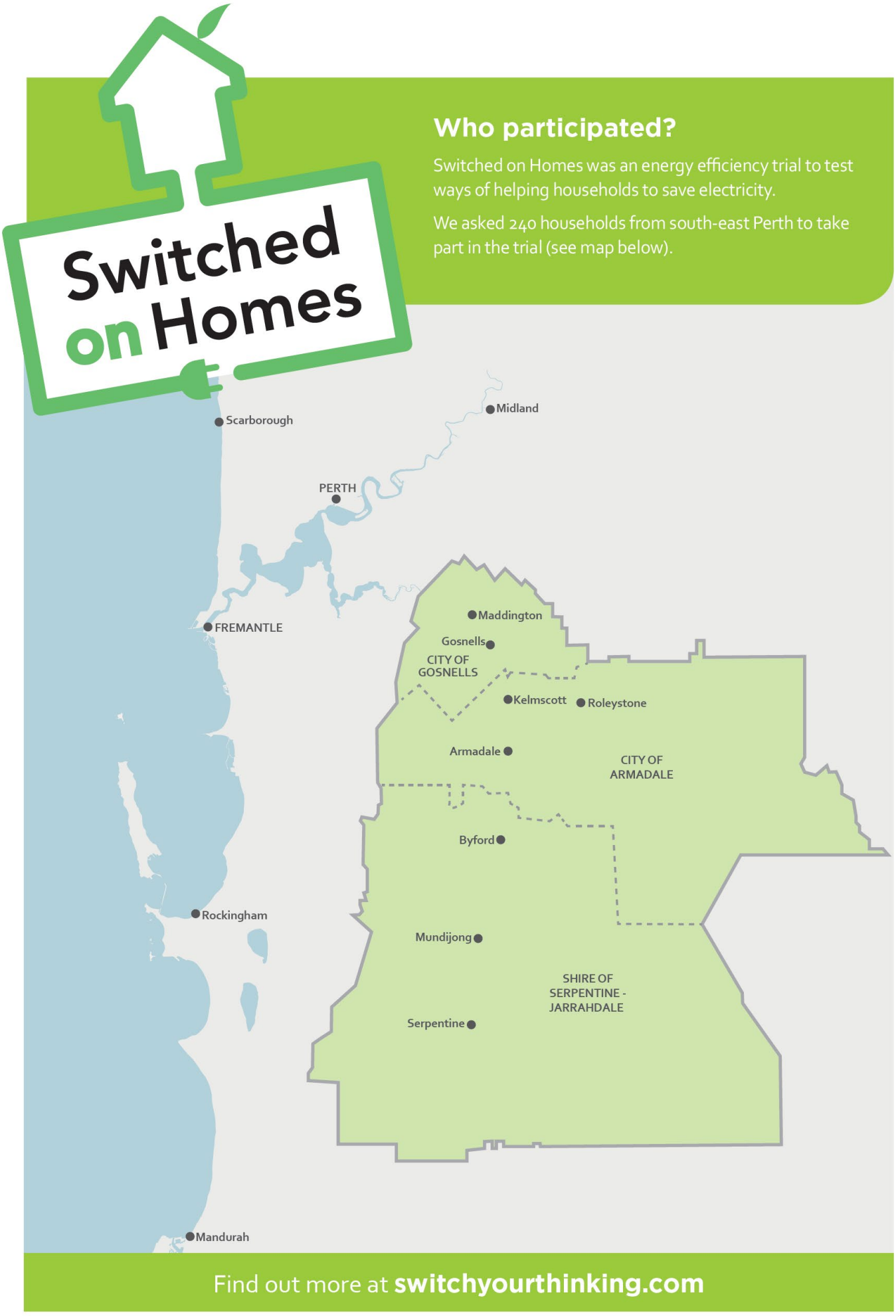


Figure 2 Location plan of the Switched on Homes trial area

The City of Armadale, City of Gosnells and Shire of Serpentine Jarrahdale are respectively the first, third and fourth most disadvantaged local government areas in Perth in the Index of Education and Occupation (source 2033.0.55.001 - Socio-economic Indexes for Areas (SEIFA), Data Cube only, 2011). This index indicates the trial area has a higher than average proportion of the population without educational qualifications, working in lowly skilled occupations or unemployed. Targeting this geographical area meets the Switched on Homes goals of recruiting households with low levels of educational and occupational obtainment resulting in:

a. poor research skills and
b. difficulty in adapting generalised advice to their circumstances.

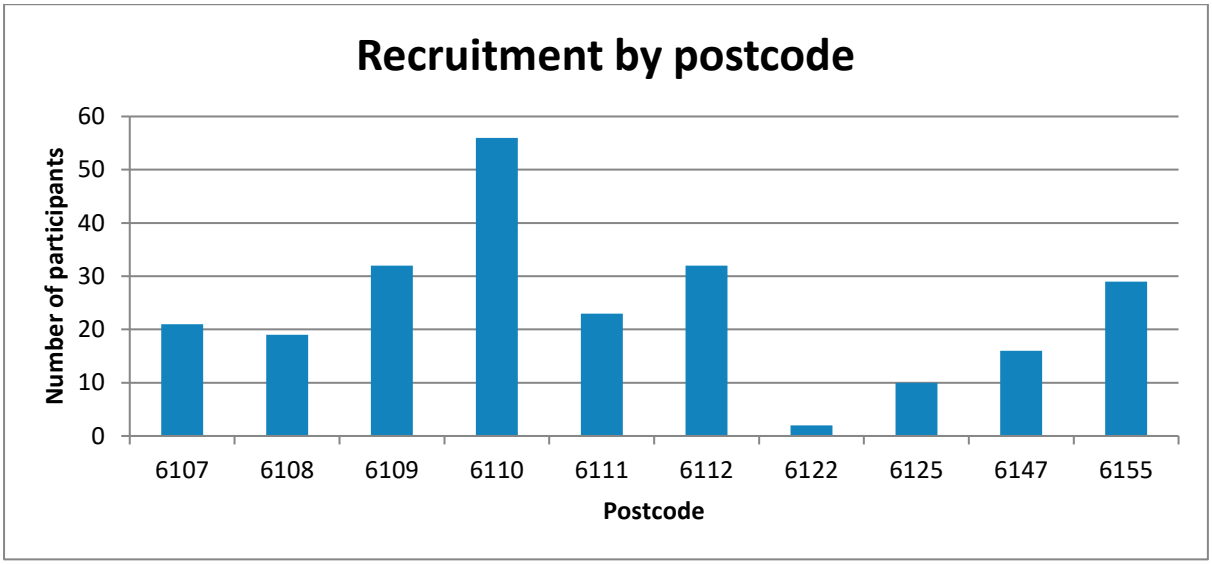


Figure 3 Recruitment to Switched on Homes by postcode

Perth's climate

Switched on Homes has drawn on the Australian Bureau of Meteorology (BoM) climate classifications to understand the Western Australian climate. The BoM employs the widely used Köppen classification in addition to classifications of temperature and humidity and rainfall. The Switched on Homes trial area is classified as:

- Temperature and humidity classification: Warm summer, cold winter
- Köppen map: Subclass sub-tropical and distinctly dry summer
- Seasonal rainfall: Winter dominant rainfall, marked wet winter and dry summer.[1]

The overall summary of Perth's climate is warm, dry summers and a distinct winter season. 2015 was the second hottest year recorded in Western Australia[2]. Weather conditions which may influence electricity consumption are analysed to provide context to the results.

[1] http://www.bom.gov.au/jsp/ncc/climate_averages/climate-classifications/index.jsp?maptype=seasb

[2] (http://www.bom.gov.au/climate/current/annual/aus/)

Data Collected

Data collection methods

Switched on Homes collected both qualitative and quantitative data through self-reported and independent information sources. Table 4 details Switched on Homes data collection.

Table 4 Switched on Homes data collection

	Type		Collection Method	
Data	**Quantitative**	**Qualitative**	**Independently Reported**	**Self Reported**
Appliances and use	✓			✓
Attitudinal and behavioural		✓		✓
Demographic	✓			✓
Building details	✓		✓	
Baseline electricity*	✓		✓	✓
Trial electricity	✓		✓	
Climatic	✓		✓	

*See Electricity data generated for details of the self-reporting of baseline electricity consumption.

The data in Table 4 was collected via the same method for all households, regardless of treatment. Full data sets were collected for all participants and the control group.

Surveys

Two telephone surveys were undertaken to collect data for Switched on Homes. The pre-trial survey was undertaken in September and October 2014 and collected information to satisfy the CSIRO LIEEP data schema. Survey questions covered appliances and their use, attitudinal measures and demographic details. The post-trial survey was conducted in January and February 2016 and included changes to the household in 2015 and attitudinal measures. Both surveys were scheduled to fall outside of the trial year to minimise the impact that self-reflection may have on behaviour.

Surveys in 2014 and 2016 included the low intervention, test 1, test 2 and control groups.

Participation in both the pre-trial and post-trial survey was mandatory for continued inclusion in Switched on Homes. Household that declined or could not be contacted to participate in the pre-trial survey were precluded from entering into the trial, resulting in the exclusion of one household. The pre-trial and post-trial surveys were both incentivized by a $25 Woolworths gift card.

Switch your thinking undertook a separate community survey in December 2014 and February 2015 that included a sub-set of questions from the pre-trial and post-trial surveys (respectively). An invitation to participate in this survey was randomly distributed to 2,158 households throughout the Switched on Homes trial area. This survey was completed online without contact with project staff.

The results of the *Switch your thinking* survey are included as an additional control group and are used in the analysis of behaviour results.

The pre-trial and post-trial survey scripts and the *Switch your thinking* survey are included as Appendix 2.

Electricity data generated

Four types of electricity data were collected by Switched on Homes, one of which was project-generated and three were collected and collated from pre-existing sources.

1. Half hourly electricity consumption data.

This data was generated through data loggers fitted in all 240 households receiving trial approaches. Half hourly electricity consumption data is intended to provide the same essential information as NEM12 data, but is not in NEM12 format.

The data loggers selected (Millennium Electronics 100A energy monitor, aka intelligy GPRS module and PMD) were fitted by electricians with the prior approval of participants. Data generated was securely transmitted to the Switched on Homes information management system so it could be tracked by Switched on Homes staff and used to create personalised feedback for test 1 and test 2 participants.

Half hourly electricity consumption data was collected for the entire trial year.

2. Bi-monthly billing data

Bi-monthly billing data was provided by Western Power for 209 of240 test households. Bi-monthly data was collected for an additional 33 control households. Bi-monthly billing data was provided in NEM13 format and was not manipulated by Switched on Homes staff except to remove identifying NMI and meter numbers.

Bi-monthly billing data was collected for the entire baseline year and trial year.

3. Self reported billing data

Self reported billing data was collected for the baseline year of households that did not receive a Synergy bill (i.e. groups dwelling sites that had one Western Power master meter and privately owned and read sub meters).

Self-reported billing data was collected from 31 of 240 test households (see Methodology: Treatments and Test Groups (Group sites)). The duration of billing cycles varied from two to four weeks and was manipulated to conform to a bi-monthly or NEM13 format by statisticians. Billing data was self recorded by the participant on a record sheet provided by Switched on Homes. The data generated was then entered into spreadsheets by Switched on Homes staff and double checked for errors.

4. Control electricity data

Aggregated, suburb level data was provided by Western Power as a control. The data was extracted by Western Power and provided to Switched on Homes as a reading for residential properties, per month, for suburbs in the Gosnells and Armadale local government areas.

Climatic data

The Jandakot Aero Bureau of Meteorology site was selected for climatic observations as it is only 11 kilometres from the trial area and collects a wide range of weather observations. Bureau of Meteorology Jandakot Aero observations were downloaded from the website http://www.bom.gov.au/climate/dwo/IDCJDW6056.latest.shtml

Ethics

Enrolment in the Switched on Homes trial was voluntary and restricted to adults who met the eligibility criteria (see Recruitment, retention and losses). All community members who expressed interest in participating in Switched on Homes were provided with a hard copy of documents outlining all trial activities (Program summary and FAQ). These documents were also publically available on switchyourthinking.com.

Through the registration process, participants and property owners provided informed consent relating to trial activities, data collection and reporting by completing:

- Registration form
- Western Power's Access to metering data by third parties consent form
- LIEEP Privacy form
- Owner consent form
- Occupant consent form

Participants could withdraw from the trial at any time without penalty by notifying the Switched on Homes team.

Treatments and test groups

Treatments and test groups

A total of 240 participants were recruited to receive trial approaches. Participants were split into three equally sized test groups that received a combination of four different treatments. Table 6 contains the details of the treatments.

Table 5 Treatments received by Switched on Homes test groups

	Treatment			
	Voltage Optimisation Unit (VOU)	**Personalised SMS Feedback**	**SMS Tip**	**Peak load SMS**
Low Intervention			✓	✓
Test 1		✓	✓	✓
Test 2	✓	✓	✓	✓

Table 6 Description of Switched on Homes treatments

Name of treatment	Description	Occurrence
Voltage Optimisation Unit (VOU)	VOUs reduce over-supply of voltage	In-situ all of 2015
SMS feedback	SMS containing feedback on the household's electricity consumption compared to their past consumption	46 times in 2015 (Monday at 7pm from 26 January – 22 December)
SMS tip	SMS containing an electricity saving tip	50 times in 2015 (Each Monday at 7pm)
Peak load SMS	SMS encouraging households to delay appliance use when there is high demand on the electricity grid	Three times in 2015 25 February 9 August 23 December

Random assignment to test groups

Random assignment of households to one of three test groups (low intervention, test 1 and test 2) was undertaken using an online group generator. Households with three phase power connections were not included in the random assignment, as they had been pre-assigned to either the low intervention or control group. Three phase households were ineligible for a fully randomised assignment due to the incompatibility of three phase meters with the data loggers. Test groups were of equal size (80 households per group).

Methods and treatments

Trial activities have been classified as either a method or a treatment. A method is defined as an experimental activity conducted in order to undertake the experiment that does not influence the outcome of the experiment (i.e. does not influence the behaviour of the participant). A treatment is

defined as an experimental activity conducted to assess its impact on the experiment (i.e. influences the behaviour of the participant).

Table 7 Switched on Homes methods and treatments, by test groups

		Group		
Intervention	**Method or treatment**	**Low intervention**	**Test 1**	**Test 2**
Recruitment	M	✓	✓	✓
Phone surveys	M	✓	✓	✓
Receive data logger	M	✓	✓	✓
Peak load SMS	T	✓	✓	✓
SMS Tip	T	✓	✓	✓
SMS Feedback	T		✓	✓
Receive VOU	T			✓

Switched on Homes delivered methods equally to all test groups (excluding the control group) to ensure the statistical integrity of the results.

Control groups

Switched on Homes control (behaviour and attitudinal responses)

A total of 33 households, not assigned to a test group, were placed in a control group. The control group completed the following activities:

- ✓ Enrolled and consented to participate
- ✓ Provided consent to access to their Western Power electricity billing data
- ✓ Completed the pre-trial survey
- ✓ Did not receive a place in the low intervention, test 1 or test 2 groups
- ✓ Lived in their homes for all of 2014 and 2015
- ✓ Completed the post-trial survey

The control group was not the result of randomised allocation. Most households in the control group had a three phase electricity connection which rendered them ineligible to receive one or more trial approaches. Some single phase households that were unable to have hardware installed, due to building constraints, were also placed in this group. The results of this control group were used for behavioural measures only. An analysis of their bi-monthly electricity records was attempted but the group was found to be unsuitable for comparative analysis.

Community control (behaviour and attitudinal responses)

A random sample of 2,158 residents in the trial area was invited to participate in the *Switch your thinking* survey, which included a subset of questions from the pre-trial and post-trial survey. Responses to relevant questions are included as a control. A total of 178 responses were received in 2014 and 199 responses were received in 2016. This data has been included as an experimental control for the behavioural and attitudinal responses. This group did not receive any incentives or any of the Switched on Homes methods or treatments.

Community control (electricity)

Western Power provided total monthly consumption for households in the trial area at a suburb level. Switched on Homes staff chose suburbs with over 2% of the total trial population to form the community control. The control group was formed from suburbs which included 91% of the Switched on Homes population. This included 61,732 properties in January 2014 and grew monthly until it reached 63,965 households in December 2015.

Group dwelling sites

Four group dwelling sites (where more than one Switched on Homes participant lived in the same group of detached houses with access to shared facilities) were recruited, totalling 36 participants. In all group dwelling sites the houses involved lived independently of each other but shared common resources (e.g. clubhouse or pool). The largest group site (20 participants) was selected for further statistical testing. The Switched on Homes team did not identify participating households to other residents and recruitment was undertaken privately to minimise interference with the trial results.

Two group dwelling sites (totalling 30 participants) were sub-metered by site management and residents privately billed. In December 2014, sub-metered households were asked to self-report their electricity billing data from January to December 2014. To limit the impact self-reporting might have on trial approaches, this activity was not conducted for the 2015 calendar year. It is assumed self-reported data is reliable and no further tests were undertaken to determine self-reporting accuracy.

Switched on Homes

Electricity Record Sheet

- ✓ This record belongs to:
- ✓ Record your household electricity use here
- ✓ Start with the first bill you received in January 2014 and continue to end of December 2014
- ✓ Return to Switched on Homes by 5/01/2015
- ✓ Call XXXX XXXX if you need help or to return

Start Date of bill	End date of bill	Units or kilowatt hours used

Figure 4 Example of self-reporting sheet for group sites

Participants living at group dwelling sites were included in the random assignment to test groups. As all participants in group dwelling sites had single phase power connections, they were more likely to be assigned to the test 1 or test 2 groups. A matched distribution was not undertaken and random allocation resulted in the assignment shown in Figure 5.

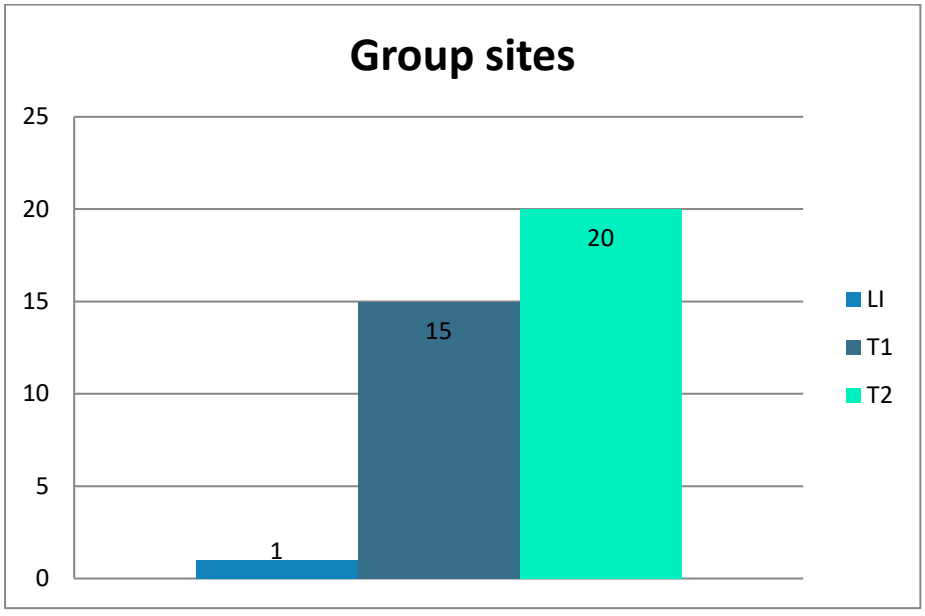


Figure 5 Allocation to treatment groups of household in group sites

Treatment description and methodology

SMS services

SMS tips for the Switched on Homes trial were delivered at 7:00pm on Monday evenings (including public holidays) during the trial year. SMS were dispatched through online SMS service, SMSGlobal. During the Switched on Homes trial year, over 25,000 SMS were dispatched. Participants were informed not to reply to SMS however the service was reply enabled, as a privacy and ethical safeguard.

The SMS tip incorporated personalised feedback for the test 1 and test 2 groups. The inclusion of feedback into the generic SMS tip minimised the variables between different test groups. Personalised feedback was delivered from 26/01/2015 – 22/12/2015. Personalised feedback was not delivered during the first three weeks of the SMS campaign (1/01/2015- 25/01/2015) due to delays sourcing and installing hardware in test 2 households.

Personalised feedback was constructed in the Switched on Homes information management system (IMS) and the resulting messages were uploaded to the SMSGlobal platform. Households did not receive personalised feedback when data loggers failed to collect or report data to the IMS. During a disruption, affected households received their SMS tips as scheduled without their personalised feedback incorporated. A widespread failure of data transmission occurred on the 27/12/2015 and no households received personalised feedback that week.

Table 8 Personalised feedback templates

Personalised feedback	Template number
Your electricity use increased/decreased by xx% last week compared to the previous week. Over a year this would add up to approximately $yy.	PM1
Did you know you used $xx of electricity last week while you were asleep (11pm-6am)?	PM2
Well done / You're on track / Renew your efforts, You used xx units of electricity last month, which is around $xx more /less than the previous month.	PM3
You used xxx units of electricity last week, equivalent to xx% more/less than your average weekly usage.	PM4
Normally you used the most electricity on Mon/Tues/Wed/Thurs/Fri/Sat/Sun (xx units), and last week you used yy units on that day.	PM5

Five personalised feedback templates were available for test 1 and test 2 households. One template was distributed each week. A full list of the SMS tips and personalised feedback dispatched during 2015 are included as Appendix 1.

Identifying peak load and scheduling ad hoc SMS

Four peak load SMS were scheduled during the trial year to alert low intervention, test 1 and test 2 participants to peak load conditions in the grid and encourage them to defer electricity use. The following guidelines were developed to identify peak load conditions, in conjunction with Western Power:

Monday – Friday during the school term

Multiple days in a row above 35 degrees Celsius

The weather forecast was monitored during the trial to schedule peak load messages. Peak conditions outlined by Western Power occurred twice during 2015 (25/02/2015 and 13/03/2015 -no peak load message sent on 13/03/2015). As peak conditions were not reached four times Switched on Homes scheduled additional peak load messages to represent the winter peak (9/08/2015) and the summer peak (23/12/2015).

Table 9 Peak load SMS

Date and time	Text
25/02/2015 4:30PM	Switched on Homes - Perth is using a lot of power today! To do your bit please minimise your power use between now and 8pm. Try cooking with gas, turning your AC to 24 degrees or better yet use a fan.
9/08/2015 4:00PM	Switched on Homes - Did you know a lot of Perth's electricity infrastructure is built to accommodate power use between 4-8pm? Do your bit by turning on your dishwasher, washing machine or pool pump after 8pm.
23/12/2015 4:00PM	Switched on Homes - Perth is using a lot of power today! To do your bit please switch off unnecessary appliances, reset your air conditioner to 24 degrees or above, slip into something cool and open your windows to catch the breeze after the sun sets.

In addition to the scheduled SMS services and peak load messages, administrative ad hoc SMS were sent during the trial.

Table 10 Administrative SMS schedule

Date and time	Text
1/01/2015 7:00PM	Welcome to Switched on Homes! Every Monday around 7pm you'll receive an Energysmart electricity reduction tip via SMS. We encourage you to try as many of the tips as possible. If you need to contact us please call 9397 3207. Thanks for volunteering, let's work together to decrease your electricity bills in 2015!
1/07/2015 7:00PM	Switched on Homes - Electricity prices increase from today. The price per unit for Synergy's standard tariff has increased by 4.5%. Stay in control by implementing our Energysmart tips. Remember 1 unit is 1 kWh.
31/12/2015 7:00PM	Switched on Homes - Thanks for participating in Switched on Homes. This is the last SMS you'll receive, but we'll call to complete a 10 minute survey with you in the new year.

Data loggers

Data loggers were fitted to all Switched on Homes households to collect half hourly electricity consumption data. Synergy and Western Power are unable to monitor half hourly electricity consumption due to the limited capabilities of residential metering equipment. Installation of data loggers was undertaken in the baseline year (December 2014) and administered equally in all test groups. All 240 households received the same communications regarding their data loggers and limited technical information was provided. Data loggers were not intended to constitute a treatment resulting in behaviour change.

Data loggers were fitted in a 432mm high x 452 mm wide waterproof housing. Data loggers were installed between the mains isolator and the consumer switchboard. This preferred position of installation was adjacent to the meter box, located outside the home.

Consortium member, Power Intelligence, selected and supplied the data logger stock. All Switched on Homes participants received the same data logger model (Millennium Electronics 100A energy monitor, aka intelligy GPRS module and PMD). A suitable battery powered model could not be sourced and the selected model consumes 2.6 watts per hour and additional electricity when transmitting data, up to 20 watts per day. In 2015 this is equivalent to approximately 82 watts per day or $7.57 per year. Participants were advised of this, which resulted in the withdrawal of one participant. Data logger electricity consumption was removed from half hourly data reading in 2015

by the statisticians, however there is no practical way to remove data logger related electricity consumption from participants' bi –monthly electricity records in December 2014.

Voltage Optimisation Units (VOUs)

VOUs have been used to reduce voltage over-supply to commercial premises and reduce electricity consumption and resulting costs. Hypothetically, equipment performs more efficiently at the ideal voltage and therefore electricity costs are reduced through voltage optimisation.

Western Power's customer charter commits to providing single phase residential customers nominal 240 volts and an allowable variance is +/- 6% (254.4- 225.6 volts).The VOU fitted through Switched on Homes create a tap change from the utility supplied voltage to 220-222 volts. Theoretically, all homes in the Switched on Homes trial area could have the voltage reduced through the VOU, while still conforming to Australian Standards. If the voltage supplied fell below 220V, the VOU ceased to operate until the voltage rises again.

The relevant Australian Standard (61000.3.100-2011 Electromagnetic compatibility (ECM) – Limits-Steady state voltage limits in public electricity systems) states electricity will be provided to Australian homes at a nominal 230 volts and an allowable variance is +10% /-6% (253 to 216.2 volts).

The VOU fitted through Switched on Homes physically resembled the data loggers. The VOU housing also contained the data logger for the test 2 households, which was the same model fitted to low intervention and test 1 households. If interested, participants could deduce from their electrical safety certificates if their household was fitted with a VOU or a data loggers.

Existing literature on residential voltage optimisation is extremely limited, and not available in an Australian context. Switched on Homes is believed to be the first trial of residential voltage optimisation in Australia. The lack of previous research in this area makes expected reductions difficult to quantify. Based on theoretical understanding of voltage optimisation the following statements hold true:

- Voltage optimisation will have little to no effect on power consumption of fluorescent lighting with electronic ballasts but will reduce power consumption in fluorescent lighting with magnetic ballasts and incandescent lighting (phased out in Australia commencing in 2007)
- Voltage optimisation will reduce the electricity drawn by pool pumps and motors
- Voltage optimisation will have mixed results in refrigerative motors (motors will run longer but this is offset by lower losses operating the motor)
- Voltage optimisation will have no effect on small household appliances (for example kettle) and personal entertainment devices
- Performance of appliances is not impaired by voltage optimisation and it may extend the lifespan of some appliance types
- The voltage reduction will vary between households as utility supplied voltage varies between premises

Recruitment, retention and losses

Recruitment

Recruitment commenced in October 2013 and continued until September 2014. Recruitment resulted in the registration of 282 households, establishing 240 households to receive trial treatments and 42 households for a waitlist. The time period for recruitment was lengthened by three months due to a sluggish response from the community and administrative delays.

Selection criteria for recruitment:

- Household eligible for a health care card or proof of household income under $51,000
- Household has a mobile phone capable of receiving SMS
- Live in the City of Armadale, City of Gosnells or Shire of Serpentine Jarrahdale
- Household is connected to single phase power
- Participant does not live in public housing

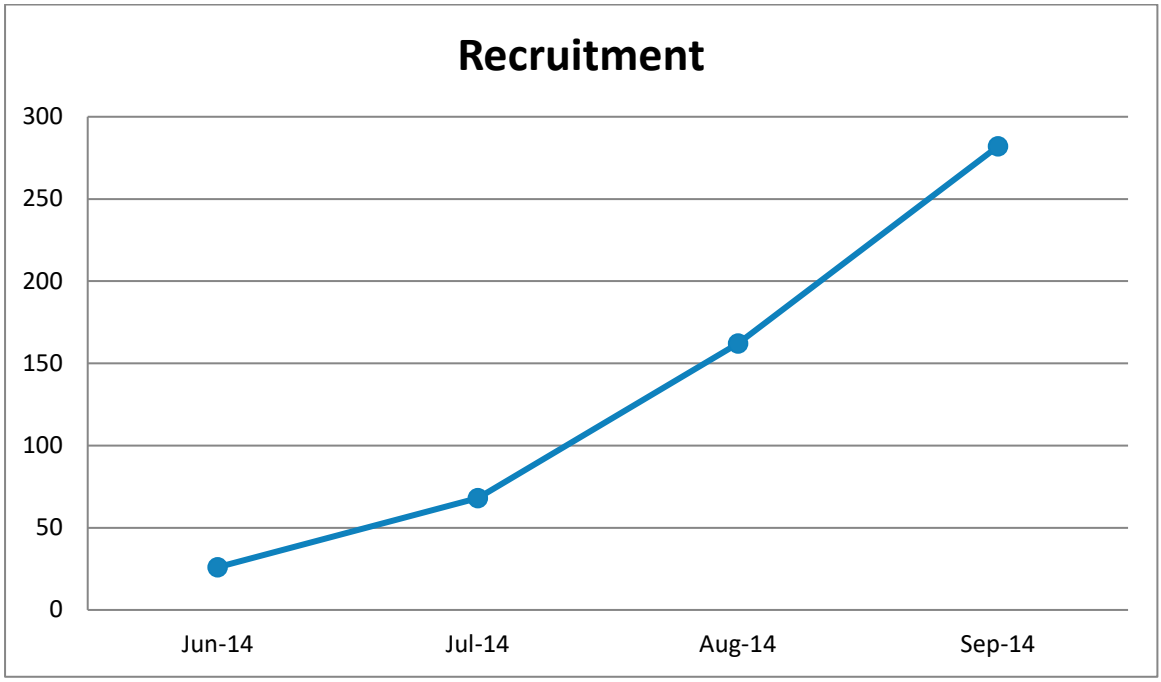


Figure 6 Switched on Homes recruitment over time

The target demographic was established as households with a health care card and households with low level of educational or occupational obtainment. Households that satisfied the selection criteria but did not meet the target demographic were accepted into the trial. There was no recruitment requirement based on tenure type or home ownership.

Figure 7 Part of campaign 2, focused on how Switched on Homes was a quick and easy solution to large electricity bills

Switched on Homes distributed three distinct recruitment campaigns.

Campaign 1	October 2013 – March 2014 the campaign focused on households checking they met the recruitment criteria. Flyers and posters were produced for this campaign. During this campaign 48 enquires were received
Campaign 2	March 2014 – June 2014 the campaign focused on how Switched on Homes was a quick and easy solution to increasing electricity bills. Flyers and posters were produced for this campaign, including a flyer dropped in mailboxes of over 20,000 households in the target area. During this campaign 123 enquiries were received
Campaign 3	July 2014 – September 2014 the campaign focused on appealing to community goodwill. This campaign stressed the scientific aspects of the trial and the community benefits of participating in research. Letters "asking for volunteers" were distributed to 23,000 households. During this campaign 434 enquiries were received

Incentives

To incentivise enrolment and facilitate retention, up to $150 of Woolworths grocery only gift cards were available to each household. Distribution and denomination of gift cards are detailed in Table 11.

Table 11 Participant incentives

Amount	Activity	Date	Eligible groups
$25	Complete enrolment paperwork	June – September 2014	All and control
$25	Complete pre-trial survey	September – October 2014	All and control
$50	Have data logger/ VOU fitted	December 2014	All
$25	Complete trial / remove hardware	January 2016	All
$25	Complete post-trial survey	February 2016	All and control

Control group households were eligible to receive a maximum of $75 of gift cards. If a trial participant did not complete the activities, they were entitled to keep the gift cards they had received to date but could not receive further gift cards or participate further in the program.

One objection was recorded to receiving incentives in the form of gift cards. The objection was that gift cards might be perceived as a type of welfare.

Figure 8 Switched on Homes recruitment

Demographics

There were no demographic exclusions for Switched on Homes, households that met the selection criteria could become part of the trial. The only demographic that the selection criteria directly identified was the provision that household income must be in the bottom 40% of the Australian population.

Demographics that are heavily represented by the trial include:

- Households with limited educational obtainment (56%)
- Retirees (64%)
- Home owners (including lease for life) (96%) and;
- Single person households (55 participants).

The average age of Switched on Homes participant was 65.5 years. The average household size was 1.9 residents and 90% of Switched on Homes participants owned or were buying the home they lived in.

Over half of households recruited received formal education to high school only, aligning with the target demographic of recruiting educationally disadvantaged households.

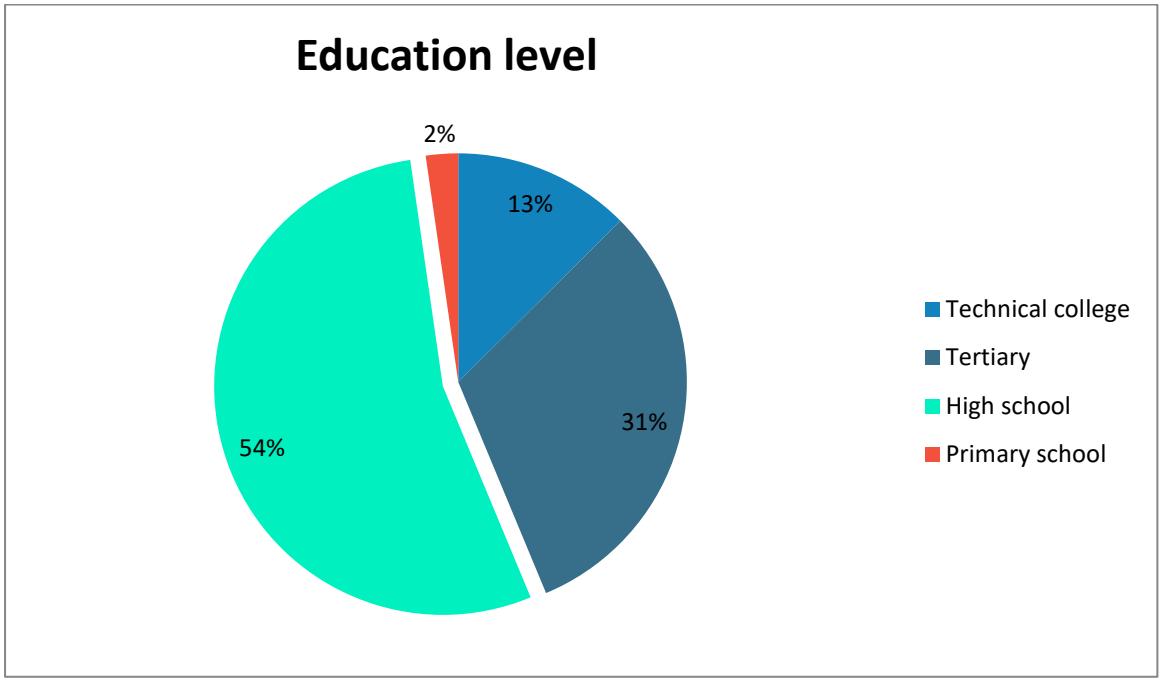


Figure 9 Educational achievement of 2014 survey respondents (n=263)

A total of 270 households reported one or more type of disadvantage in the pre-trial survey. Types of disadvantage are illustrated in Figure 10. A total of 180/270 respondents identified as a senior citizen, making this the largest group by type of disadvantage. Single person households (55/270 respondents) and single parents (26/270 respondents) were the other significant groups. These

figures underestimate the total prevalence of some groups. Notably only five survey respondents identified themselves as migrants, when 133 listed a country of birth overseas.

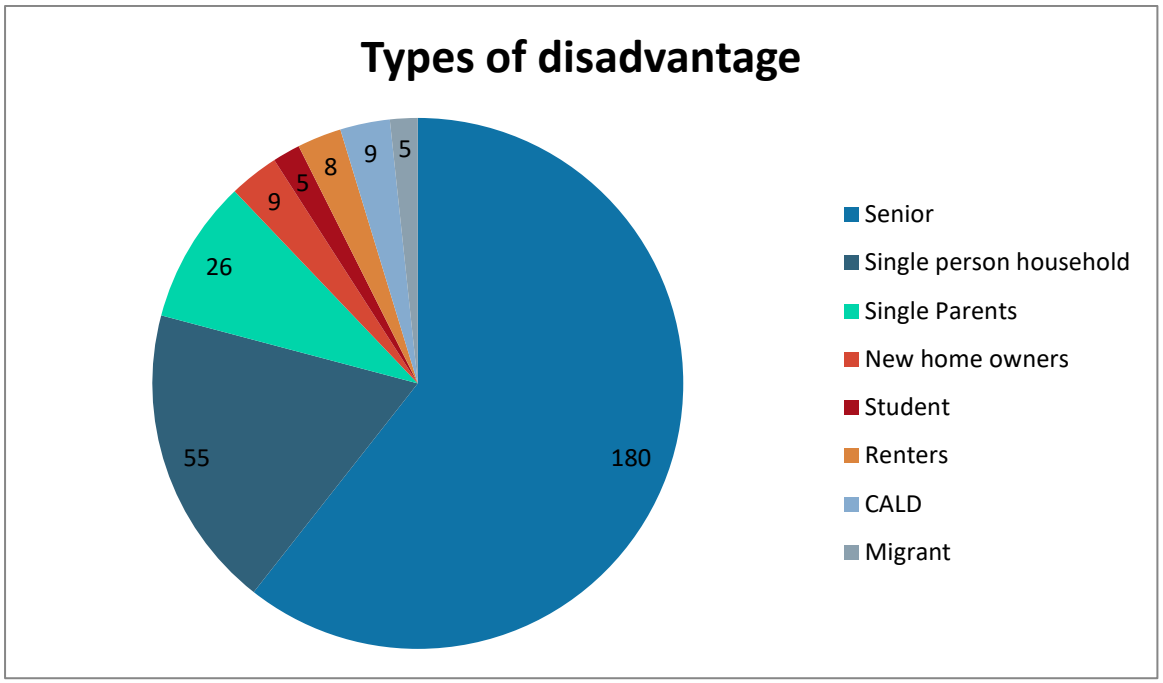


Figure 10 Types of disadvantage experienced by 2014 survey participants (multiple response, n=270)

The largest groups in the trial by age were 70-74 year olds. 184/283 respondents were between the ages of 60-79.

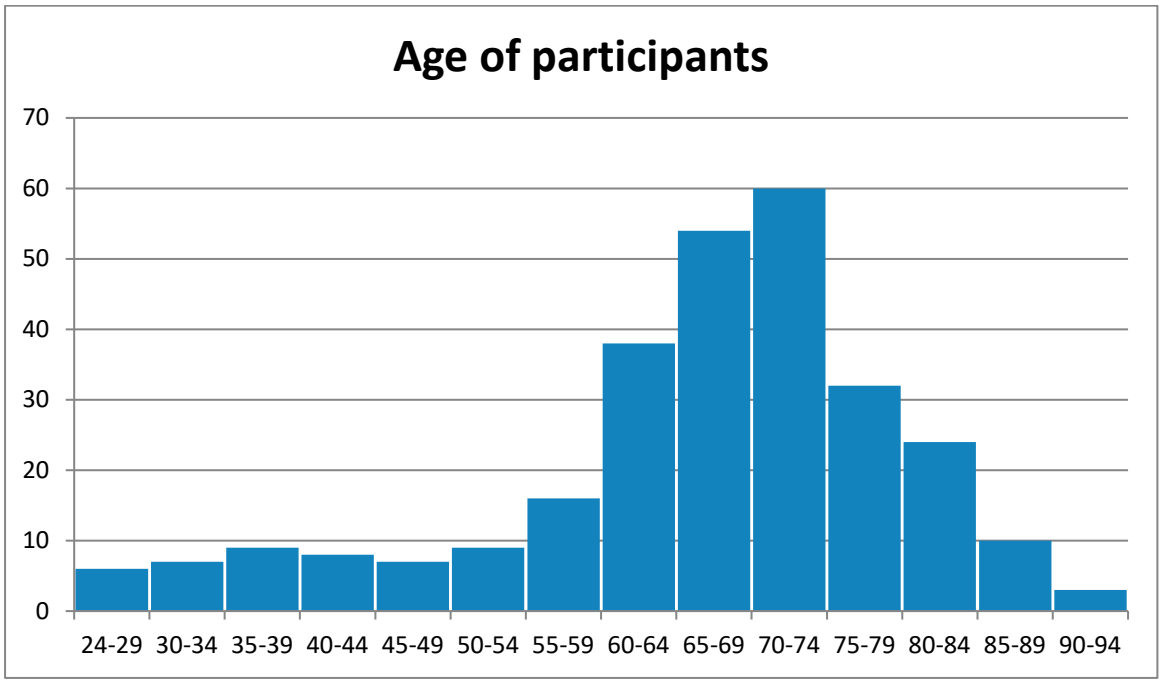


Figure 11 Age demographics of 2014 survey participants (n = 283)

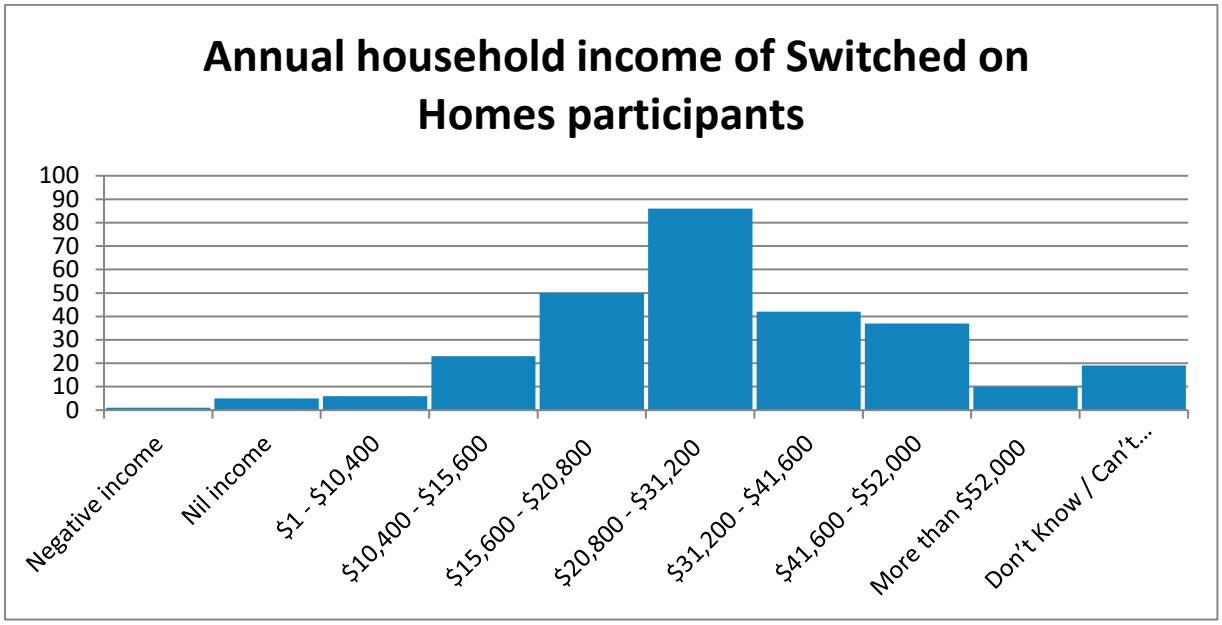


Figure 12 Annual household income (n=279)

The median household income of a Switched on Homes participant was $20,800 - $31,200.

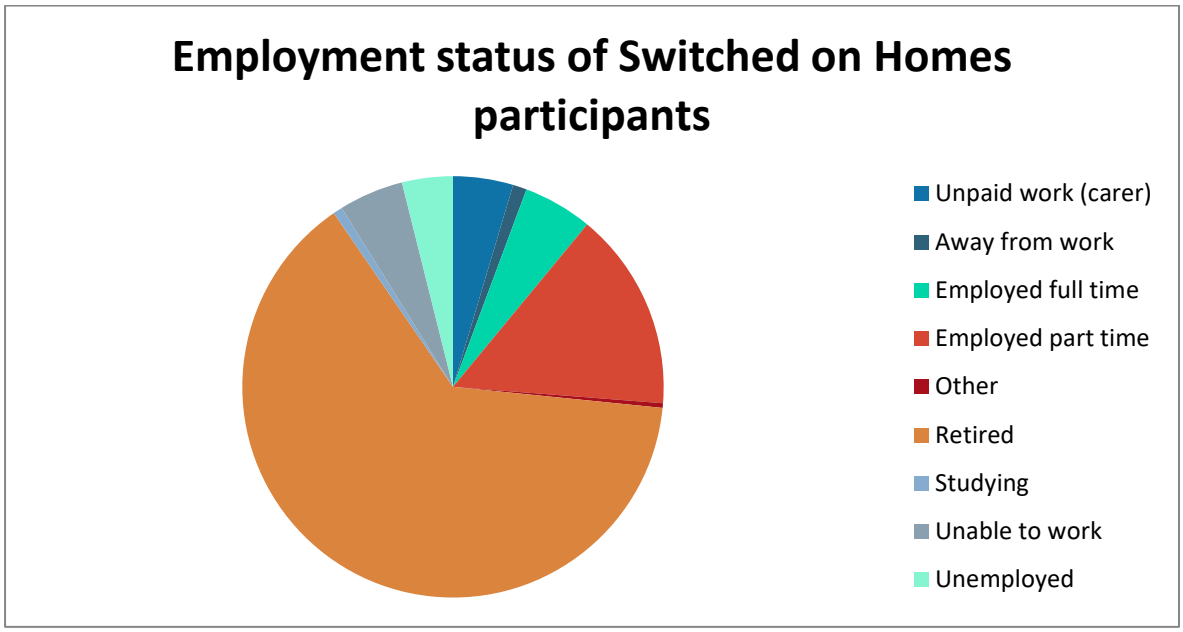


Figure 13 Employment status (n=282)

Most Switched on Hommes participants were retired, which aligns with the age demographics and average age of 65.5. There was also a significant group of part time workers.

Retention and loss

Switched on Homes had a retention rate of approximately 97% during the trial year. Reasons for withdrawals are recorded in Table 12.

Table 12 Reasons for withdrawal from the trial

Date of Withdrawal	Reason	Test Group
5/01/2015	Objection to VOU	Test 2
15/01/2015	Moved house	Test 1
25/01/2015	Objection to VOU performance	Test 2
9/02/2015	Moved house	Test 1
15/05/2015	Moved house	Low intervention
29/05/2015	Objection to data logger (faulty data logger)	Low intervention
1/10/2015	Moved house	Test 2
6/10/2015	Moved house	Test 1

Specific retention activities were not undertaken and the incentive for completing the trial year was $50 of gift cards, delivered after the trial was complete. Despite few resources being put into managing the retention of households, the retention rate during the trial year was higher than anticipated. Due to the age demographic of participants, the chance of participants moving was below average. A total of 89% of survey respondents were over 45 years of age and a Curtin University study found that home owners in this age demographic moved homes at a rate of 5% per annum[3]. Switched on Homes participants were even less likely to move, with only 2% of households moving during 2015.

Registration packs were delivered to 605 potential participants with a completed return rate of 47%. Potential participants who did not complete the registration process were not contacted again and surveyed, but reasons for not completing registration may anecdotally include:

- Not suitable
- Household income too high
- Live in public housing
- Could not gain consent from landlord
- Deterred by lengthy paperwork
- Deterred by hardware
- Connected to three phase power
- Not interested

Lengthy delays were encountered drafting privacy statements and creating registration documents. After expressing interest in registering for the trial, some households had to wait six months to receive registration paperwork, during which time their circumstances or interests may have changed. This delay caused difficulty in assessing the efficacy of recruitment activities.

[3] (http://business.curtin.edu.au/wp-content/uploads/sites/5/2015/11/bcec-securing-our-future-report.pdf).

After completing registration and the pre-trial survey, 17 participants (6%) withdrew prior to the trial starting. Reasons for these withdrawals are outlined in Table 13. These households received incentives for the trial activities they completed.

Table 13 Withdrawal prior to the trial

Reason	Number of withdrawals prior to trial commencement
Discouraged by A Current Affair segment about smartmeters	1
Evicted	1
Lost contact	1
Compensation considered insufficient to operate data logger during trial year	1
Health concerns regarding radiation	1
Moving house	3
Meter or house construction unsuitable to receive VOU/data logger, not interested in control group	9

Communication and Promotion

Marketing and Promotion

Communication and promotional activities can be split into three distinct periods outlined in Table 14.

Table 14 Marketing and promotional activities

	Activity	Timeframe	Description
1.	Pre-trial activities	August 2013 – October 2014	Marketing and promotion in the pre-trial period focused on recruitment
2.	Trial activities	October 2014 – March 2016	Contact with participants was kept to a minimum to prevent communications from influencing trial outcomes

3.	Post-trial activities	March 2016 – July 2016	Promotion of the trial outcomes and results

Pre-trial

During the pre-trial period, communications focused on recruitment. Communications during this period included:

- www.switchyourthinking.com/our-projects/switched-on-homes contained information about the trial including a "register" button and FAQ
- Delivery of registration packs including consent forms, privacy statements and consent to access electricity metering data were circulated to potential participants
- Marketing and promotion to drive recruitment. This is discussed in detail Methodology: Recruitment, retention and losses

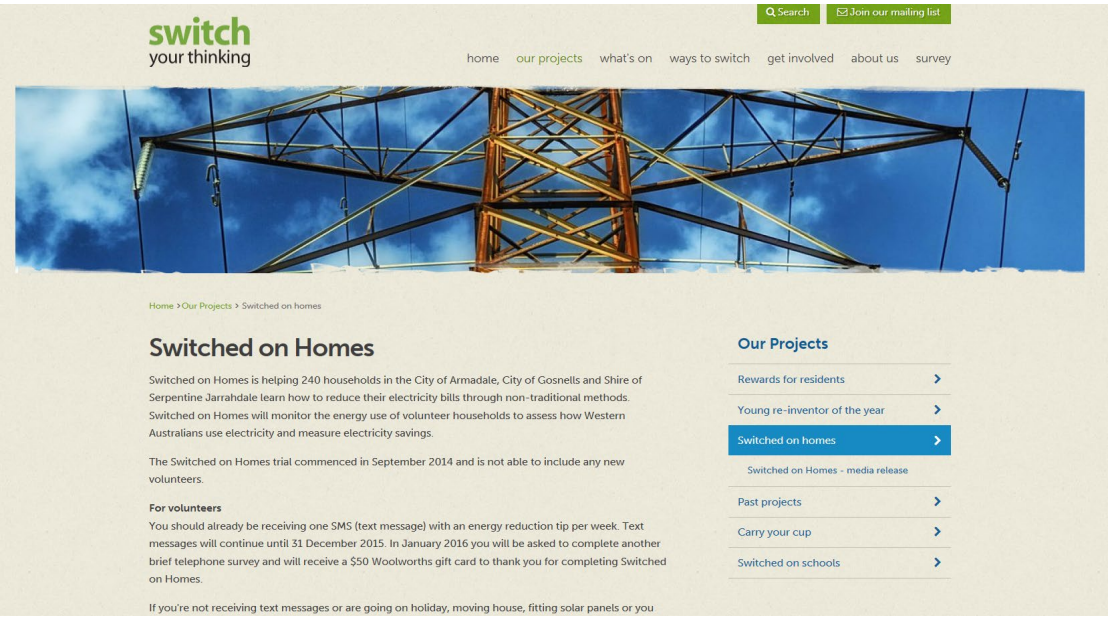


Figure 14 Image of the Switched on Homes homepage extracted on 8/02/2016

Trial activities

During the trial, communications (excluding SMS messages, which are discussed in Methodology: Treatments and test groups) were provided only when necessary. Direct communications were undertaken via mail out to inform participants of upcoming activities. This included:

- Incentives were delivered via post on completion of trial activities (completing the trial and completing the survey in 2014 and 2016)
- Information about upcoming activities (post-trial survey, removal of hardware)

General communications that participants could have been exposed to during the trial phase include:

- www.switchyourthinking.com/our-projects/switched-on-homes contained information for trial participants to contact program staff
- Promotional activities undertaken by partners included a blog post about Switched on Homes by Greensense (Information Management System providers) and a media release by consortium member, Stockland.

Promotion and communication during the trial was intentionally minimised to reduce the impact of media and promotion on participant behaviour.

Figure 15 Image of the Greensense blog extracted on 8/02/2016

Post-trial promotional activities

Results of the trial were not publicised until a full statistical analysis had been completed in March 2016. Promotional and communication activities include:

- Updating www.switchyourthinking.com/our-projects/switched-on-homes to feature the results of the trial
- Interview with ScienceNetwork WA
- Media release
- Participating in a myth busters themed panel at Australian Summer Study on Energy Productivity.

Statistical Analysis

Statistical methods

General mixed effect models were employed to compare the electricity use in the baseline measurements between groups and paired samples t-test was used to compare the mean daily

electricity usage in 2014 and 2015. A linear mixed effect model was used to compare annual electricity use in 2014 and 2015 between groups. Fixed effects were identified as time, group and the interaction of time and group. Household was applied as the random effect. A similar approach was used for the analysis of peak load SMS messages.

Data analysis was completed using the R environment for statistical computing.

Statistical assumptions

The following statistical assumptions were applied to all statistical tests.

- 2014 electricity consumption is a suitable baseline for 2015 electricity consumption
- Participants had no access to other electricity efficiency services during the trial
- Self-selection bias did not affect the outcome of the trial
- Participants are a representative sample of the health care card holding population in the trial area
- Data loggers do not influence behaviour
- Monitoring does not influence behaviour
- Participant motivation and interest in electricity efficiency is comparable to the general population
- Rebound effect did not occur (specific to the test 2 group). Specifically there is no reduction in behaviour change due to the provision of voltage optimisation units

Exclusions

Several scenarios resulted in the exclusion of all data collected from an individual household, from both stages of analysis. The conditions outlined in Table 15 resulted in exclusion from all statistical tests.

Table 15 Exclusions from statistical analysis

Reason for exclusion	Number of exclusions
Withdrawal from the trial	4
Moving house during 2015 resulting in withdrawal	5
Installed solar-PV in 2014 or 2015	14 (9 in 2014 and 5 in 2015).
Moved away for part of 2015 (when the electricity account was disconnected)	2
Data logger broke or malfunctioned	1
TOTAL	26

In addition, exclusions were made when data was not provided consistently or gaps occurred that precluded an analysis which would meet the experimental objectives. Exclusions from specific tests are indicated in the results.

Adjustments to half hourly electricity consumption data

To generate meaningful and useable data, some adjustments were made to the half hourly electricity consumption data. All half hourly electricity consumption data collected was manipulated by statisticians to remove the effect of data logger power consumption on overall power consumption. The approach to removing the effect of data logger power consumption was to divide the daily data logger consumption (82.4 watts) into 48 equal half hourly periods. This resulted in a subtraction of 1.7 watts per half hour.

Cleaning building records

Building records yielded highly variable data, depending on the date of collection and the local government data collection requirements. In order to make building data comparable across years and geographic locations, significant cleaning was required. All data collected was transcribed into the format outlined by the CSIRO and where there was ambiguity in the record or a lack of information, no entry was recorded. The only data collected from building records that was analysed by Switched on Homes was the building age. The built date was recorded as dd/mm/yy on building application, but was cleaned to fit in the following categories:

- Zero to five years
- Five to nine years
- 10 – 19 years
- 20 – 29 years
- 30 – 39 years
- 40 – 49 years
- 50 – 59 years

A total of 107 building records did not contain a date of build or built age record and were excluded from age related analysis.

Analysis cohorts and groups

Trial participants were randomly split into three groups based on treatment: low intervention, test 1 and test 2 groups (see Methodology: Treatments and Test Groups). In addition to these groups the following subsets were established for statistical analysis:

1. Post-2000 housing subset.
   Households assigned a trial treatment were classified by built year as pre-2000, post-2000 or unknown. All 62 households built post-2000 were used to form a subset to represent modern housing stock. At the time of test group assignment, the built age was not known and the allocation to test group is random. Households that did not return a built age were excluded from consideration for this subset.

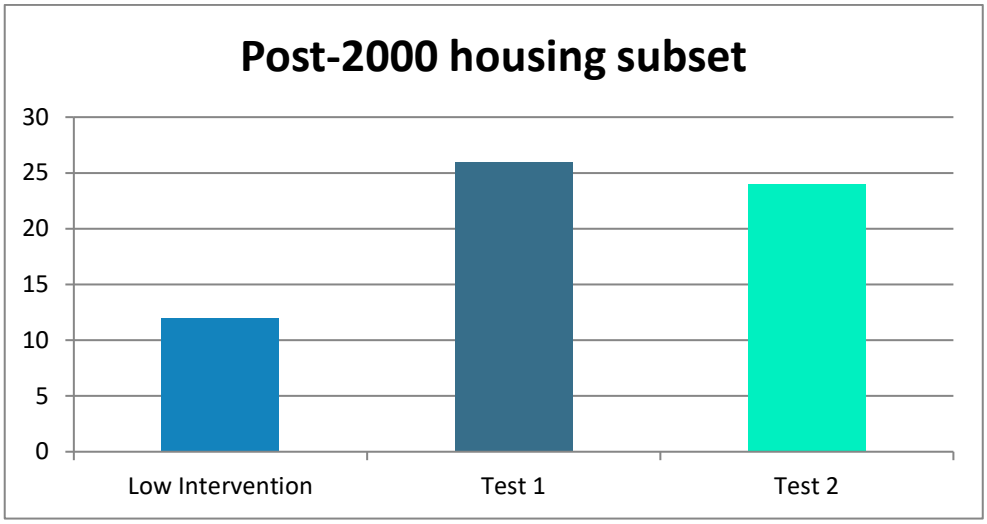


Figure 16 Treatments received by post-2000 households

2. Group site subset.

   One of the multiple dwelling sites contained enough participants to be considered as a subset for further statistical analysis. All 20 households from this site were included in the tests. Group sites are explained in more detail in Methodology: Treatments and Test Groups.

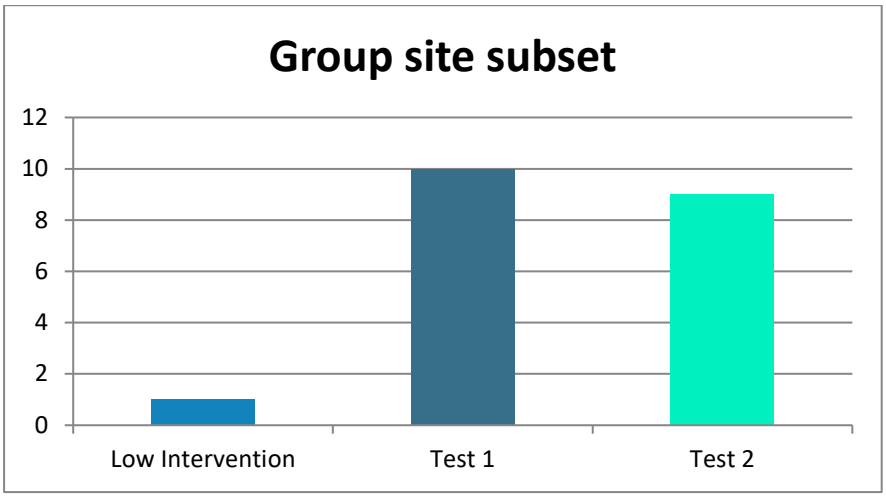


Figure 17 Treatments received by the group dwelling participants

The group site selected had a central management, shared resources (including a common area, club house and bowling green) and all households were equipped with solar-PV. This site provided self-reported electricity data for the baseline period. Self-reported electricity data is discussed further in Methodology: Data Collected. Group dwelling households were randomly assigned to test groups and matched distribution was not undertaken for this subset.

3. Solar-PV subset

A separate statistical analysis of households without solar-PV systems is undertaken for some tests to discuss the differences in performance.

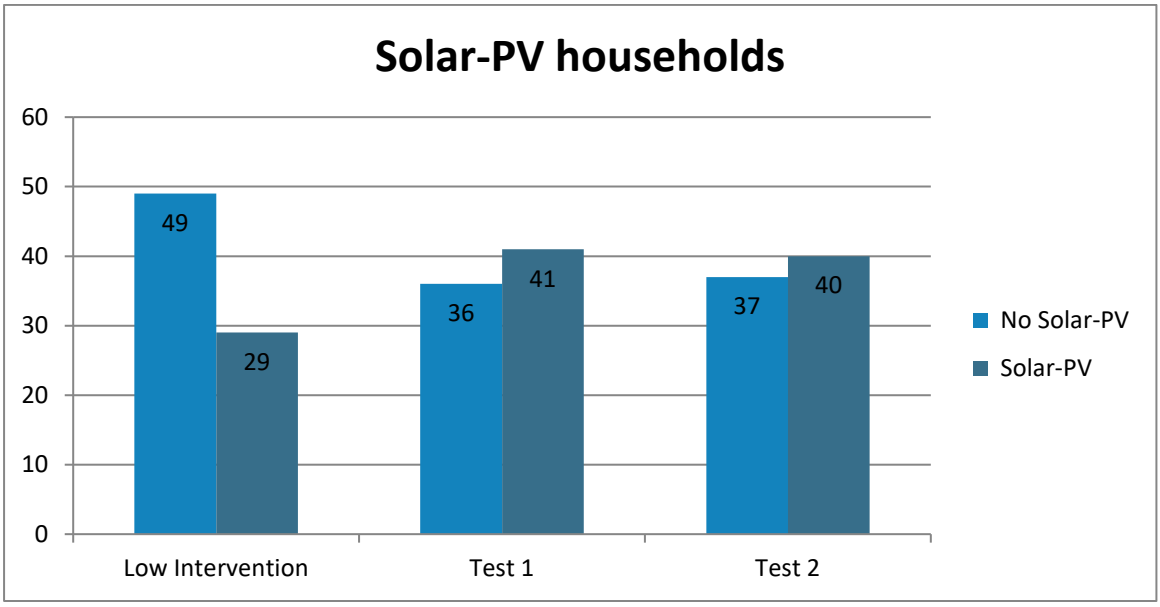


Figure 18 Number of households with and without solar-PV by test group.

All test groups have a large component of households with solar-PV. A disparity in prevalence of solar installation between the test groups is clear, although a random assignment was undertaken. Geography has not been a factor in determining the prevalence of solar-PV installation. All local government areas in the trial had higher than average solar PV installation, however the majority of households in the trial are located in the City of Gosnells and the City of Armadale, which had similar penetration of solar-PV.

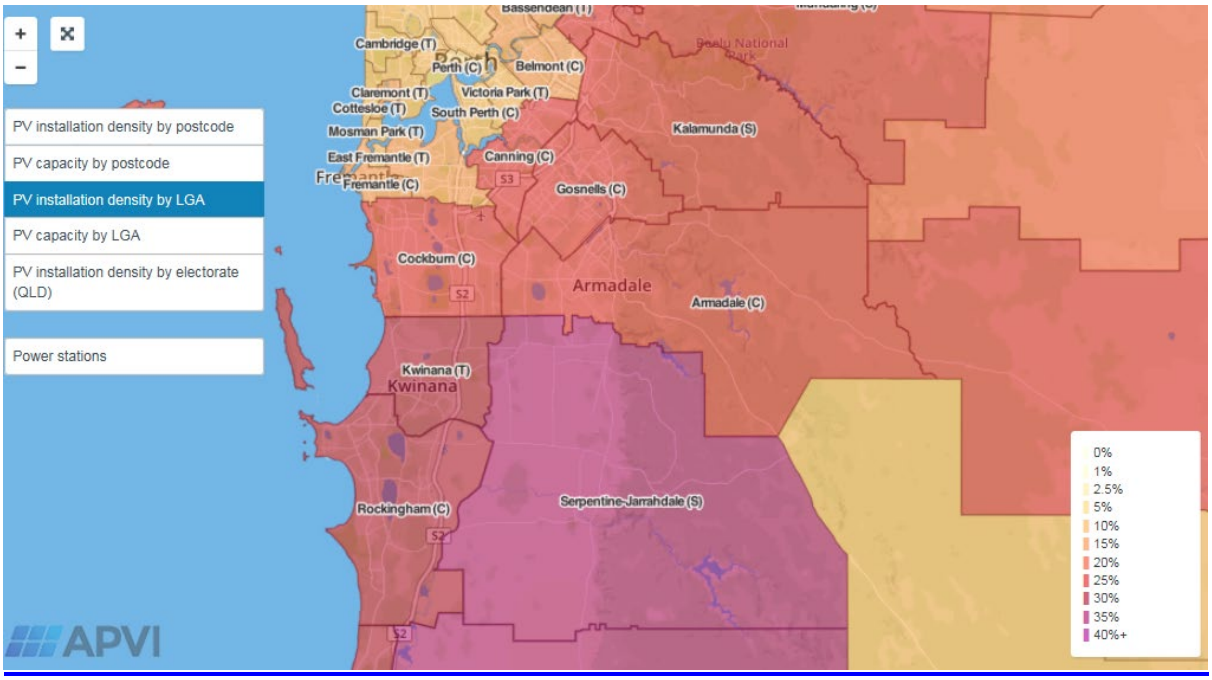


Figure 19 Map of solar-PV density by local government. Extracted from http://pv-map.apvi.org.au/ on 29/02/2016

Results

Electricity consumption data

Annual electricity consumption and cost summary for 225 households in the low intervention, test 1 and test 2 groups are summarised in Table 16 and Table 17. Data was collected from bi-monthly billing records (all 2014 usage and three-phase households in 2015) and half hourly electricity consumption data was used for all 2015 calculations.

Table 16 Summary of electricity use in 2014 and 2015

Solar	Variable	N	Mean	Std Dev	Minimum	Median	Maximum
No	2014 Usage	115	4928.61	2511.10	969.14	4422.26	13755.91
	2015 Usage		4802.75	2416.39	1065.86	4389.73	14133.48
	Change in Usage		-125.85	729.06	-2283.17	-92.86	2794.42
Yes	2014 Usage	90	2553.06	2058.25	-1275.65	2290.82	12667.66
	2015 Usage		2519.31	2314.94	-1044.11	2157.74	15718.81
	Change in Usage		-33.74	1007.59	-3403.42	-107.97	3051.16

Table 16 Summary of electricity use of all trial participants in Switched on Homes.

Overall there was a decrease in total electricity consumption in 2015 compared to 2014. While there is an apparent difference in response based on presence or absence of solar-PV, there was no significance in the difference between the two groups (p=0.4487). Households without solar-PV saved on average 126kWh in 2015, whereas households with solar-PV save 34kWh. It is obvious from the mean results that households without solar-PV have a higher electricity demand in both years. Households without solar-PV used on average 4929 kWh in 2014, equating to 13.5kWh per day while households with solar-PV used 2553kWh, equating to 7.0kWh per day. Considering the difference in baseline electricity consumption, a percentage change is useful to compare the groups. The percentage change in electricity consumption of households without solar-PV is -2.9% and with solar-PV is -1.3%.

Over all, Switched on Homes participants mean daily electricity usage was 10.64kWh in 2014 and 10.41kWh in 2015. The change in average electricity use of -0.23kWh is not statistically significant.

Table 17 Summary of electricity cost in 2014 and 2015.

Solar	Time	N	Mean	Std Dev	Minimum	Median	Maximum
No	2014	113	$1,215.05	$598.89	$243.74	$1,108.65	$3,167.86
	2015		$1,181.80	$568.19	$268.06	$1,082.83	$2,935.40
	Change		-$33.24	$184.53	-$574.22	-$23.85	$702.80
Yes	2014	84	$626.12	$522.54	-$320.83	$563.62	$3,185.92
	2015		$622.27	$593.18	-$262.59	$535.08	$3,953.28
	Change		-$3.85	$246.50	-$855.96	-$19.74	$767.37

Table 17 shows that both groups decreased their electricity costs in 2015, consistent with the results of Table 16. Comparing the change in cost between the groups, non-solar households reduced their annual electricity costs by more than households with solar-PV, but this was not statistically significant (p=0.3395). All households included in this analysis were on a flat rate tariff. A total of 8 households included in Table 16 were excluded from this analysis due to them opting in to a time of use tariff.

Annual electricity consumption

Annual electricity consumption for each household was measured in 2014 and 2015. Bi-monthly electricity consumption from billing records provided 2014 data. Half hourly electricity consumption data, recorded by data loggers, provided 2015 data. As half hourly electricity data was utilised for the 2015 analysis, three phase households in the low intervention group were not included because this information could not be captured accurately from three phase meters.

To answer the question "did any group change electricity consumption in 2015 compared to 2014?" and "was there any difference in electricity consumption between groups in 2015?" a significance threshold of 5% ($p \leq 0.05$) was used. Key statistics of annual electricity consumption are displayed in Table 18 and Figure 20. A mean, median, maximum, minimum and standard deviation was calculated for each group in 2014 and 2015. The change in usage is calculated individually for each household as 2015 use minus 2014 use. Using the annual change values the change in usage mean, standard deviation, median, maximum and minimum are calculated.

Table 18 Key statistics of annual electricity use per group in 2014 and 2015.

Group	Variable	N	Mean	Std Dev	Minimum	Median	Maximum
Low Intervention	2014 Usage	69	4417.17	2777.97	-758.16	4190.94	12667.66
	2015 Usage		4458.33	2794.01	-350.99	4089.28	15718.81
	Change in Usage		41.16	1041.75	-2283.17	-92.86	3051.16
Test 1	2014 Usage	70	3574.73	2348.40	2.91	2976.61	12595.88
	2015 Usage		3580.60	2253.99	-128.06	3189.34	11671.59
	Change in Usage		5.87	732.39	-1474.69	9.83	2649.89
Test 2	2014 Usage	66	3659.83	2619.08	-1275.65	3249.66	13755.91
	2015 Usage		3345.28	2710.44	-1044.11	2672.75	14133.48
	Change in Usage		-314.56	738.15	-3403.42	-187.40	1453.99

In 2015 compared to 2014 the low intervention and test 1 groups increased their energy usage on average by 41kWh (0.95%) and 6kWh (0.16%), respectively. The difference between the low intervention and test 1 group was not significant (p=0.8071). Conversely, test 2 households decreased their usage on average by 315kWh (8.59%). Test 2 households reduced their usage significantly compared to both test 1 and low intervention households, by 320.4kWh (SE=146.0, p=0.0293) and 355.7kWh (SE=146.5, p=0.0160).

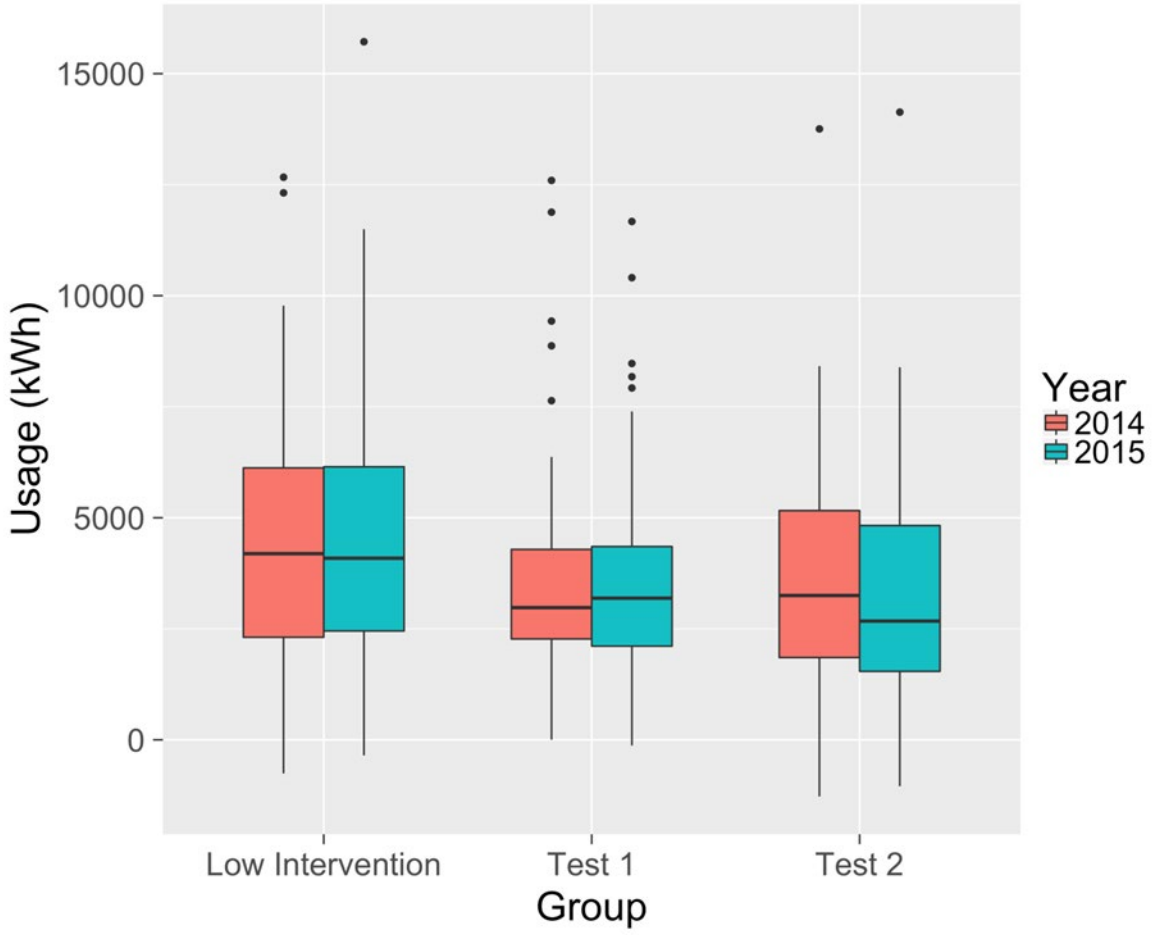


Figure 20 Boxplots showing key statistics of annual electricity use in 2014 and 2015 by group

Table 18 shows that 2014 mean electricity usage is similar for the test 1 and 2 groups but different in the low intervention group. In 2014 the mean electricity consumption was 3575 kWh and 3660kWh in the test 1 and test 2 groups respectively. The low intervention group's mean electricity consumption in 2014 was 4417 kWh. This is 19.1% and 17.1% higher than the test 1 and test 2 group respectively. In all three groups median electricity use is higher than mean, indicating that a few households with much higher than average electricity consumption are affecting the overall results. Examining Figure 20, it is apparent that the test 1 group shows a smaller interquartile range and a higher number of outliers than the other groups. The outliers indicate a strong base of borderline high electricity consumers in this group, not present in other groups.

Percentage change from baseline electricity consumption is presented in Table 19. Percentage change was calculated as the (2015 – 2014 usage) / absolute value of 2014 usage and was calculated individually for each household before reaching a mean value. Percentage change in electricity consumption removed two outliers from Table 18, one household in the test 1 group and one household from the low intervention group with percentage change in electricity consumption of 4,508% and 1,799% respectively. Both excluded households had baselines very close to zero in the baseline year, rendering them unsuitable for percentage change comparison.

Table 19 Key annual electricity use statistics as percentage change within group

Group	N	Mean	Std Dev	Minimum	Median	Maximum
Low Intervention	68	3.23	57.03	-322.64	-2.17	151.67
Test 1	69	3.86	29.08	-44.16	0.54	126.36
Test 2	66	-14.55	34.95	-200.99	-4.12	35.77

The only statistically significant change in electricity consumption was in the test 2 group, which decreased by 14.55%. Although an increase of 3.23% was recorded in the low intervention group, the median change in electricity consumption decreased, indicating that the change was not significant. The test 1 group increased electricity consumption the most during the trial, increasing mean electricity consumption by 3.86%.

Table 20 Percentage of participants who changed electricity use

Group	N	Decrease of more than -5%	No meaningful change	Increase of more than 5%
Low Intervention	69	30 43.48%	16 23.19%	23 33.33%
Test 1	70	23 32.86%	24 34.29%	23 32.86%
Test 2	66	30 45.45%	22 33.33%	14 21.21%

A threshold of 5% was applied to assess how many households meaningfully changed their electricity consumption. The results are contained in Table 20. Summary results indicate that more households in the test 2 group reduced their electricity use than the low intervention and test 1 groups. A similar number of households in the low intervention and test 2 groups reduced their electricity use by more than 5% (43% and 45% respectively). These groups behaved differently thereafter, a higher proportion of the low intervention group increased their electricity use by over 5% (33%) than the test 2 group (21%), meaning overall the test 2 group were less likely to have increased than the low intervention. This aligns with the results displayed in Table 18. A smaller proportion (33%) of the test 1 group reduced their electricity use by more than 5% and this group was quite equally distributed between decreasing, no change and increasing.

Control annual electricity consumption

Monthly electricity consumption for the trial area (local government areas of Gosnells and Armadale, see Treatments and test groups: Community control electricity for more details) was received from Western Power. This data is summarised to form Table 21. The average daily electricity consumption of the control group was 14.9kWh in 2014 and 14.6kWh in 2015, indicating a 2% decrease in mean electricity consumption occurred in 2015. Mean electricity consumption in the control group was higher than all Switched on Homes groups, and the Switched on Homes trial overall in both 2014 (10.6kWh/day) and 2015 (10.4kWh/day).

Table 21 Average electricity consumption in the community control group

	Average kWh per day		
Month	**2014**	**2015**	**Percentage change**
January	18.32	17.43	-4.86%
February	18.17	17.43	-4.07%
March	15.79	14.6	-7.54%
April	14.32	13.32	-6.98%
May	14.29	13.75	-3.78%
June	15.49	14.79	-4.52%
July	16	15.79	-1.31%
August	14.63	15.12	3.35%
September	12.71	12.98	2.12%
October	12.05	12.23	1.49%
November	12.43	13.2	6.19%
December	14.38	15.12	5.15%
Annual daily average Gosnells / Armadale LGA	**14.87**	**14.64**	**-1.54%**
Annual daily average Perth metro	**15.23**	**15.00**	**-1.51%**

In 2015 the control group decreased electricity consumption to 14.6kWh/day, a decline of 1.56% over the baseline (2014) year. This is smaller than the decrease recorded in all Switched on Homes households (2.16%), measured over the same time period. From January to July, electricity consumption in 2015 was less than 2014, and in August to December, each month was higher than the 2014 baseline. The largest departures from the 2014 baseline by percentage change were March

and April, when -7.5% and -7.0% changes were observed respectively. The largest increase in electricity consumption as a percentage change occurred in November and December, and was 6.2% and 5.2% respectively. A marked decrease in electricity consumption is noticeable in April to May and September to November in both years.

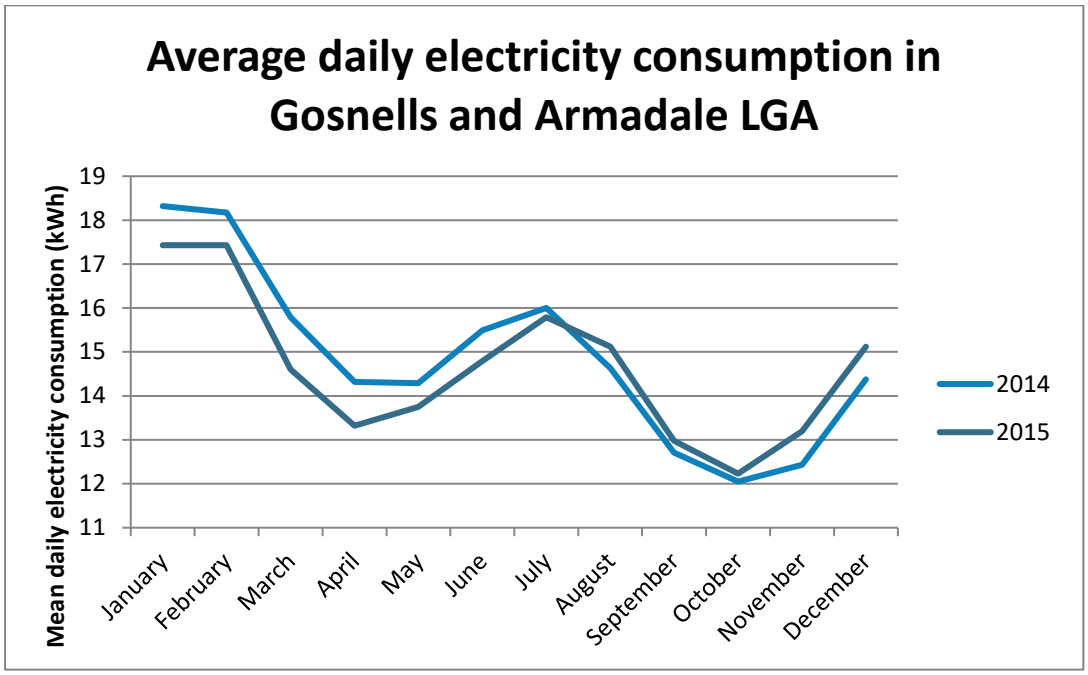


Figure 21 Daily electricity consumption in the community control group by month

Weekly electricity consumption

Electricity consumption was aggregated and averaged per test group. The results are shown on a graph of time in 2014 and 2015. Week 0 includes 1 January – 5 January, week 1 commences on 6 January in 2014 and 2015. The data source was bi-monthly electricity consumption from billing records in 2014 and half hourly electricity consumption data recorded by data loggers in 2015. A summary is produced for each test group in Figure 22, Figure 23 and Figure 24. The 2014 data appears as a smoothed line due to the averaging used from bi-monthly billing data. The 2015 line shows much clearer peaks and troughs as a result of the data being averaged half hourly.

SMS communications

Does the SMS energy efficiency campaign decrease household electricity use over the calendar year 2015?

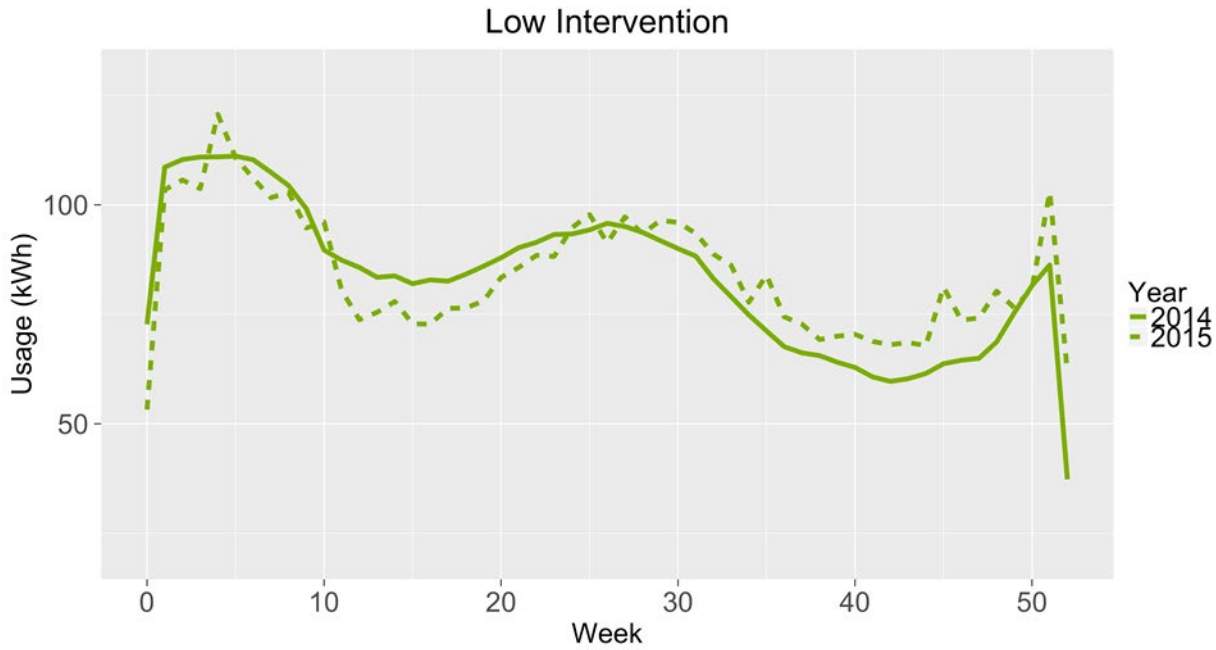


Figure 22 Average weekly electricity consumption of the low intervention group during 2014 (solid line) and 2015 (dashed line).

This analysis includes 28 low intervention households, excluding three phase households as half hourly electricity consumption data was not available in 2015. A close fit in the 2014 and 2015 years is noted in both shape and usage. Overall electricity use was slightly lower than the baseline in most weeks during the first 25 weeks of the trial, then consistently slightly higher than the baseline after week 25. This is reflected by the annual electricity consumption of the group and average percentage change, which Table 18 shows increased 0.95% in 2015 (for the whole group, including three phase households which are excluded from Figure 22). Similarities are apparent between the community control group's electricity consumption relative to the baseline when examining Table 21, particularly from July (week 25) onwards, when both the community control and the low intervention group increase relative to their baseline.

Figure 22 indicates that only minor differences were observed in 2014 and 2015 in the low intervention group. This indicates that the SMS communications were not an effective tool for

changing electricity consumption in the low intervention group. SMS tips may have had a short term effect (in the first 25 weeks of the trial); however the results of the control group indicate that the general population also experienced a decrease in electricity consumption during that time.

Personalised feedback

Can households receiving personalised feedback reduce their electricity consumption in the trial year (2015) compared to the baseline?

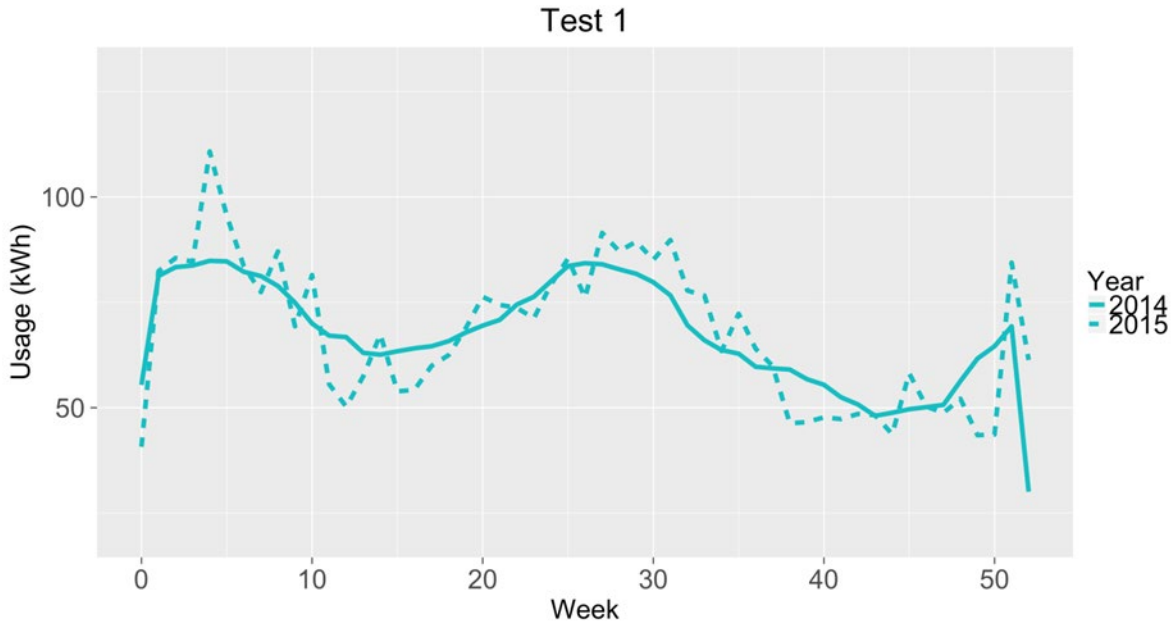


Figure 23 Average weekly electricity consumption of the test 1 group during 2014 (solid line) and 2015 (dashed line)

This analysis includes 68 test 1 households. Table 18 shows there is an insignificant increase in electricity consumption in 2015 amounting to 0.16%. Despite the minor change in the annual usage, Figure 23 shows there is variation in the time and amount of electricity consumed. While the overall trend is increased electricity use in 2015, there are a few noticeable reductions in 2015 to 2014. A large and extended increase to the baseline is noted in the first 10 weeks of the trial, correlated to late summer. While all three test groups increased relative to their baseline in this time period (as shown by Figure 22 and Figure 24), the scale of the increase is much higher in the test 1 group. Extended decreases relative to the baseline were observed between weeks 11 and 19 and between weeks 38 and 43, correlating to autumn and spring respectively. From week 43 onwards electricity consumption increased relative to the baseline, correlating to the period of highest increase in the community control group (November and December 2015, see

Table 28). In 2015 there is a noticeable shift in peak electricity demand. Peak demand of the test one group occurred twice in 2014 (around week 4 and week 26). In 2015 peak demand of the test one group occurred once around week 4 and was higher than 2014 peak.

Figure 23 illustrates that personalised feedback was not helpful in helping households reduce electricity consumption relative to their baseline outside of autumn and spring. Compared to Figure

23 the test 1 group experienced a decrease relative to their baseline and relative to the control group only in weeks 38-43, corresponding to spring.

Voltage optimisation units

Can voltage optimisation reduce energy consumption of households over the calendar year 2015?

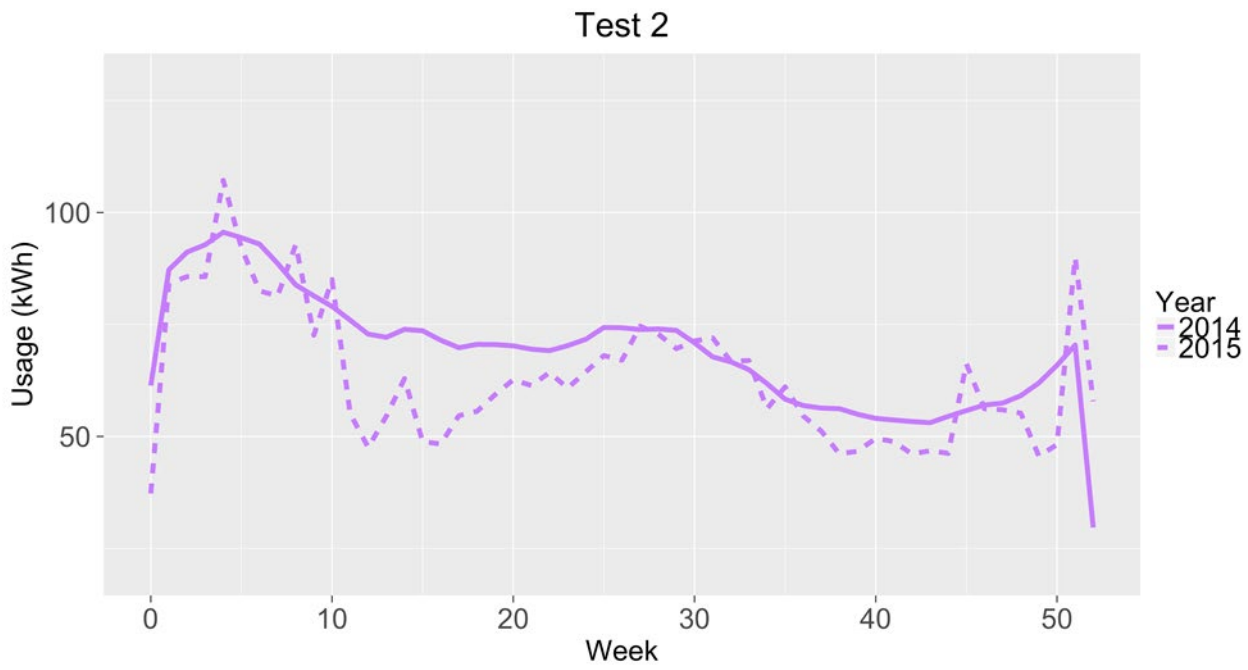


Figure 24 Average weekly electricity consumption of the test 2 group during 2014 (solid line) and 2015 (dashed line)

This analysis includes 62 households in the test 2 group. A decline in electricity consumption from 2014 baseline is apparent in 2015, although the shape remains the same. As noted in the low intervention and test 1 groups, electricity demand between weeks one and ten regularly exceeded the baseline and this is the period of peak demand. Outside of the first ten weeks, the test 2 group consistently decreased electricity consumption in 2015, relative to 2014. A noticeable decrease compared to 2014 is sustained from week 11 to 50, with the exception of week 45. As noted in the other test groups and the control group, electricity demand in week 44 onward was higher in 2015 than in the previous year. The test 2 group were still able to decrease relative to their baseline for an extended period of time (between weeks 47 and 50).

Figure 24 indicates that voltage optimisation (trialled in conjunction with SMS tips and personalised feedback in the test 2 group) was effective in reducing electricity consumption; both relative to the baseline and relative to the control group (Table 21). The only time period that the test 2 group experienced an increase in electricity consumption that was not also present in the control, was during weeks one to ten of the trial year.

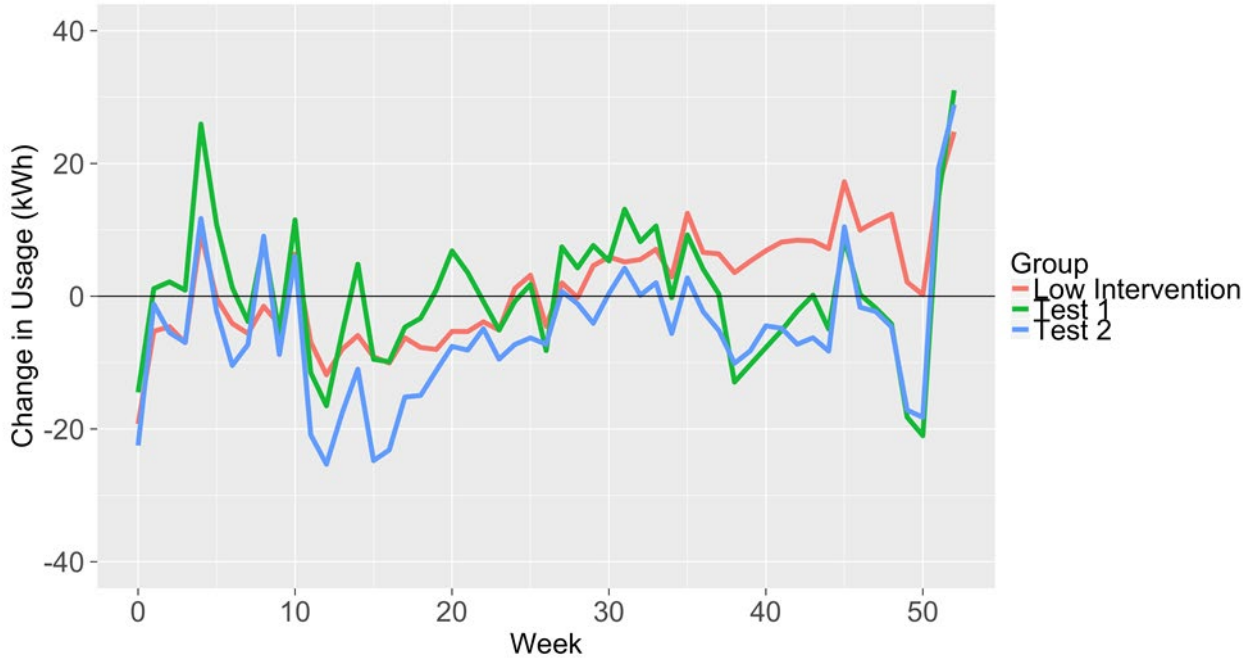


Figure 25 Weekly change in electricity consumption in 2015 per group

Figure 25 shows the departure from the average baseline weekly electricity use in 2015. The baseline average was calculated weekly including all households in Table 18 except three phase households in the low intervention group. Figure 25 highlights trends in movement only.

Synchrony between the three groups is noticeable in weeks 0 to 25, with all three groups performing similarly to the baseline. From weeks 1 to 10, all groups increased relative to the baseline, which was not observed in the control group (Table 21). From week 10 onwards all groups were lower than the average baseline for varying lengths of time. The test 2 group had the greatest and most sustained decrease relative to the baseline, followed by the test 1 group and then the low intervention group.

After week 25, a divergence between the groups is apparent and there is more spread between the three groups. From week 25 onward the low intervention group has the largest change and continues to increase relative to the baseline. This is similar to the trend observed in the control group (Table 21). After week 25 both the test 1 and test 2 groups are able to show some reduction in electricity consumption relative to the baseline, when the low intervention and control group (Table 21) did not. The test 2 group maintains a reduction relative to the baseline for most of 2015 after week 10. The test 1 group has a performance intermediate to the low intervention and test 2 groups and spends noticeable lengths of time both above and below the baseline.

Figure 25 indicates that the low intervention group consumed more electricity relative to the baseline than either the test 1 or test 2 group. The results in Table 18 confirm this and also show that the low intervention group had higher mean electricity consumption in 2014 than the test 1 and test 2 groups (4417, 3574 and 3659 kWh respectively). Based on the dissimilarity in the 2014 electricity consumption of the low intervention group, the baseline in Figure 25 might not be well fitted to that group, and results should be interpreted accordingly.

Daily profile

Using half hourly electricity consumption data from the households included in Table 18, the daily electricity use profile (Figure 26) of Switched on Homes households in 2015 was created.

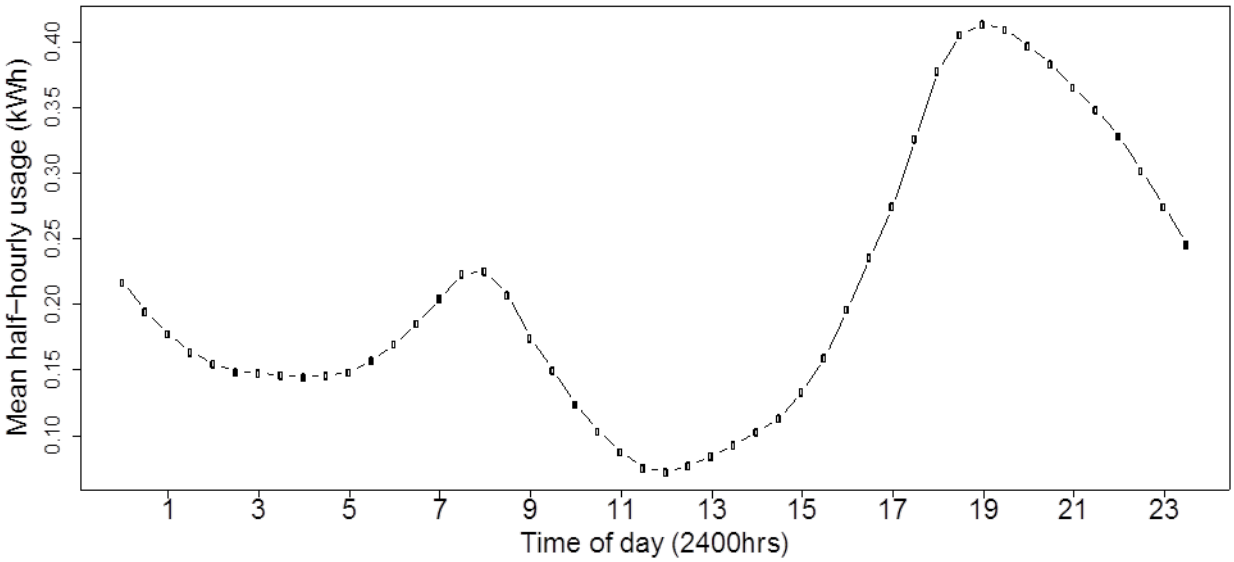


Figure 26 Daily electricity use profile

Figure 26 contains data from all seasons and clearly shows a peak demand period between 6PM and 9PM. Peak demand occurred in the 6:30PM-7:00PM period at 0.41kWh per half hour. Figure 26 also illustrates the drop in electricity demand between 11AM and 1:30PM, when households with rooftop solar-PV are exporting electricity. Baseline electricity consumption (electricity consumption between 2AM – 5AM) appears to be approximately 0.15kWh per half hour. In this instance baseline electricity consumption represents the household's minimum constant electricity demand, resulting from ongoing standby power use and appliances which are not routinely switched off (for example refrigerators and some types of hot water heaters).

Households without solar-PV subset

A smaller subset of households without solar-PV are analysed in the same manner as all households. All households in this subset were included in Table 18.

Table 22 Key statistics of annual electricity consumption in households without solar-PV by trial group

Group	Variable	N	Mean	Std Dev	Minimum	Median	Maximum
Low Intervention	2014 Usage	45	5246.52	2372.59	1180.97	5069.64	12316.70
	2015 Usage		5000.25	2267.23	1157.85	4935.29	11497.80
	Change in Usage		-246.27	799.67	-2283.17	-173.50	2794.42
Test 1	2014 Usage	36	4637.84	2667.19	969.14	3999.96	12595.88
	2015 Usage		4667.86	2441.26	1065.86	3983.50	11671.59
	Change in Usage		30.02	738.14	-1474.69	33.31	2649.89
Test 2	2014 Usage	34	4815.71	2547.41	1761.41	4021.86	13755.91
	2015 Usage		4684.19	2628.44	1533.99	4159.55	14133.48
	Change in Usage		-131.52	599.48	-1940.61	-88.49	1453.99

From 2014 to 2015, test 1 households increased their energy usage on average by 30 kWh (0.65%). Conversely, for the same time period, low intervention and test 2 households decreased their usage on average by 246kWh (-4.7%) and 132kWh (-2.7%), respectively. Contrary to the analysis of all households included in Table 19, which found the low intervention group increased electricity consumption slightly in 2015, this subgroup of the low intervention group decreased electricity consumption. The test 2 group decreased mean electricity consumption in 2015 in the overall test by 8.6%, whereas Table 23 shows a decrease of 4.7% was achieved in households without solar-PV. In both the total group and the subgroup without solar-PV, the test 1 group increased their consumption by less than 1%. While the results of Table 18 and Table 22 indicate that there was no difference in response in the test 1 group, there is an obvious difference in the response of the low intervention and test 2 groups in this subgroup.

Table 23 examines the average percentage change in households with and without solar-PV. Percentage change was calculated as the (2015 – 2014 usage) / absolute value of 2014 usage and was calculated individually for each household before reaching a mean value.

Table 23 Key statistics as percentage change in households without solar-PV

Group	N	Mean	Std Dev	Minimum	Median	Maximum
Low Intervention	45	-3.58	15.91	-33.77	-3.45	63.39
Test 1	36	3.25	18.88	-23.11	1.03	77.08
Test 2	34	-2.56	16.28	-55.85	-1.76	35.77

The analysis of all households noted that the low intervention group had a higher mean electricity usage in 2014 than the other groups. This is not the case in the households without solar-PV subset, where all three test groups had a similar mean consumption in 2014. The p-value test of the households data presented in Figure 27, Figure 28 and Figure 29 found no significant difference between the groups. While this test does exclude a large portion of the low intervention subgroup, it still appears to be suitable to apply to this analysis.

Weekly electricity use profiles (households without solar-PV)

Bi-monthly energy consumption data in 2014 was compared to half hourly electricity consumption data in 2015 to measure electricity consumption in low intervention households. Week 1 commences on 6 January 2014 and 2015. Included are the households included in Table 22, with the exclusion of households connected to three phase power in the low intervention group and 2 household each in the test 1 and test 2 groups whose data was not suitable for inclusion. In this analysis are 16 of the low intervention households without solar-PV.

Low intervention group

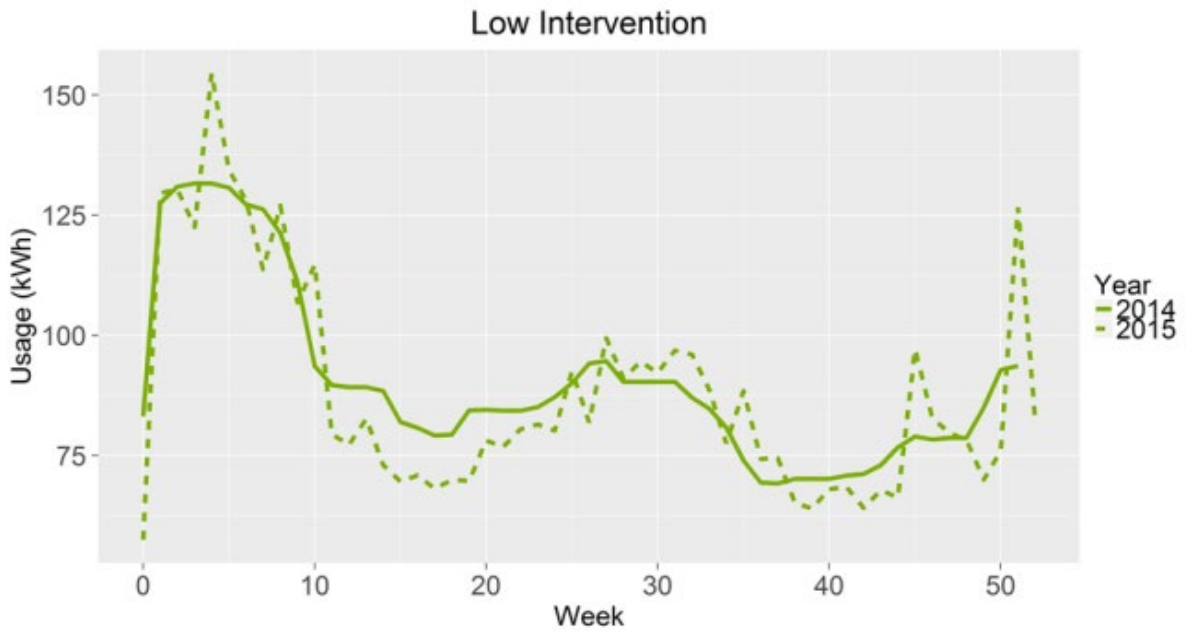


Figure 27 Average weekly electricity consumption of the households without solar-PV in the low intervention group during 2014 (solid line) and 2015 (dashed line).

A total of 16 low intervention households, all without solar-PV and single phase power connections, were included in this analysis. The electricity use pattern was closely correlated in the trial and baseline years, with the exception of an extended decrease between weeks 11 and 26. Comparing the subset of households without solar-PV to the total low intervention group (Figure 22), it is clear that the summer peak is much higher, however winter performance is similar.

Overall, a small but sustained decrease in electricity consumption relative to the baseline is noticeable in 2015 compared to the 2014 baseline. This indicates that SMS tips were an effective

tool in helping households without solar-PV decrease their electricity consumption in autumn and spring. This conclusion does not extend to all households (with and without solar-PV) in the low intervention group.

Due to the small size of this sub-group care should be taken when applying and interpreting the results of Figure 27.

Test 1 group

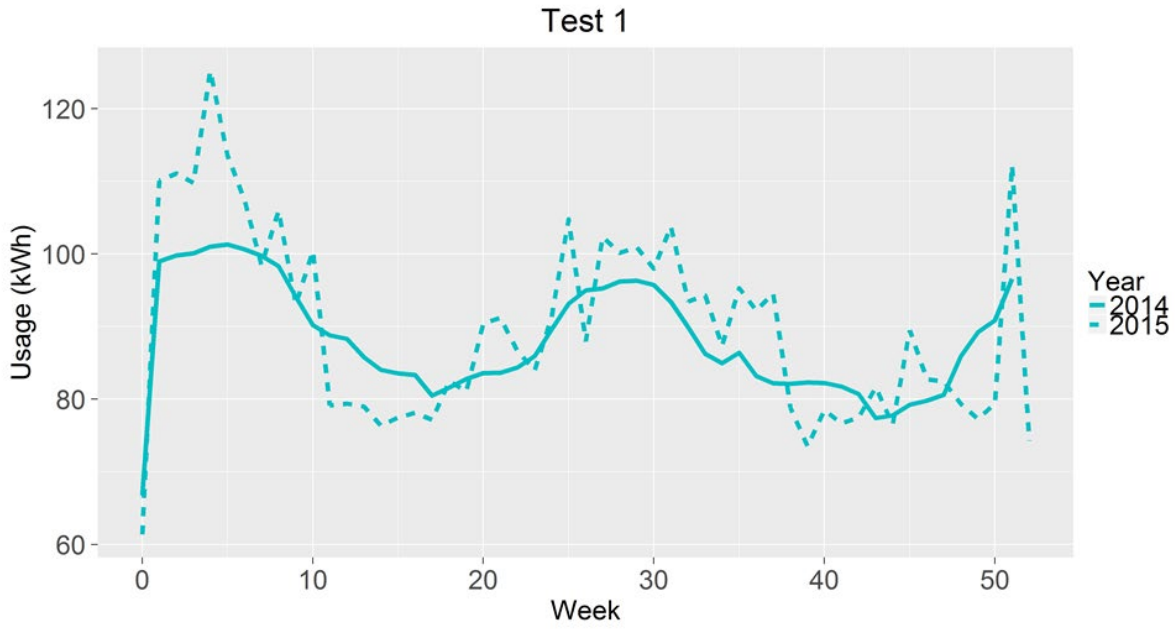


Figure 28 Average weekly electricity consumption of households without solar-PV in the test 1 group during 2014 (solid line) and 2015 (dashed line).

Included in this analysis were 34 test 1 households, all without solar-PV. Electricity consumption during the baseline and trial years was not closely related. Electricity consumption during 2015 exceeded 2014 in most weeks. This is reflected in the results in Table 23, which shows that on average, households in this subgroup increased electricity consumption by 3.25% in 2015. Smoothing is noted in the baseline year where bi-monthly electricity data was used; however the correlation between baseline and trial data is not as close as in the low intervention (Figure 27) and test 2 (Figure 29) groups.

Between weeks one to five, weekly electricity consumption is noticeably higher in 2015 compared to 2014. A small decrease is noticed between weeks 11 and 19 and again in weeks 38 and 42, which correlate to autumn and spring respectively.

The results shown in Figure 28 and Table 22 indicate that personalised feedback was not useful in helping households without solar-PV, or in the test 1 group overall (Table 18), reduce electricity consumption.

Test 2 group

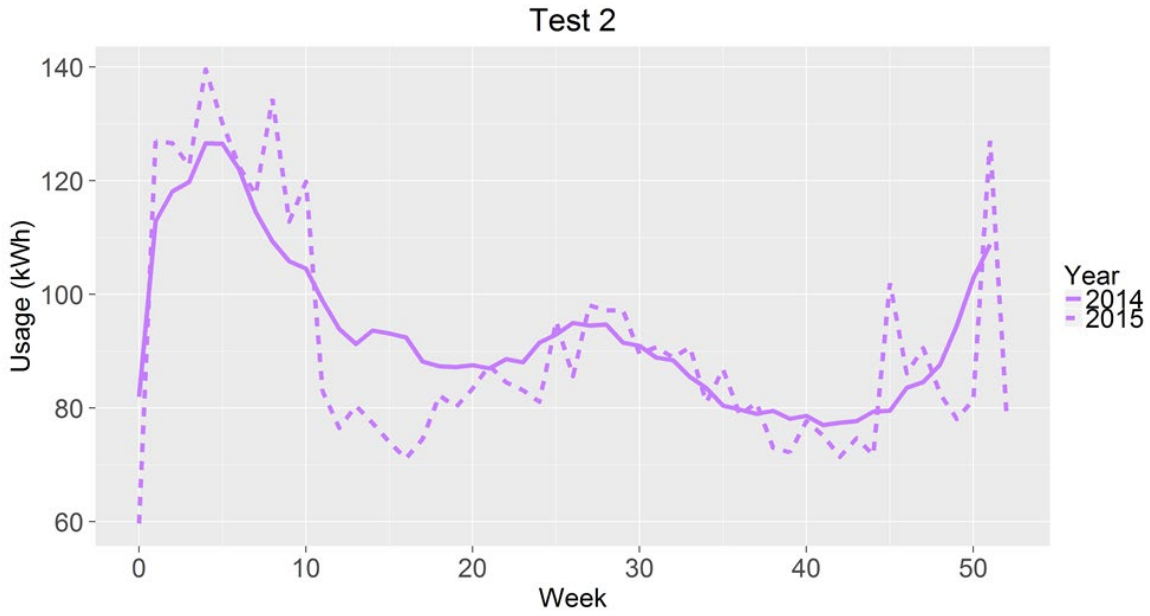


Figure 29 Average weekly electricity consumption of households without solar-PV in the test 2 group during 2014 (solid line) and 2015 (dashed line).

Included in this analysis are 32 test 2 households, all without solar-PV. Electricity consumption during the baseline and trial years was roughly correlated. A substantial increase was noticeable between weeks 1 and 10 (late summer) followed by a sustained decrease between weeks 11 and 26 (autumn and early winter). After week 26 it appears that the trial and baseline years are quite closely matched. This is different to the results of the test 2 group overall (Figure 24), which showed a distinctive profile in the baseline year and the trial year. This difference is reflected in the results in Table 19, which shows that overall the test 2 group decreased electricity consumption by 14.55% in the trial year, and Table 23 that showed the subset of these households without solar-PV saved only 3.58%.

Based on the results of Figure 29, it appears that voltage optimisation (delivered in conjunction with SMS and personalised feedback in the test 2 group) was effective in helping households without solar-PV reduce electricity consumption in autumn. This conclusion does not apply to the entire test 2 group, where it appears that voltage optimisation resulted in sustained decreases to the baseline after week 5 of the trial (Figure 24).

Average electricity users in the Switched on Homes trial

In order to assess the effectiveness of Switched on Homes approaches if rolled out to the wider population, an analysis of users with electricity consumption above the Perth Metro Average in 2014 (15.23 kWh/day) was undertaken. The results of this analysis are presented in Table 24. As the average electricity consumption in 2014 was lower than the metro average (10.64kWh/day) the majority of test households were excluded from this analysis, and consequently the sample sizes are small. Mean percentage change was calculated as the individual percentage change (2014 usage – 2015/ absolute value of 2014 usage) averaged.

Table 24 Observed change in households with above Perth average electricity consumption in 2014

Group	N	2014 usage	2015 Usage	kWh change	Mean Percentage Change
Low Intervention	21	7365.828	6921.026	-444.801	-5.78
Test 1	10	8023.005	7617.421	-405.584	-3.87
Test 2	8	7750.645	7547.175	-203.47	-3.08

Table 24 indicates that above average electricity consumers in all three test groups decreased electricity consumption in 2015 compared to 2014. Overall, in above average electricity consumers the low intervention group saved the most electricity (-5.78% average change in 2015), followed by the test 1 and test 2 groups respectively. This is contrary to Table 18, which showed the largest decrease in electricity consumption in the test 2 group, followed by the smallest change in the test 1 then low intervention group. In Table 23 all three groups save more electricity than the control (-1.54% decrease in community control electricity consumption, see Control annual electricity consumption).

Group housing subset

A subset of 17 individual homes at one group site was analysed, three eligible households were excluded due to gaps in data collection. The remaining households included one low intervention household, nine test 1 group households and seven test 2 group households.

Table 25 Annual electricity consumption statistics of group households in the Switched on Homes trial

Group household	Variable	N	Mean	Std Dev	Minimum	Median	Maximum
No	2014 Usage	188	4091.67	2600.15	-1275.65	3703.51	13755.91
	2015 Usage	188	4006.19	2624.72	-1044.11	3723.19	15718.81
	Change in Usage	188	-85.48	884.18	-3403.42	-87.51	3051.16
	Perc. Change in Usage	187	-2.33	43.62	-322.64	-1.96	151.67
Yes	2014 Usage	17	1607.73	1127.54	2.91	1465.91	3774.91
	2015 Usage	17	1523.04	1157.55	-128.06	1271.49	4020.96
	Change in Usage	17	-84.69	569.28	-1189.29	-203.76	1226.77
	Perc. Change in Usage	16	-2.43	32.19	-31.59	-14.31	72.05

Table 25 shows that group households have decreased their electricity use in 2015 compared to 2014, by 84.7kWh/annum and 85.5kWh/annum respectively. The difference in electricity consumption (0.8 kWh, SE=218.7) was not significant (P=0.9971). Even though the baseline electricity use was much lower in the group housing subset than all other households (1607.7kWh/annum and 4091.7kWh/annum respectively), the mean percentage change was similar (percentage change equal to -2.4% and -2.3% respectively). In calculating the percentage change, one outlier was removed from both groups. The change as a proportion of total annual electricity use was -5.27% in the group households subset and -2.09% in the non-group housing subset.

Given the average electricity consumption of all Switched on Homes households in 2014 (10.64kWh/day – see discussion of Table 16), compared to the average daily consumption of group households in 2014 (4.40kWh/day) it is likely that the inclusion of group households in Switched on Homes had the following effects:

1. Lowered average electricity consumption for the whole trial
2. The unequal distribution of group households in the test groups (only one in the low intervention group) increased the baseline electricity consumption of the low intervention group relative to the test 1 and test 2 groups.

Peak load SMS

Peak load SMS

Can households reduce their electricity use during peak demand periods in response to an SMS that asks them to do so?

In order to compare if households could reduce their energy usage during peak demand periods in response to an SMS that asks them to do so, each households' usage 4 hours pre- and post-SMS deployments on the following dates/times was calculated:
25th February 2015 – 4:30PM
9th August 2015 – 4:00PM
23rd December 2015 – 4:00PM

Table 26 Key statistics in the 4 hours pre and post peak load SMS deployment by solar-PV installation

Peak load message	Solar	Variable	N	Mean	Std Dev	Minimum	Median	Maximum
1	No	Pre	86	4.32	3.47	0.30	3.38	15.33
		Post		6.83	4.03	0.44	5.70	19.85
		Change		2.51	2.81	-4.54	2.28	10.78
	Yes	Pre	79	2.16	3.93	-3.48	0.81	14.73
		Post		5.73	5.03	-0.28	4.29	26.33
		Change		3.57	4.29	-4.68	2.84	16.43
2	No	Pre	86	2.29	2.20	0.17	1.69	14.04
		Post		4.34	3.51	0.13	3.49	22.72
		Change		2.06	2.52	-3.80	1.55	8.86
	Yes	Pre	79	0.78	2.01	-2.26	0.26	11.90
		Post		4.35	3.90	0.18	2.59	18.04
		Change		3.57	3.79	-4.46	2.28	19.28
3^	No	Pre	84	5.24	4.17	0.29	4.28	16.51
		Post		6.62	4.41	0.47	5.51	19.87
		Change		1.38	2.64	-4.55	1.31	9.67
	Yes	Pre	77	2.68	4.77	-4.53	1.37	18.10
		Post		5.99	5.52	-1.28	4.22	25.09
		Change		3.30	3.88	-4.14	2.61	18.75

^Four households (two solar and two non-solar) had no data for the 23rd of December 2015 and were therefore excluded from third deployment summaries.

All peak load message results exclude control households and households connected to three phase power in the low intervention group. As the four hours post-SMS message coincides with the period of time the sun is setting, solar-PV output decreases in the post-SMS analysis. This will influence the ability of households with solar-PV to respond. Due to this major comparative difference, households without solar-PV will form the basis of the analysis. 87 households (16 in the low

intervention group, 36 in the test 1 group and 35 in the test 2 group) remain which are suitable for a robust analysis.

Overall, households with solar-PV exhibited a larger change in electricity consumption in the post-deployment period to all three messages. Prior to deployment of all three messages, households with solar-PV consumed less electricity (only electricity purchased the grid is measured) than households without solar-PV. In the four hours post deployment, electricity consumed from the grid was more similar between the two groups, although the households without solar-PV consumed slightly more over the four hour period. In winter, when the output of solar-PV is lower and the sun sets sooner, households with and without solar-PV used a very similar amount of electricity in the four hours post-SMS deployment (4.34kWh and 4.35kWh respectively). Overall, the results indicate that households with solar-PV require additional electricity from the grid during peak demand and these households have a similar demand to households without solar-PV.

Table 27 Percentage of households in each solar group whom decreased their energy usage within 4 hours following an SMS deployment requesting them to do so

Peak load message	Solar	
	No	Yes
1	13.95%	15.19%
2	13.95%	5.06%
3	26.19%	11.69%

Table 27 records the percentage of households who reduced their electricity use in the four hours after deployment of a peak load message. The majority of households did not respond to the messages. The greatest response by number of households was to peak load message 3 when 26% of households without solar-PV decreased electricity consumption. This also aligns with the results of Table 26, which shows average electricity usage increased the least in the four hour period following Peak Message 3.

The ability to respond to peak load messages was not uniformly related to the presence of solar-PV. The proportion of households that responded by reducing electricity use was not seasonal in households without solar-PV (14% responded to both summer and winter messages) but fewer households with solar-PV responded to the winter message (5%). Taking into account the higher number of households that responded to peak load messages 2 and 3 were households without solar-PV, it indicates that households with solar-PV were somewhat less responsive to peak load messages.

To separate the impact of declining solar productivity on response, the same test was performed in the one hour post-message deployment. The results are displayed in

Table 28.

Table 28 Percentage of households in each solar group whom decreased their electricity usage within 1 hour following an SMS deployment requesting them to do so

Peak load message	Solar	
	No	Yes
1	45.35%	32.91%
2	45.35%	26.58%
3	51.19%	16.88%

Table 28 shows that in the one hour after deployment of a peak load message up to 51.2% of households reduced electricity use, indicating a greater response to the peak load SMS than suggested in Table 26. There is a clear indication that households, regardless of presence of solar-PV, are able to reduce electricity use in response to the peak load message for some period of time. In the households without solar-PV, over 45% of households responded to all three messages. In households with solar-PV, the response rate was lower and more variable, ranging from 17 to 33% of participants responding. Responsiveness in the one hour after deployment (

Table 28) was much higher in households without solar-PV. While the data presented in the four hours post deployment included a period of time when solar production ceased, the solar productivity one hour pre and post deployment (3pm-5pm) is similar. This is an indication that the presence of solar-PV, not just the output of the solar-PV at that particular time, affected the response of households with solar-PV.

New housing subset

A subset of 55 homes built post-2000 was included as the new housing subset. A total of 74 homes built prior to 2000 were included as a comparison. Households that did not return a built age were excluded from the analysis. The percentage change was calculated as (2015 usage – 2014 usage)/2014 usage. An absolute value was used for the 2014 usage.

Table 29 Annual electricity consumption statistics of pre and post-2000 build homes

Built age	Variable	N	Mean	Std Dev	Minimum	Median	Maximum
Pre-2000	2014 Usage	74	4018.48	2688.67	-1275.65	3499.25	12667.66
	2015 Usage	74	4027.12	2790.16	-1044.11	3927.07	15718.81
	Change in Usage	74	8.63	925.13	-2283.17	-6.71	3051.16
	% Change in Usage	74	3.59	47.70	-200.99	0.01	151.67
Post-2000	2014 Usage	54	2956.48	1899.84	-313.57	2749.00	7197.54
	2015 Usage	54	2889.48	2064.75	-582.84	2467.72	7960.62
	Change in Usage	54	-66.99	853.48	-2091.55	-124.25	2794.42
	% Change in Usage	53	-3.42	31.36	-85.87	-3.74	77.08

Table 29 shows that households built post-2000 had decreased their electricity use in the trial year (2015) compared to 2014 (67kWh), conversely the pre-2000 households increased their electricity consumption. The difference in consumption of 75.6kWh (SE=160.3) was not statistically significant (p=0.6379), indicating that built age was not a factor in responding to Switched on Homes. Other key statistics presented in Table 29 show that post-2000 households consume less electricity than the pre-2000 group (2956 kWh and 4018 kWh per annum respectively in 2014). Due to this difference in electricity consumption, it is useful to consider the change in 2015 as a percentage of the subgroup's total electricity use. The group of households built pre-2000 increased electricity consumption by 3.6% on average, while the households built post-2000 decreased by 3.4%. One outlier was removed from the post-2000 group (change =-4508.09) to calculate the percentage change.

Weather

To examine the role weather conditions play on mean daily electricity use, plots were created for a number of variables:

- Maximum temperature
- Minimum temperature
- 9am relative humidity, and
- 3pm relative humidity.

Half hourly electricity consumption data during 2015 was compared to weather readings from the Jandakot Aero Bureau of Meteorology site to generate the plots.

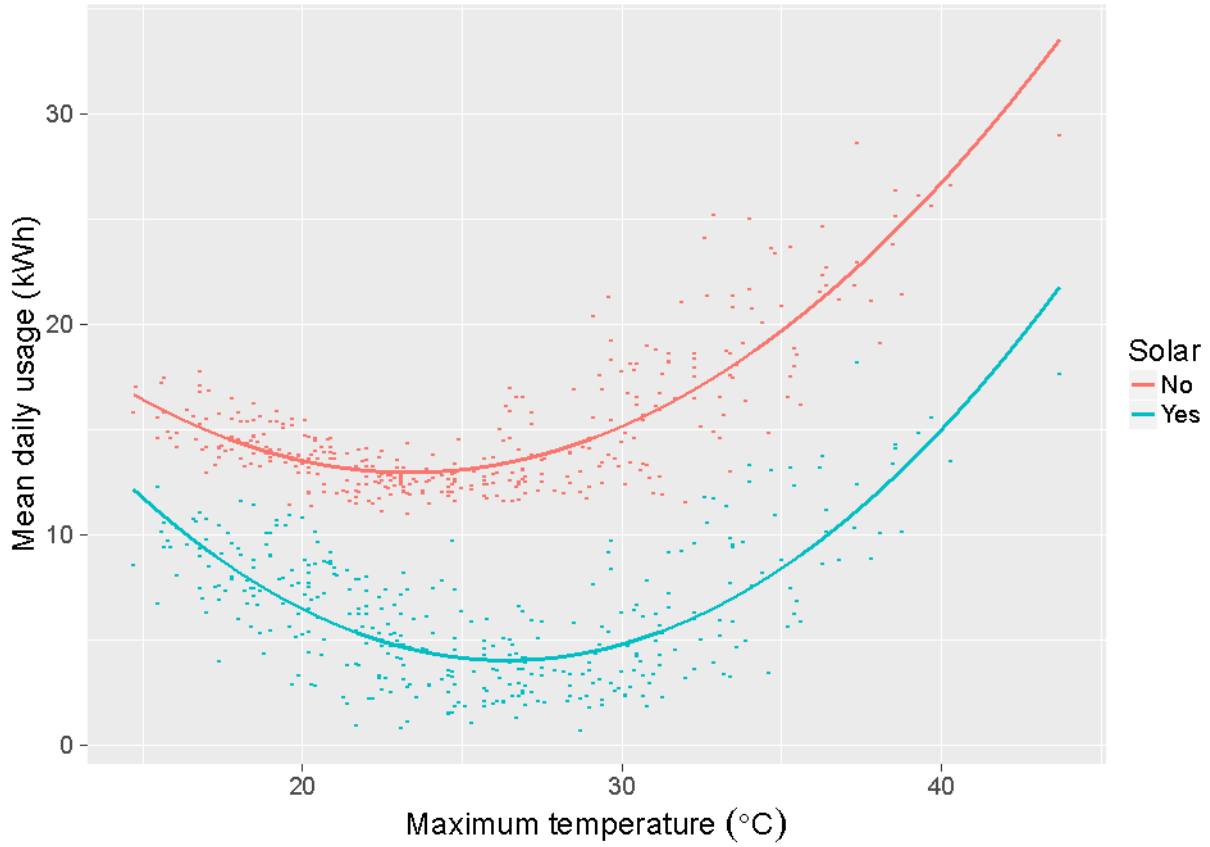


Figure 30 Scatterplot of mean daily electricity use against maximum temperature

Figure 30 shows increased electricity use under conditions of both high and low maximum temperatures. The line of best fit shows mean daily electricity use increasing rapidly on days when the maximum temperature is above 30 degrees Celsius, particularly in households without solar-PV. In households with solar-PV, the line of best fit shows that demand for electricity is relatively higher at lower maximum temperatures (15 degrees Celsius) than households without solar-PV. Table 30 explores this relationship, indicating that mean daily consumption is lowest for households without solar-PV at 20 degrees Celsius, and lowest for households with solar-PV at 30 degrees Celsius. For households with solar-PV the demand is overall lower, reaching a maximum of 15kWh when the

maximum temperature is 40 degrees Celsius. A higher proportion of electricity demand is at lower maximum temperatures in household with solar-PV.

Table 30 Mean daily electricity demand (kWh) under different maximum temperature conditions

Group	Maximum Temperature (°C)			
	15	20	30	40
Non-solar	16.41	13.51	15.15	26.73
Solar	11.74	6.46	4.79	14.99

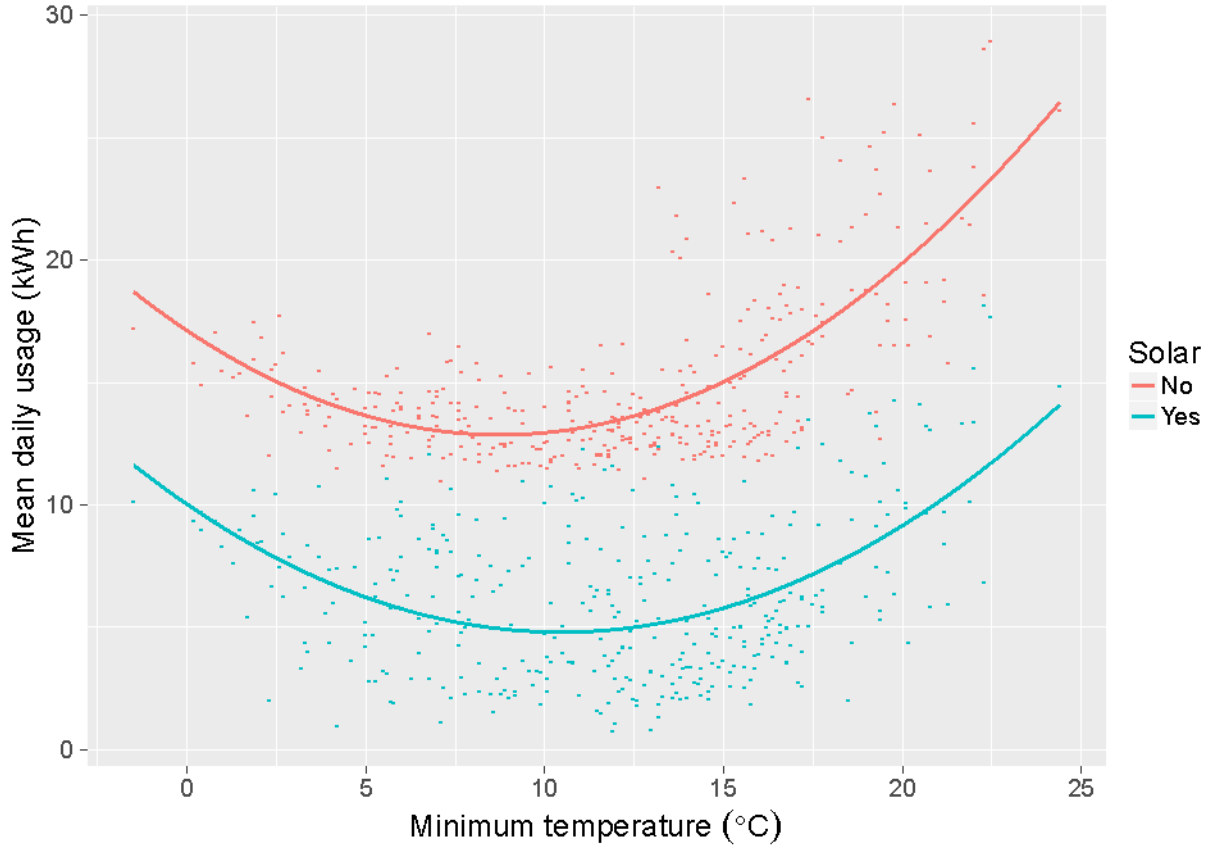


Figure 31 Scatterplot of mean daily electricity use against minimum temperature

Figure 27 shows the line of best fit for households mean daily electricity consumption and minimum daily temperature. The points of the scatterplot are not as closely related to the line of best fit as the data in Figure 30, indicating that the relationship between minimum temperature and electricity use is not as strong as maximum temperature. The line of best fit shows a curve, with both high and low minimum temperatures corresponding with higher electricity use. The slope of the line of best fit is steeper at higher minimum temperatures (20 and 25 degrees Celsius) than lower minimum temperatures (0 and 5 degrees Celsius). Electricity consumption increases relative to minimum temperature more in households without solar-PV than households with solar-PV. This is evident by examining the increase in mean daily usage (kWh) between 15 and 25 degrees Celsius.

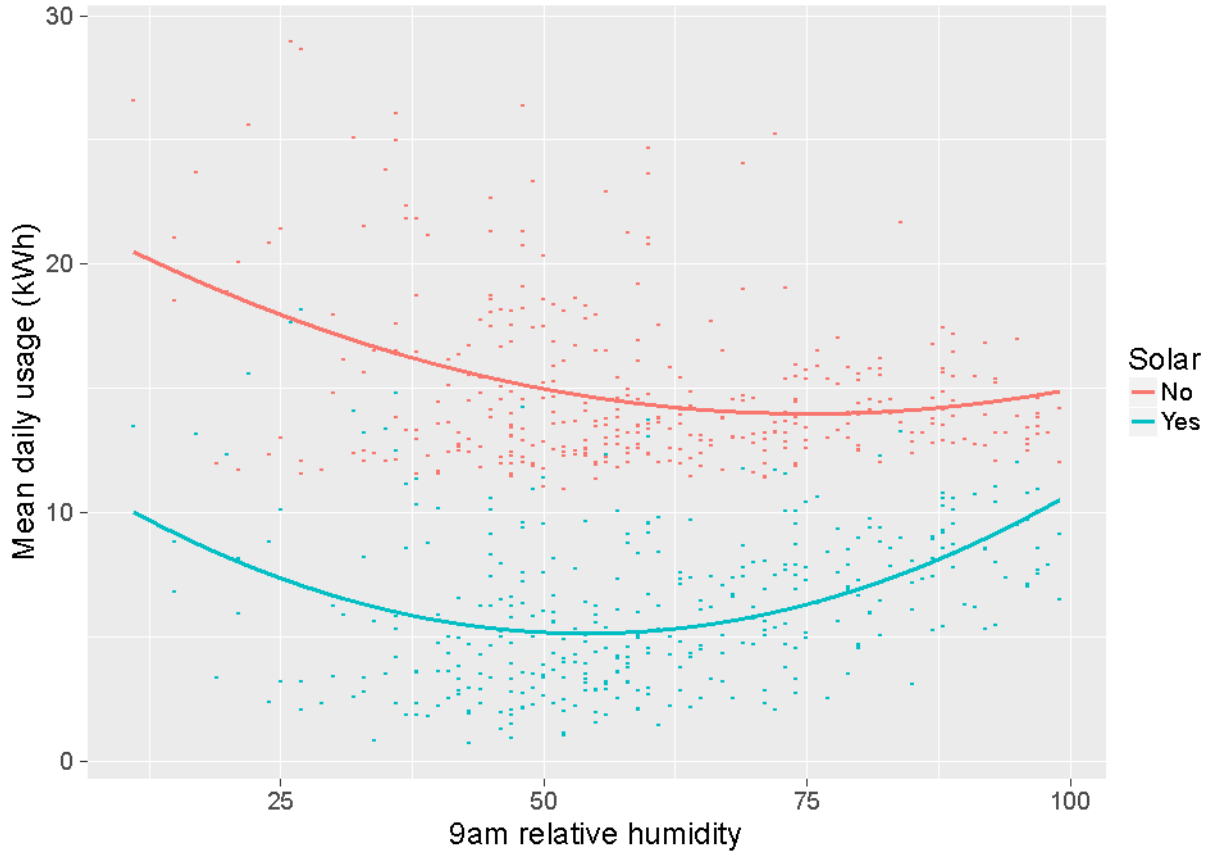


Figure 32 Scatterplot of mean daily electricity usage and humidity at 9AM

Figure 32 indicates that there is not a strong relationship between humidity at 9AM and daily electricity usage. The line of best fit shows a trend of higher electricity use when humidity at 9AM is lower than 50% for households without solar-PV, and very little impact thereafter. In households with solar-PV it appears that 9AM humidity above 75% and below 25% both correspond to higher mean electricity use.

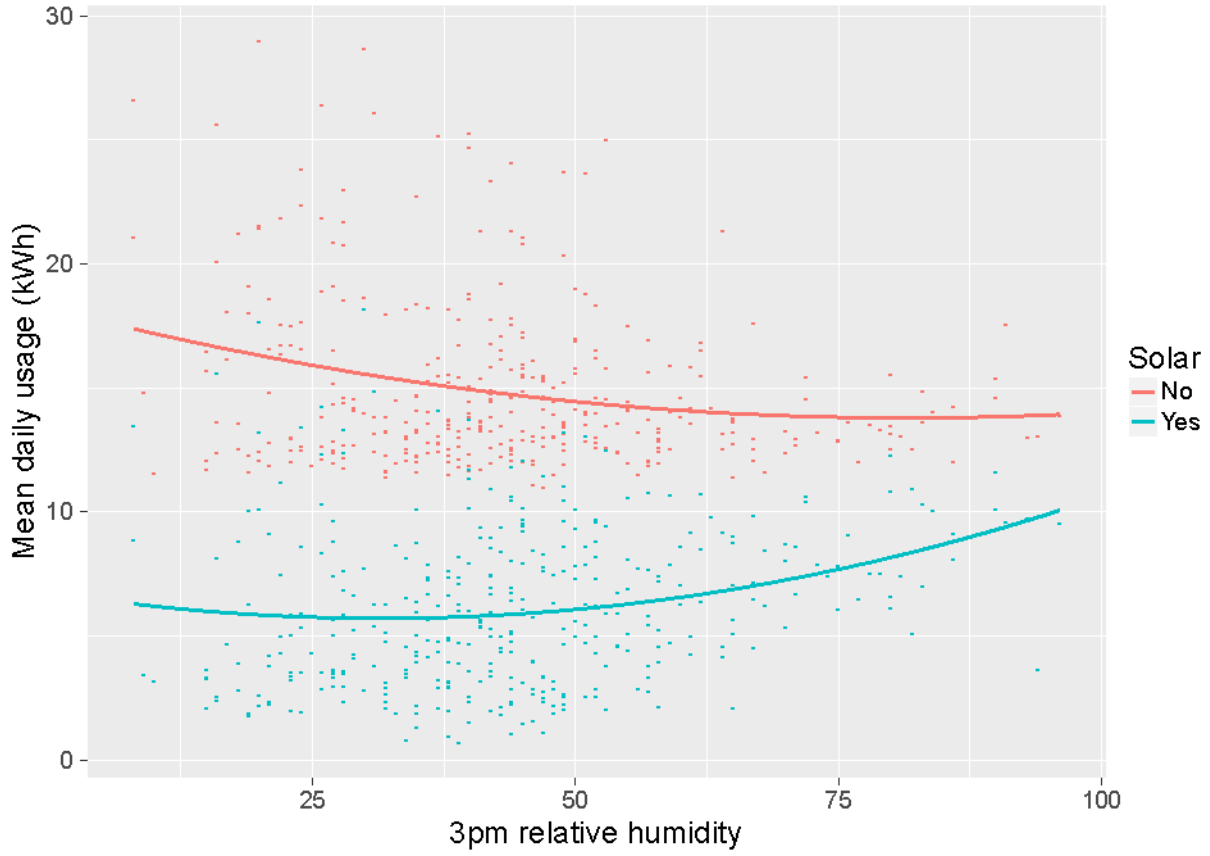


Figure 33 Scatterplot of mean daily electricity usage and humidity at 3PM

Figure 33 indicates a weak relationship between humidity at 3PM and mean electricity use. A similar relationship exists with 9AM humidity (Figure 32) in that households without solar-PV demonstrate slightly higher daily usage when 3PM humidity is below 30%. The relationship in households with solar-PV is converse, with daily electricity use increasing slightly when 3PM humidity is higher than 50%.

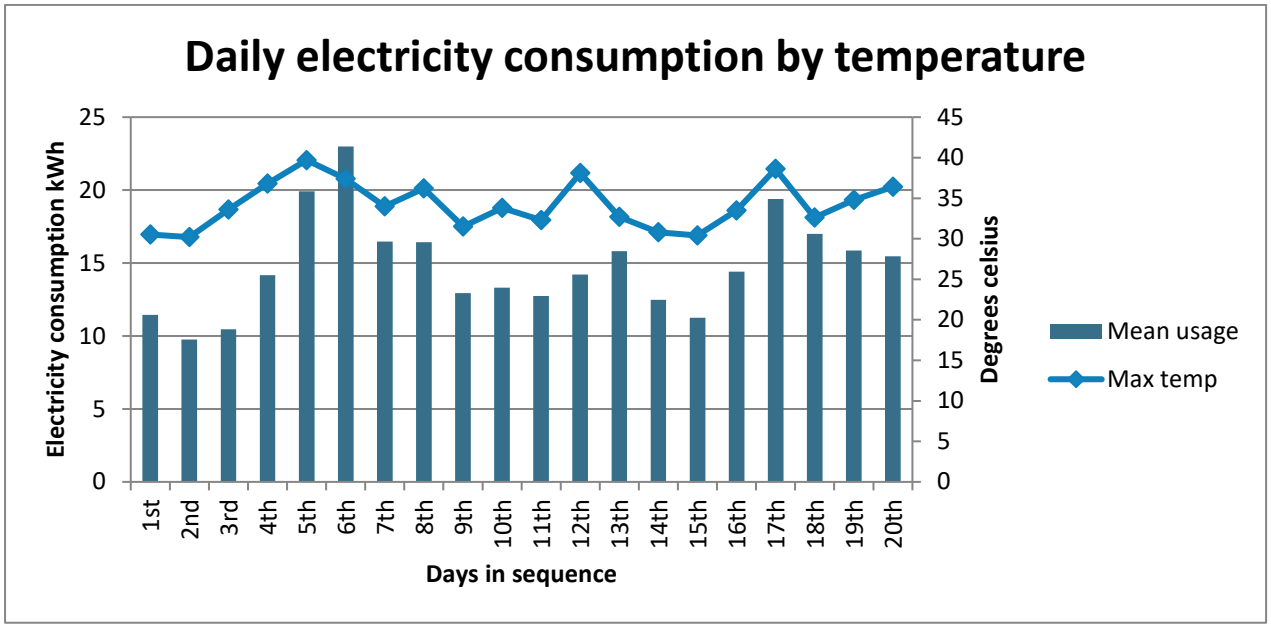


Figure 34 Mean daily energy usage on consecutive days over 30 degrees Celsius

Figure 34 displays the relationship between consecutive days over 30 degrees Celsius and mean daily electricity consumption. Figure 34 includes the mean electricity consumption for all Switched on Homes households (excluding three phase households in the low intervention group) over a 20 day period in 2015 (23rd January – 11th February). This was the longest sequential period of days exceeding 30 degrees Celsius during the trial year, with the next longest sequence being 12 days.

Figure 34 does not show a clear cause and effect relationship between temperature and electricity consumption. Table 31 displays the actual maximum daily temperature and mean electricity consumption and indicates a multi-factor relationship between maximum temperature and electricity consumption. Generally a trend is observed between increased maximum temperature and increased electricity consumption; however more factors are contributing to the relationship. The highest electricity consumption (22.99 kWh) occurred on day 6 (37.4 degrees), the day after the hottest day in this data set (day 5 = 39.7 degrees and 19.92 kWh). This indicates that temperature the day before may play a role in determining electricity consumption. Figure 30 illustrates that there is a closer relationship between maximum temperature and electricity consumption at lower maximum temperatures, and that quite a lot of variance is occurring in electricity consumption at temperatures around 30 degrees. Figure 34 supports this conclusion, and that summer electricity consumption is not driven by a single weather condition.

Table 31 Daily electricity use on consecutive days over 30 degrees Celsius

Day	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Max temperature	30.5	30.2	33.6	36.8	39.7	37.4	34	36.2	31.5	33.8
Mean usage	11.45	9.75	10.46	14.17	19.92	22.99	16.48	16.43	12.93	13.31

Day	11th	12th	13th	14th	15th	16th	17th	18th	19th	20th
Max temperature	32.3	38.1	32.7	30.8	30.4	33.5	38.6	32.6	34.8	36.4
Mean usage	12.75	14.21	15.82	12.48	11.24	14.40	19.40	17.00	15.86	15.47

Further analysis of behaviour on days over 35 degrees Celsius on the 20/12/2015 – 24/12/2015 is displayed in Figure 35.

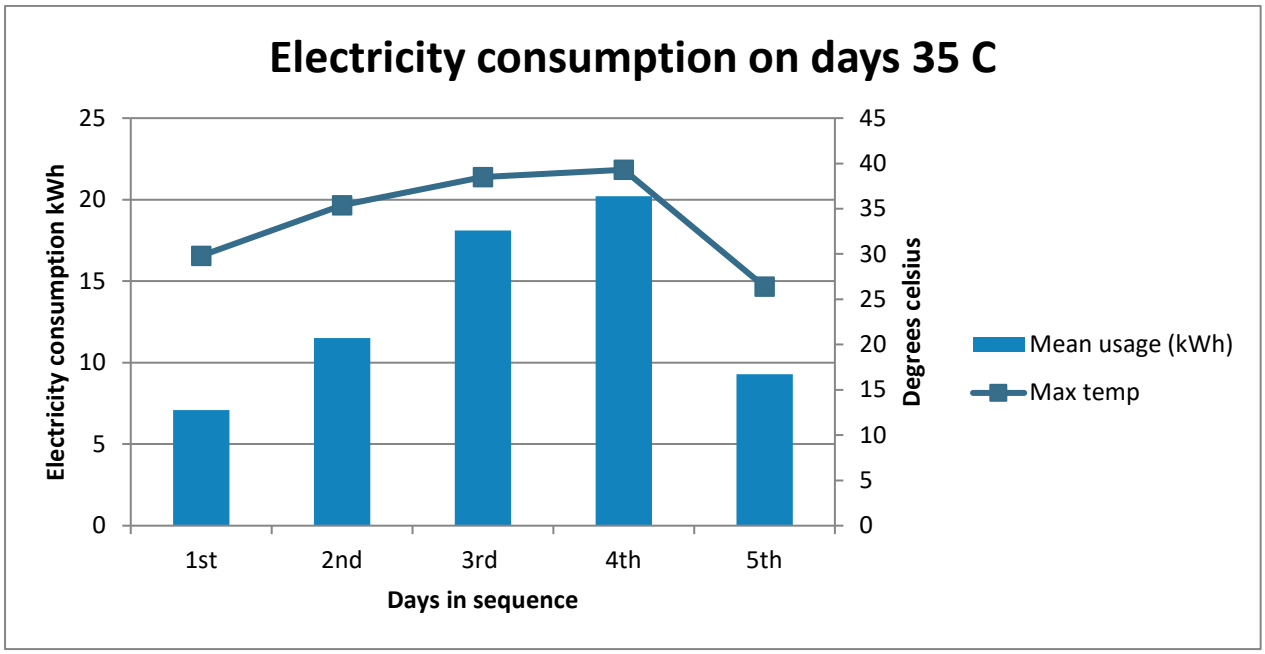


Figure 35 Mean daily electricity usage on consecutive days over 35 degrees Celsius

Figure 35 shows a relationship between electricity consumption and temperature, with daily electricity consumption rising with temperature. The maximum electricity consumption coincides with the maximum temperature (20.2 kWh at 39.3 degrees). Conversely, the lowest temperature does not coincide with the lowest electricity consumption. It is noted that on day 5, although temperature is lower compared to day 1 (26 degrees and 30 degrees respectively), electricity demand is higher (9.3kWh compared to 7.1kWh). As noted in the analysis of days over 30 degrees Celsius (Figure 34) this indicates previous day temperature may be linked to daily electricity consumption.

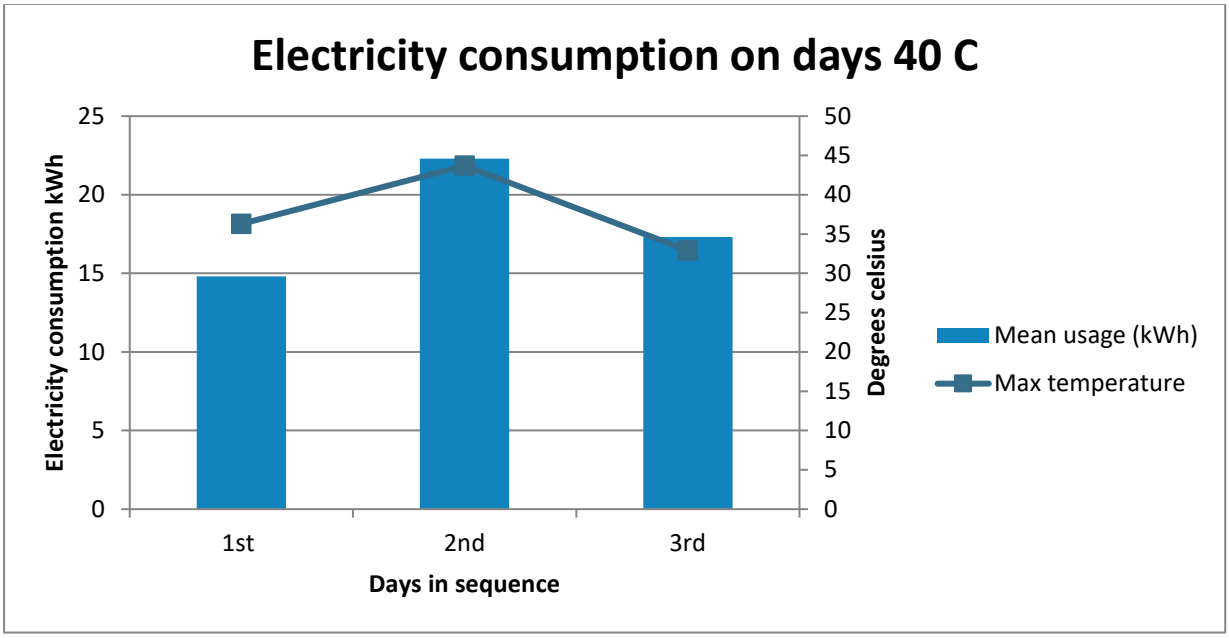


Figure 36 Mean daily electricity usage on day over 40 degrees Celsius

Figure 36 shows that electricity consumption on a 43.7 degree day (Day 2) was 22.3kWh. The following day (day 3) electricity use was 17.3kWh at 32.9 degrees. This is considerably higher electricity demand than day 1 (14.8kWh) when the temperature was comparatively hotter (36.3 degrees). This supports the conclusion drawn from Figure 34 and Figure 35, that there is a sustained increase in electricity demand on days after a high maximum temperature is observed. The observation that the previous day's maximum temperature plays a role in determining electricity consumption weakens the correlation between maximum temperature and electricity consumption. This is observed in Figure 30, where a weaker relationship between maximum temperature and electricity consumption is observed on days above 25 degrees Celsius and the previous day's maximum temperature may be one factor in the weaker relationship at higher temperatures.

Seasonal analysis

Using half hourly electricity consumption data collected in 2015 from all monitoring points (single phase households in the low intervention group, test 1 and test 2 groups) a seasonal daily average was determined. The results are shown in Table 32.

Table 32 Mean energy usage of Switched on Homes participants by season

Season	Summer (Jan-Feb)	Autumn	Winter	Spring	Summer (Dec)
Mean	13.18	9.22	11.04	7.83	9.64
Std dev	9.65	6.6	7.72	7.11	8.4

The results contained in Table 32 indicate that Switched on Homes consumed the most electricity in the last two months of summer (13.18kWh / day), followed by winter (11.04kWh). The early summer season (December) mean electricity consumption is 9.64kWh per day, which is closer to autumn electricity consumption (9.22kWh / day) than the January –February summer period. Spring was the season of lowest electricity consumption. Compared to the electricity consumption of the control

group (Table 21), Switched on homes participants have lower electricity consumption year round, however the same trends in seasonal demand are observed.

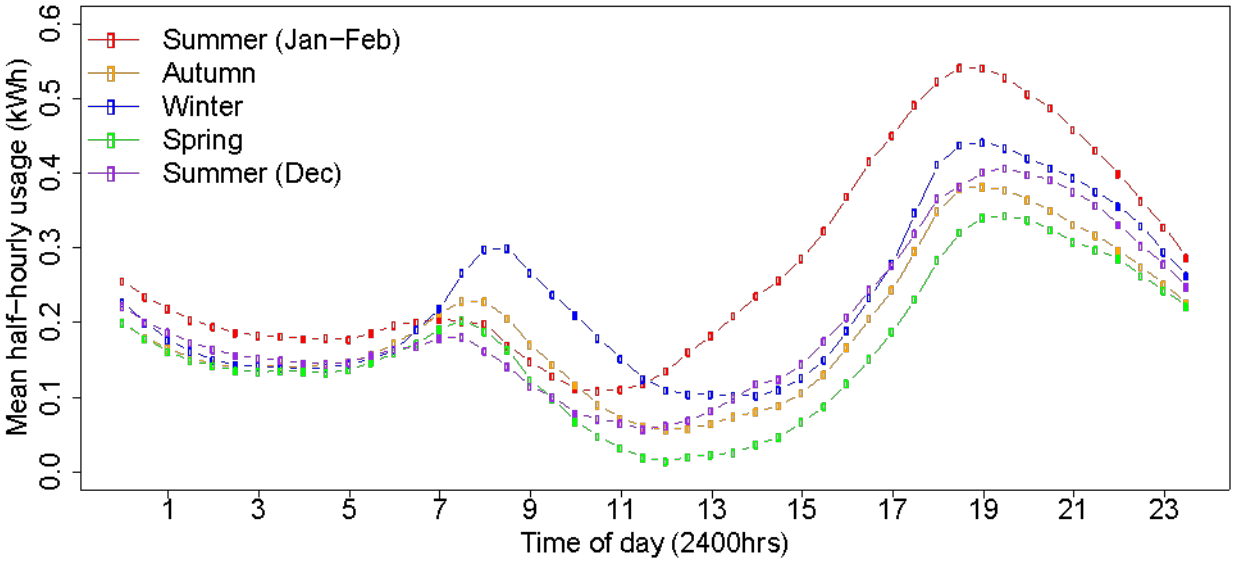


Figure 37 Seasonal daily electricity consumption (average) of Switched on Homes

Throughout the seasons the daily distribution of electricity consumption varies. Figure 37 shows that overall electricity use is highest during summer, but this is relatively stable overnight regardless of season (between 11PM and 6AM). There is also a peak in demand between 4PM and 8PM regardless of season. During this time period electricity use is not seasonal and is around 0.2kWh / half hour. The seasonal effect in summer is experienced between 11AM and 7PM, when electricity consumption is notably higher than other seasons. This is only true in the summer months of January and February. December behaves more similarly to autumn then it does to January-February. During summer (January and February), peak demand occurs from 6:00-6:30PM, when mean electricity consumption is 0.54kWh. During early summer (December), peak demand occurs from 7:00-7:30PM and reaches 0.41kWh. Peak demand in spring is also 7:00-7:30PM, although demand is lower, equalling 0.34kWh. Autumn and winter peak occurs from 6:30-7:00PM and is equal to 0.38kWh and 0.44kWh respectively. In the winter season, a second peak occurs in the morning between 7AM and 9AM, which is not noticed in other seasons. Electricity demand was lowest during the daytime in spring (9AM – 3PM).

New housing subgroup

To determine the effect of building age on electricity performance and response to Switched on Homes treatments, households were grouped into post-2000 (67 households) and pre-2000 (94 households). All control, three phase households in the low intervention group and households with unknown built age were excluded from this analysis.

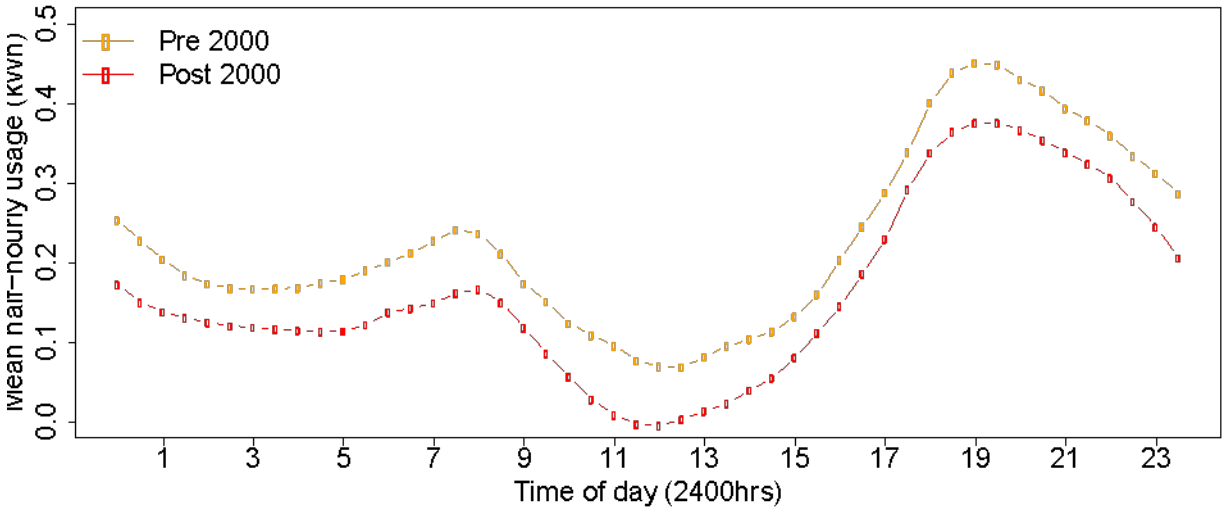


Figure 38 Average daily electricity use in 2015 grouped by building age

Figure 38 illustrates the daily electricity consumption of a household built prior to the year 2000 and post year 2000. Throughout the day, homes built post-2000 used less electricity than older homes. The biggest differences appear to be between 9AM-3PM and from 5PM-9PM. On average, a home built post-2000 reached peak consumption of 0.38kWh between 6:30-7:00PM and homes built pre-2000 peaked half an hour later at 0.45kWh.Table 33 shows that post-2000 homes more often had solar-PV, contributing to the different performance during daylight hours, but not affecting the performance between 8PM and 6AM.

Table 33 Presence of solar-PV in households built pre and post-2000

	Solar-PV	No solar-PV	Total
Pre-2000	48	46	**94**
Post-2000	39	28	**67**

Table 34 Mean electricity consumption by built year and season

Group	Summer (Jan-Feb)	Autumn	Winter	Spring	Summer (Dec)
Pre-2000 Mean	14.57	10.59	11.18	8.68	10.29
Post-2000 Mean	10.41	6.72	9.84	5.28	7.22
Difference	4.16	3.87	1.34	3.4	3.07

The performance between pre-2000 and post-2000 built households is particularly responsive to seasonality. Table 34 shows that in all seasons electricity consumption is lower in households built post-2000. This difference is the smallest in winter, when both ages of housing stocks perform similarly. The seasonal effects of building age are explored in Figure 39 to Figure 43. Overall post-

2000 households routinely consumed less electricity than households built pre-2000, except during the winter months, specifically during peak demand times (5PM-9PM).

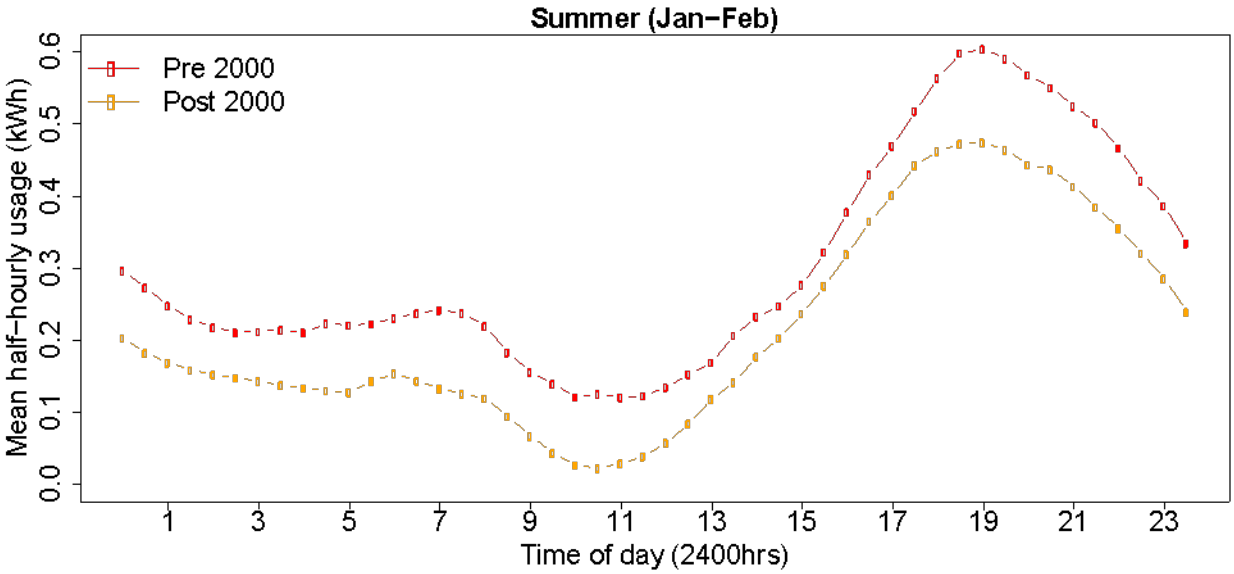


Figure 39 Average daily electricity use by built age in summer (January February)

Figure 39 shows that overall daily electricity use is higher in households built post-2000 during the months of January-February. The times of day when the greatest difference in performance is observed are 5PM-9PM, followed by 9AM-2PM. While it is possible that the 9AM-2PM difference is caused by an increased prevalence of solar-PV in post-2000 homes (Table 33), this is not a contributing factor in the 5PM-9PM period. Early summer, December, shows a similar pattern (Figure 40), however overall pre-2000 and post-2000 households consume less electricity and are more similar in their electricity consumption in December than in January-February.

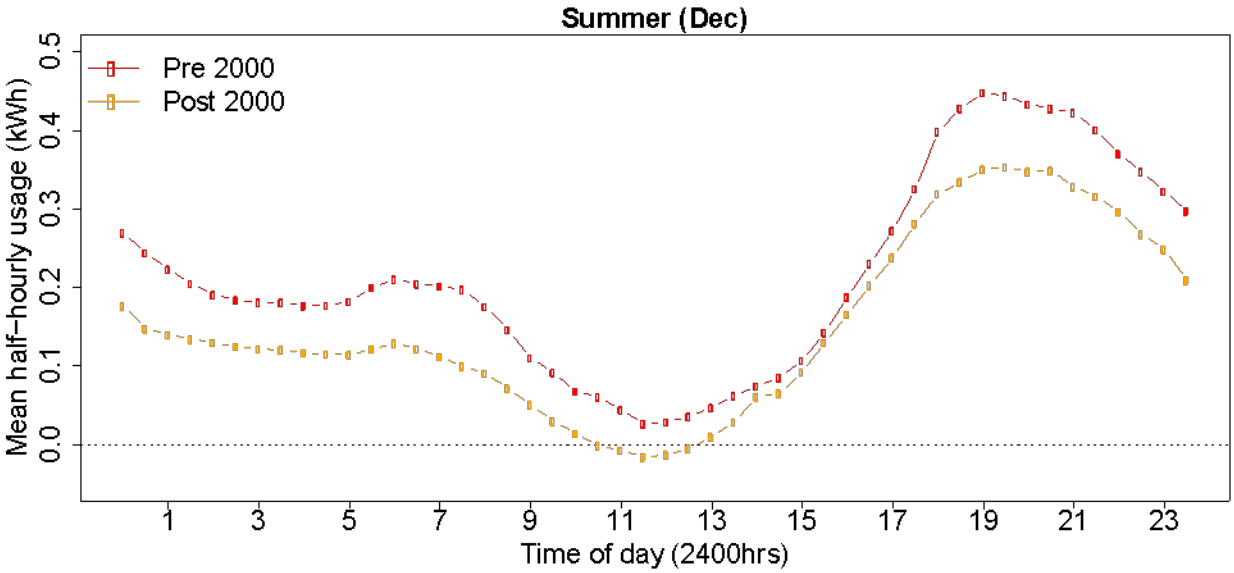


Figure 40 Average daily electricity use by built age in early summer (December)

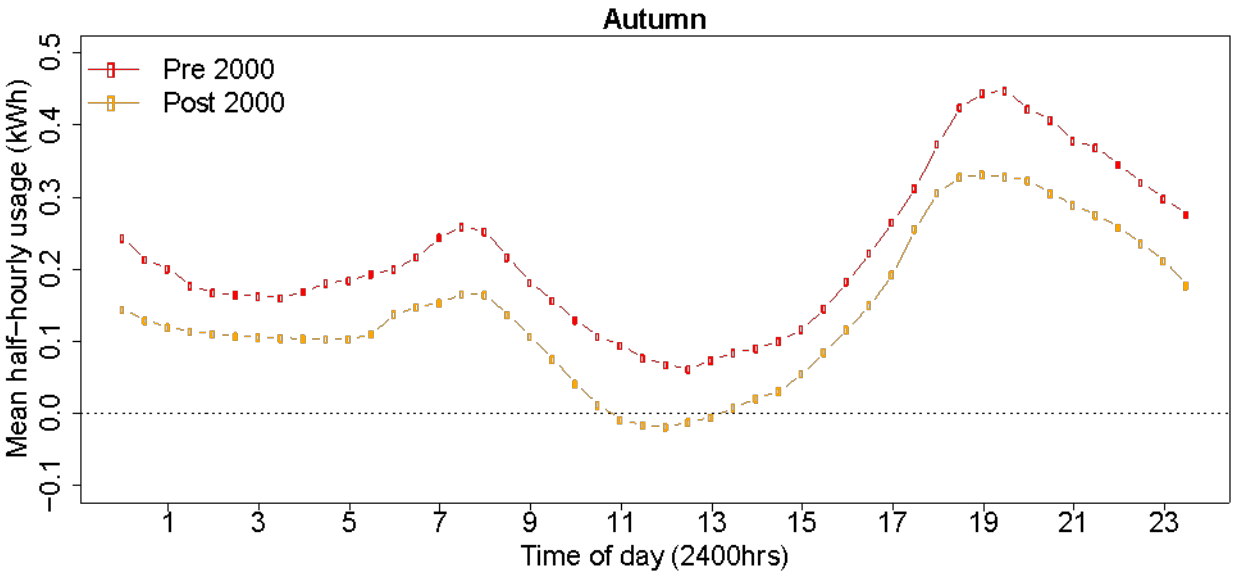


Figure 41 Average daily electricity use by built age in autumn

Figure 41 extends the pattern established in Figure 39, although both groups decreased electricity use in autumn relative to summer. The post-2000 homes continuously consume less electricity than the pre-2000 homes. The relative performance and decrease in electricity consumption in both groups continues into spring (Figure 42).

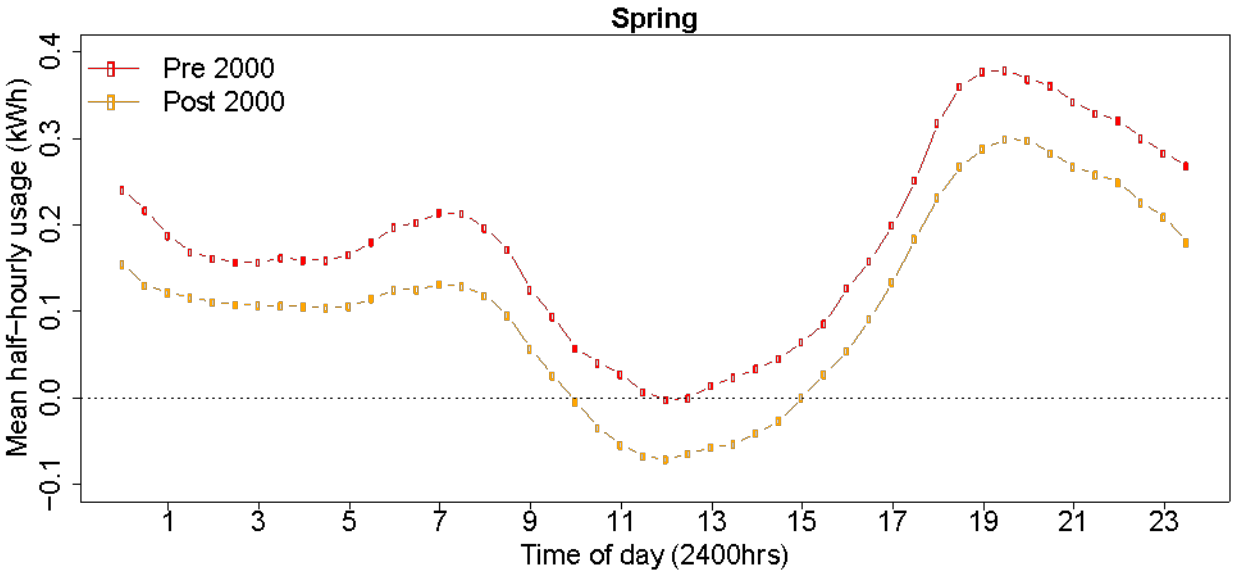


Figure 42 Average daily electricity use by built age in spring

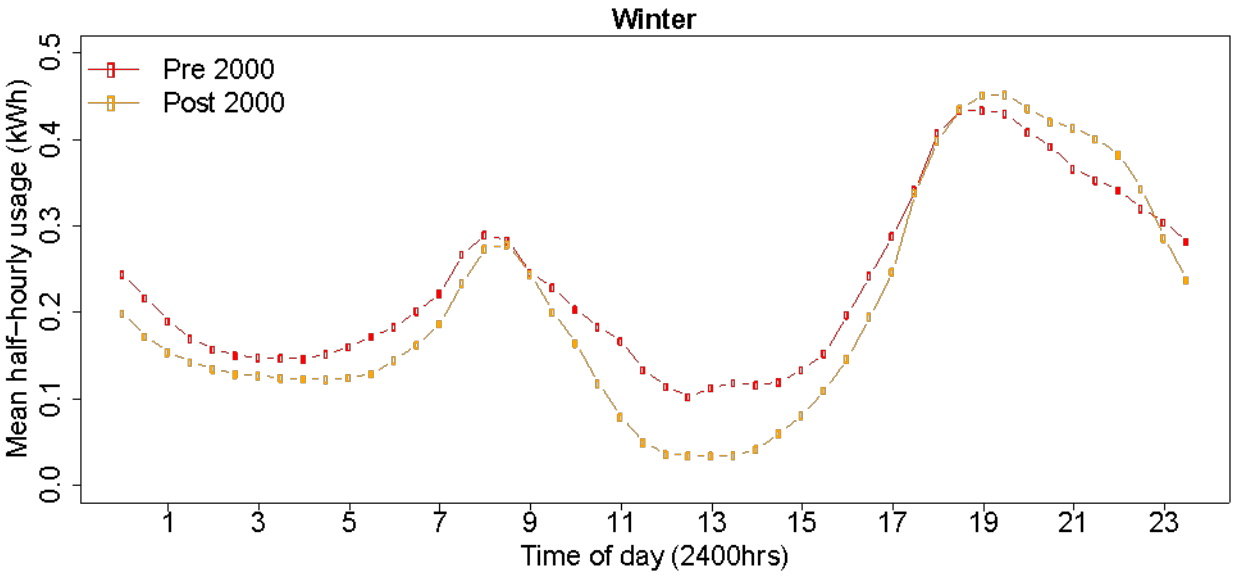


Figure 43 Average daily electricity use by built age in winter

Winter is the only season examined in which households built post-2000 do not consistently consume less electricity than households built pre-2000. Figure 43 illustrates that daytime (9AM-5PM) consumption of electricity in post-2000 homes is lower than pre-2000 homes, however from 5PM-1PM electricity consumption is higher in post-2000 homes. The overnight (11PM-6PM) electricity consumption is also very similar in pre-2000 and post-2000 homes in winter.

Behaviour

Two surveys were conducted to measure the attitudes and opinions of low income households towards energy efficiency. The first survey was conducted in October 2014 (pre-trial) and the second survey was conducted in January 2016 (post-trial). The subset of questions included in this analysis were presented to the same households in both surveys, except for the community control. The control group consists of households recruited to the trial who did not receive a place in one the test groups. The community control was gathered from a community survey (see Treatments and test groups for more details).

A weighted average was calculated by assigning a weight to each response (strongly disagree =1, strongly agree =5) and calculated for each group. Households that "did not know" were excluded from the analysis.

Effort into energy efficiency

Table 35 Frequency and percentage of response to survey statement "over the past two years have your efforts into energy efficiency been…"

Year	Group	N	In the last two years, has your effort into energy efficiency been…					Weighted average
			A lot more than usual	More than usual	About the same	A little less than usual	No effort at all	
2014	**Community Control**	172	23 13.37%	85 49.42%	56 32.56%	5 2.91%	3 1.74%	3.70
	Control	32	3 9.38%	15 46.88%	13 40.63%	1 3.13%	0 0.00%	3.63
	Low Intervention	75	4 5.33%	29 38.67%	36 48.00%	5 6.67%	1 1.33%	3.40
	Test 1	76	13 17.11%	32 42.11%	30 39.47%	1 1.32%	0 0.00%	3.75
	Test 2	75	6 8.00%	31 41.33%	35 46.67%	2 2.67%	1 1.33%	3.52
2016	**Community control**	196	25 12.76%	76 38.78%	87 44.39%	3 1.53%	5 2.55%	3.58
	Control	32	2 6.25%	11 34.38%	16 50.00%	2 6.25%	1 3.13%	3.34
	Low Intervention	76	12 15.79%	23 30.26%	37 48.68%	3 3.95%	1 1.32%	3.55
	Test 1	76	5 6.58%	38 50.00%	28 36.84%	3 3.95%	2 2.63%	3.54
	Test 2	74	11 14.86%	29 39.19%	24 32.43%	10 13.51%	0 0.00%	3.55

The 2014 survey measured effort into energy efficiency from October 2012 to October 2014. The 2016 survey measured effort into energy efficiency from January 2013 to January 2015. In 2014 the response of the community control and the test groups was quite different, and the control group more often reported "a lot more effort" than the test groups. The test groups also performed differently from each other. Despite the random assignment that would occur after the survey, the test 1 group also reported more effort than the other groups prior to starting the trial. The response that effort had been 'a lot more than usual' or 'more than usual' declined in all test groups between the 2014 and 2016 surveys and all three test groups reported a similar level of effort in 2016 which meant respectively, an increase in the low intervention group, decrease in the test 1 group and steady in the test 2 group. In the 2016 survey all test groups performed similarly to the community control, whereas in 2014 the community control reported more effort than the low intervention and test 2 groups.

Interest in energy efficiency

Table 36 Frequency and percentage response to the statement "I am interested in energy efficiency".

Year	Group	N	"I am interested in energy efficiency"				
			Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
2014	**Community Control**	174	7 4.02%	3 1.72%	15 8.62%	70 40.23%	79 45.40%
	Control	33	0 0.00%	1 3.03%	0 0.00%	15 45.45%	17 51.52%
	Low Intervention	77	0 0.00%	2 2.60%	4 5.19%	31 40.26%	40 51.95%
	Test 1	77	1 1.30%	2 2.60%	0 0.00%	35 45.45%	39 50.65%
	Test 2	76	1 1.32%	1 1.32%	2 2.63%	31 40.79%	41 53.95%
2016	**Community control**	188	5 2.66%	5 2.66%	15 7.98%	78 41.49%	85 45.21%
	Control	32	2 6.25%	1 3.13%	1 3.13%	7 21.88%	21 65.63%
	Low Intervention	76	3 3.95%	1 1.32%	2 2.63%	19 25.00%	51 67.11%
	Test 1	76	0 0.00%	2 2.63%	0 0.00%	19 25.00%	55 72.37%
	Test 2	76	0 0.00%	4 5.26%	0 0.00%	18 23.68%	54 71.05%

The statement "I am interested in energy efficiency" was strongly or somewhat agreed to by all test groups. Over 94% of participants in the control and test groups "somewhat agreed" or "strongly agreed" that they were interested in energy efficiency in 2014. A similar response was recorded in the 2016 survey with a slight increase in interest in all test groups while the community control reported a similar level of interest and the control group decreased interest.

Energy efficiency is too much hassle

Table 37 Frequency and percentage response to the statement "Energy efficiency is too much hassle".

Year	Group	N	"Energy efficiency is too much hassle"				
			Strongly disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Strongly agree
2014	**Community control**	173	58 33.53%	53 30.64%	37 21.39%	22 12.72%	3 1.73%
	Control	32	8 25.00%	18 56.25%	3 9.38%	3 9.38%	0 0.00%
	Low Intervention	75	15 20.00%	38 50.67%	7 9.33%	11 14.67%	4 5.33%
	Test 1	77	27 35.06%	42 54.55%	2 2.60%	5 6.49%	1 1.30%
	Test 2	75	16 21.33%	43 57.33%	6 8.00%	10 13.33%	0 0.00%
2016	**Community control**	188	62 32.98%	66 35.11%	40 21.28%	19 10.11%	1 0.53%
	Control	31	11 35.48%	11 35.48%	3 9.68%	5 16.13%	1 3.23%
	Low Intervention	75	31 41.33%	26 34.67%	7 9.33%	8 10.67%	3 4.00%
	Test 1	75	37 49.33%	34 45.33%	4 5.33%	0 0.00%	0 0.00%
	Test 2	75	39 52.00%	27 36.00%	5 6.67%	4 5.33%	0 0.00%

In response to the statement "energy efficiency is too much hassle", a high proportion of respondents either disagreed or somewhat disagreed in both 2014 and 2016. The weighted average of the test groups ranged from 1.84 – 2.35 in 2014 and all test groups decreased their weighted average in 2016, indicating less agreement with the question. Of particular note, the test 1 group decreased agreement to this question to 0%. Over the same time period the control group remained quite stable and their agreement did not significantly change.

Barriers to undertaking energy efficiency

Table 38 Frequency and percentage response by group to the multi-response question "Which of the following, if any, do you feel are barriers to you undertaking energy efficiency activities in your home?" by test group.

2014: "Which of the following, if any, do you feel are barriers to you undertaking energy efficiency activities in your home?								
	N	You already do everything you can	The cost of energy efficient appliances	You don't know what	You don't have the	You are not motivated	Other	None

		related to energy efficiency	is too great	else to do	time			
Community Control	179	58 32.40%	86 48.04%	34 18.99%	16 8.94%	4 2.23%	10 5.59%	14 7.82%
Control	33	21 63.64%	5 15.15%	5 15.15%	0 0.00%	4 12.12%	2 6.06%	4 12.12%
Low Intervention	78	43 55.13%	19 24.36%	12 15.38%	2 2.56%	4 5.13%	11 14.10%	6 7.69%
Test 1	77	51 66.23%	18 23.38%	8 10.39%	1 1.30%	1 1.30%	7 9.09%	5 6.49%
Test 2	77	47 61.04%	17 22.08%	6 7.79%	1 1.30%	6 7.79%	6 7.79%	6 7.79%

2016: "Which of the following, if any, do you feel are barriers to you undertaking energy efficiency activities in your home?								
	N	You already do everything you can related to energy efficiency	The cost of energy efficient appliances is too great	You don't know what else to do	You don't have the time	You are not motivated	Other	None
Community Control	203	67 33.00%	97 47.78%	33 16.26%	13 6.40%	8 3.94%	13 6.40%	13 6.40%
Control	32	15 46.88%	8 25.00%	5 15.63%	1 3.13%	4 12.50%	2 6.25%	7 21.88%
Low Intervention	76	43 56.58%	15 19.74%	2 2.63%	0 0.00%	0 0.00%	6 7.89%	14 18.42%
Test 1	77	37 48.05%	15 19.48%	2 2.60%	1 1.30%	2 2.60%	4 5.19%	20 25.97%
Test 2	76	29 38.16%	15 19.74%	5 6.58%	1 1.32%	4 5.26%	4 5.26%	26 34.21%

Among most groups the most frequently report a barrier was that participants are “already doing everything you can related to energy efficiency”. The percentage of respondents claiming they ‘already do everything’ did not increase significantly in any group between 2014 and 2016. Frequency of this response declined in the test 1 and test 2 groups but remained the same in the low intervention and community control group. The proportional decline was similar in the test 1 and test 2 groups, who decreased frequency of response by 18% and 23% respectively. By frequency of response, this was still the most common barrier in 2016, but was the barrier which declined the most.

The community control most frequently chose “the cost of energy efficient appliances is too great” in both 2014 and 2016 (48% of respondents chose this barrier). This was a smaller barrier in Switched on Homes households in both 2014 and 2016. In all groups except the community control, the frequency of this barrier was below 25%.

The answer “don’t know what else to do” remained stable in the control group between 2014 and 2016. The low intervention and test 1 groups decreased the frequency of this response significantly, in the low intervention group, the percentage of respondents decreased from 15.4% to 2.6% in 2016. In the test 1 group, the frequency of the response decreased from 10.4% in 2014 to 2.6% in 2016. The test 2 group reported this answer only slightly less frequently in 2016 (6.6%), compared to 2014 (7.8%) and was the only test group not to exhibit a major decline in this barrier.

‘Not having time’ was not a barrier for any of the test groups. In both the control and test groups, not having time was only selected as a barrier by 1-2 respondents and this did not change pre and post-trial. The frequency of response was higher in the community control group (8.9% in 2014 and 6.4% in 2016); however this was still not a major barrier for the community control.

The frequency of response to the answer “not motivated” had mixed results. The control group remained stable in this barrier between 2014 and 2016 (approximately 12%), while the community control chose this answer very infrequently (2.2% and 3.9% in 2014 and 2016 respectively). The test groups all exhibited a much lower frequency of response to the question in both 2014 and 2016. The low intervention group’s response “not motivated” decreased from 5.56% to 0% in the 2014 and 2016 surveys respectively, where the test 1 and test 2 groups had a slight increase and decrease respectively. Overall the motivation of trial participants and the community control to undertake energy efficiency activities is very high both pre and post-trial.

The frequency of the answer “none” increased considerably across all test groups between 2014 and 2016, but not the community control. There are significant differences between the groups both in the frequency of response and the percentage change. The largest change between the groups was the test 2 group, where 7.8% of respondents answered “none” in 2014 and 34.2% answered “none” in 2016. “None” was the second highest frequency answer the test 1 and test 2 groups in 2016, whereas in 2014 it had been the fifth most frequent and the equal third most frequent in these groups respectively in 2014.

Energy efficiency will restrict my freedom

Table 39 Frequency and percentage response to the statement "Energy efficiency will restrict my freedom".

Year	Group	N	"Energy efficiency will restrict my freedom"					
			Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Don't know
2014	Control	34	8 23.5%	22 64.7%	1 2.9%	3 8.8%	0 0.0%	0 0.0%
	Low Intervention	72	16 22.2%	40 55.6%	5 6.9%	7 9.7%	3 4.2%	1 1.4%
	Test 1	76	22 28.9%	41 53.9%	5 6.6%	5 6.6%	3 3.9%	0 0.0%
	Test 2	75	23 30.7%	31 41.3%	7 9.3%	10 13.3%	4 5.3%	0 0.0%
2016	Control	32	14 43.8%	12 37.5%	3 9.4%	1 3.1%	2 6.3%	0 0.0%
	Low Intervention	75	35 46.7%	23 30.7%	5 6.7%	8 10.7%	4 5.3%	0 0.0%
	Test 1	75	43 57.3%	25 33.3%	3 4.0%	3 4.0%	0 0.0%	1 1.3%
	Test 2	76	40 52.6%	24 31.6%	4 5.3%	5 6.6%	2 2.6%	1 1.3%

No community control was available for this question.

There was a high frequency of disagreement with the statement "Energy efficiency will restrict my freedom". In 2014 the total disagreement to the statement ranged from 72.0% to 88.2% between groups. In 2016 this increased to 77.4% to 90.6%. Between 2014 and 2016 the disagreement with the statement decreased in the control, but increased in the test groups. Between 2014 and 2016, disagreement with the statement increased by 7.8% and 12.2% in the test 1 and test 2 groups respectively.

My household often feels in control of our finances

Table 40 Frequency and percentage response to the statement "My household often feels in control of our finances".

Year	Group	N	"My household often feels in control of our finances"						Weighted average
			Strongly disagree	Some what	Neither agree	Somewhat agree	Strongly agree	Don't know	

				disagree	nor disagree				
2014	**Control**	34	0 0.0%	4 11.8%	0 0.0%	19 55.9%	11 32.4%	0 0.0%	4.09
	Low Intervention	72	4 5.6%	7 9.7%	6 8.3%	33 45.8%	22 30.6%	0 0.0%	3.86
	Test 1	76	2 2.6%	17 22.4%	6 7.9%	34 44.7%	17 22.4%	0 0.0%	3.62
	Test 2	75	5 6.7%	9 12.0%	8 10.7%	33 44.0%	20 26.7%	0 0.0%	3.72
2016	**Control**	32	1 3.1%	6 18.8%	2 6.3%	8 25.0%	15 46.9%	0 0.0%	3.94
	Low Intervention	75	8 10.7%	11 14.7%	1 1.3%	25 33.3%	30 40.0%	0 0.0%	3.77
	Test 1	76	3 3.9%	9 11.8%	2 2.6%	27 35.5%	34 44.7%	1 1.3%	4.07
	Test 2	75	4 5.3%	4 5.3%	7 9.3%	31 41.3%	29 38.7%	0 0.0%	4.03

No community control was available for this question. A weighted average was calculated by assigning a weight to each response (strongly disagree =1, strongly agree =5) and calculated for each group. Households that "did not know" were excluded from the weighted average.

Households in all test groups agreed strongly to the statement "My household often feels in control of our finances" in both 2014 and 2016. The lowest percentage of households that agreed to this statement was the test 1 group in 2014, in which 67.1% agreed, resulting in a weighted average of 3.6. In 2016, the weighted average for the control group and low intervention group decreased, while the weighted average for the test 1 and test 2 groups increased. The percentage of the test 1 group that agreed with the statement in 2016 increased by 13.1% and agreement in the test 2 group increased 9.3%. In 2016 the test 1 and test 2 group had a very similar weighted average, whereas the low intervention group was noticeably lower. The control group decreased financial control significantly during the same time period, decreasing by 16.4%.

Table 41 Percentage change in agreement to the statement "My household often feels in control of our finances"

Year	Group	% households who agree	Change
2014	**Control**	88.3%	
	Low Intervention	76.4%	
	Test 1	67.1%	
	Test 2	70.7%	
2016	**Control**	71.9%	-16.4%
	Low Intervention	73.3%	-3.1%
	Test 1	80.2%	13.1%
	Test 2	80.0%	9.3%

Change - Change in proportion of households who agree from 2014 – 2016

My household often feels in control of our energy use

Table 42 Frequency and percentage response to the statement "My household often feels in control of our energy use".

Year	Group	N	"My household often feels in control of our energy use"						Weighted average
			Strongly disagree	Some what disagree	Neither agree nor disagree	Some what agree	Strongly agree	Don't know	
2014	Control	34	0 0.00%	1 2.90%	1 2.90%	25 73.50%	7 20.60%	0 0.00%	4.1
	Low Intervention	72	4 5.60%	11 15.30%	8 11.10%	36 50.00%	13 18.10%	0 0.00%	3.6
	Test 1	76	3 3.90%	12 15.80%	3 3.90%	44 57.90%	14 18.40%	0 0.00%	3.7
	Test 2	75	4 5.30%	11 14.70%	5 6.70%	39 52.00%	16 21.30%	0 0.00%	3.7
2016	Control	32	1 3.10%	3 9.40%	3 9.40%	13 40.60%	12 37.50%	0 0.00%	4.0
	Low Intervention	75	6 8.00%	9 12.00%	1 1.30%	30 40.00%	29 38.70%	0 0.00%	3.9
	Test 1	75	2 2.70%	9 12.00%	4 5.30%	26 34.70%	33 44.00%	1 1.30%	4.1
	Test 2	76	1 1.30%	6 7.90%	4 5.30%	32 42.10%	32 42.10%	1 1.30%	4.2

No community control was available for this question. A weighted average was calculated by assigning a weight to each response (strongly disagree =1, strongly agree =5) and calculated for each group. Households that "did not know" were excluded from the weighted average.

Overall households agreed that they felt in control of their electricity use. Between 68% and 73% of participants from the test groups agreed to this statement in 2014, while the control group agreed 94% of the time. From 2014 to 2016, the proportion of control households who felt in control of their energy use decreased by 16%. Conversely, the three test groups experienced an increase in control. The low intervention group increased agreement by 1.6% and the test 2 group increased agreement by 10.9%. The test 1 group increased agreement by a more modest 2.4%. In 2014 the control group had the highest weighted average for control over energy use, and this decreased slightly in 2016. All test groups increased their weighted average, the largest increase and the highest control (by weighted average) was in the test 2 group, followed by the test 1 group and low intervention group.

The temperature at home is often too hot or cold for me to be comfortable

Table 43 Frequency and percentage response to the statement "The temperature at home is often too hot or cold for me to be comfortable".

Year	Group	N	"The temperature at home is often too hot or cold for me to be comfortable"						Weighted average
			Strongly disagree	Some what disagree	Neither agree nor disagree	Some what agree	Strongly agree	Don't know	
2014	Control	34	1 2.9%	13 38.2%	7 20.6%	10 29.4%	2 5.9%	1 2.9%	2.97
	Low Intervention	71	10 14.1%	24 33.8%	12 16.9%	17 23.9%	6 8.5%	2 2.8%	2.78
	Test 1	76	6 7.9%	32 42.1%	16 21.1%	17 22.4%	5 6.6%	0 0.0%	2.78
	Test 2	75	9 12.0%	19 25.3%	19 25.3%	18 24.0%	10 13.3%	0 0.0%	3.01
2016	Control	32	3 9.4%	4 12.5%	8 25.0%	11 34.4%	6 18.8%	0 0.0%	3.41
	Low Intervention	75	14 18.7%	19 25.3%	6 8.0%	23 30.7%	13 17.3%	0 0.0%	3.03
	Test 1	75	15 20.0%	20 26.7%	9 12.0%	22 29.3%	9 12.0%	1 1.3%	2.91
	Test 2	76	9 11.8%	17 22.4%	13 17.1%	25 32.9%	12 15.8%	0 0.0%	3.18

No community control was available for this question. A weighted average was calculated by assigning a weight to each response (strongly disagree =1, strongly agree =5) and calculated for each group. Households that “did not know” were excluded from the weighted average.

A significant proportion of households agreed strongly or somewhat that they often felt uncomfortably hot or cold in their home. Between 2014 and 2016 the proportion of respondents agreeing (strongly or somewhat) to this statement increased in all groups and weighted averages increased. The change observed between 2014 and 2016 was larger in the control group than in the test groups. Between the two surveys the increase in the control group was 17.9% and in the low intervention, test 1 and test 2 groups it was 15.6%, 12.3% and 11.4% respectively.

Cost analysis

Based on the annual electricity usage in Table 18 a cost comparison has been undertaken. Exactly 96% of households in the Switched on Homes trial were on a flat rate tariff. Households accessing a time of use tariff have been excluded from this analysis, resulting in the removal of three and five households from the test 1 and test 2 groups respectively.

The analysis undertaken compared key statistics for electricity costs per group in 2014 to 2015. Electricity prices are adjusted every year on 1 July. In order to compare baseline and trial years, prices were adjusted to a standardised price of $0.2515/kWh. Actual electricity prices during this time were $0.246/kWh for the A1 tariff on 1 January 2014 and $0.257/kWh on 1 January 2015. This cost model excludes supply charges and other costs that may be levied by electricity retailers (meter reading fees, late fees and other costs). Supply charges and other costs were excluded on the basis that many of these charges attract a discount for some low income demographics, including senior citizens and many of these fees are not influenced through behaviour change or low income status

A summary of the key statistics of electricity cost is included in Table 44. This data is calculated using net electricity consumption. For households that generate electricity, this means that their electricity consumed minus their electricity generated is included in analysis. The effect of this is that some households are able to return negative values for minimum annual electricity consumption data (Table 18 Key statistics of annual electricity use per group in 2014 and 2015.). These results must be interpreted with care, as feed-in tariffs vary and are outside the scope of this analysis. For the purpose of this analysis it is assumed that the cost of one kWh of electricity is equal, regardless of whether it is being bought (positive integers) or sold (negative integers).

A mean, median, maximum, minimum and standard deviation was calculated for each group in 2014 and 2015. The change in usage is calculated individually for each household as 2015 use minus 2014 use. Using the annual change values the change in usage mean, standard deviation, median, maximum and minimum are calculated.

Table 44 Summary of annual electricity cost use in 2014 and 2015.

Group	Variable	N	Mean	Std Dev	Minimum	Median	Maximum
Low Intervention	Cost in 2014	69	$1,110.92	$698.66	-$190.68	$1,054.02	$3,185.92
	Cost in 2015		$1,121.27	$702.69	-$88.27	$1,028.45	$3,953.28
	Change in Cost		$10.35	$262.00	-$574.22	-$23.35	$767.37
Test 1	Cost in 2014	67	$907.01	$600.84	$0.73	$763.50	$3,167.86
	Cost in 2015		$901.57	$576.80	-$32.21	$782.04	$2,935.40
	Change in Cost		-$5.44	$171.71	-$370.88	$2.44	$666.45
Test 2	Cost in 2014	61	$860.18	$579.68	-$320.83	$751.17	$2,116.22
	Cost in 2015		$787.57	$593.44	-$262.59	$658.64	$2,109.79
	Change in Cost		-$72.61	$184.31	-$855.96	-$44.62	$365.68

The mean annual electricity cost increased in the low intervention group by $10.35, or 0.93%, compared to 2014 (p=0.6745). Conversely, the test 1 and test 2 groups decreased mean annual electricity cost by $5.44 (0.6 %) (p=0.8279) and $72.61 (8.44%) (p=0.0079) respectively. Converse to the mean cost, the median cost reduced in the low intervention group and increased in the test 1 group, (Table 44). The only group to experience a statistically significant change in cost is the test 2 group (p=0.0079), which is reflected in a decreased mean and median electricity consumption. The discrepancy between the mean results in annual electricity use (Table 18) and annual electricity cost (Table 44) is caused by the exclusion of households who had time of use tariffs. Taken together, the difference between the mean and median in the low intervention group, coupled with the higher standard deviation, indicates that the variability in this group is greater than other test groups and conclusions are less likely to be applicable to an individual household. Conversely, a decreased cost for both the mean and median in the test 2 group and a lower standard deviation, is a strong indication that overall costs in this group reduced and this is a broadly recognised trend.

The key statistics of annual cost are represented graphically in Figure 44. Boxplots display the range (maximum and minimum), first quartile, third quartiles, median and outliers. Outliers are calculated as three times the interquartile range.

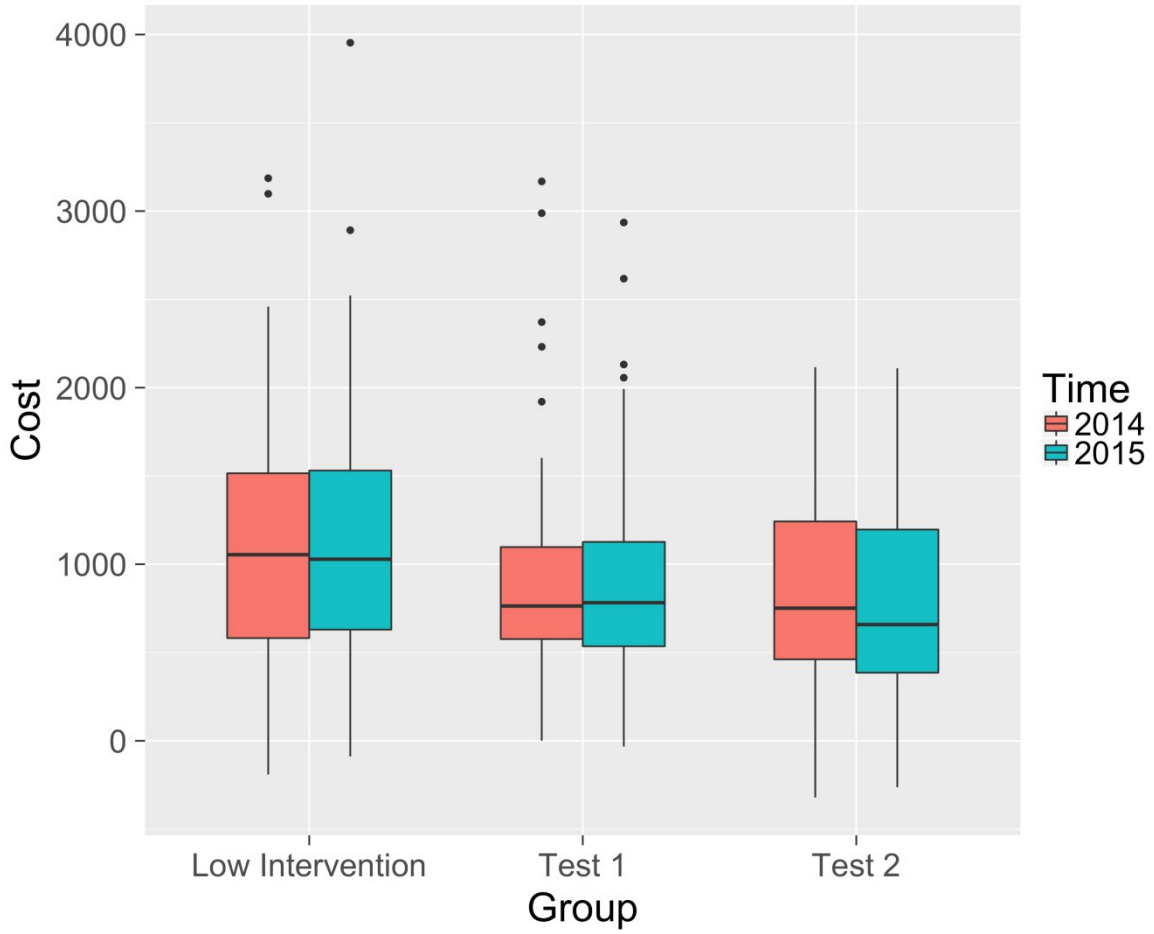


Figure 44 Boxplots showing annual electricity costs in 2014 and 2015 by test group.

Figure 44 illustrates there are a number of outliers in the test 1 group, which may be skewing the results of this group upward. The low intervention group also has a wider interquartile range than

the test 1 and test 2 groups, indicating a higher variability within the group. The range of all three groups is similar, with the exception of the test 1 group in 2014 which appears to have a smaller range in 2014 than the other readings, and a number of outliers.

Discussion

SMS

The results of Switched on Homes indicate that SMS may be a preferred and highly convenient method of communicating energy efficiency information but did not result in significant reductions in electricity consumption for over half of households in the low intervention group (who received only SMS tips as a treatment).

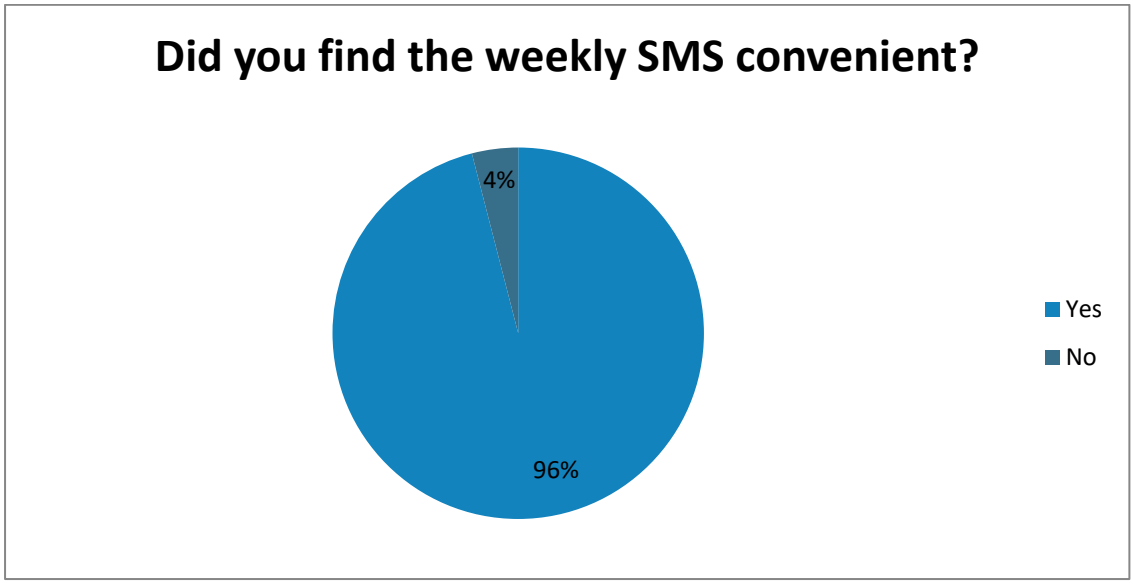


Figure 45 Response to the 2016 survey questions "During Switched on Homes did you find the weekly SMS convenient" (n=224)

Although the SMS message campaign was convenient for 96% of participants and anecdotally well received, it did not result in a significant change in electricity consumption (Table 18) and only insignificant cost savings (median electricity costs declined by $23.35 per year). The analysis of mean electricity consumption showed that the group that received only SMS tips (low intervention) did not significantly change compared to their 2014 baseline or the control group (Table 18 and Table 21 respectively). There are two contributing factors to the lacklustre reduction in annual electricity consumption in the low intervention group.

Firstly, it is important to note that overall 43.5% of the low intervention group significantly reduced their electricity consumption in 2015 (Table 20). A smaller percentage of households increased their electricity use significantly in 2015 (33.3%); however the overall result was a slight increase in electricity consumption by the low intervention group. A reasonable conclusion to draw from this is that untargeted SMS tips will not be helpful to all of the low income population. Interestingly, households that consume a similar amount of electricity to the Perth average were able to reduce their use by 5.8%, indicating that outside of the low income population, SMS messaging might be a more successful approach than within the Switched on Homes population.

In order to specifically target households that would benefit from SMS tips, Switched on Homes has found two factors important; pre-existing electricity use (as evident by the result of average electricity users) and the absence of solar-PV. In households with average electricity use the

untargeted SMS was the most successful intervention trialled in Switched on Homes. It was also the most successful intervention in households without solar-PV that decreased their electricity usage by 4.7% (246kWh/year) in response to SMS (Table 22). This is likely related to the overall higher annual electricity consumption of households without solar-PV (allowing more opportunity for reduction). There are also factors which may reduce the relevance of SMS tips to households with solar-PV, for example there may be conflicting interests in households with feed-in tariffs from enacting all tips.

Another factor influencing the success of SMS tips might be that they improve education (as indicated by the behavioural results of Switched on Homes), but do not change behaviour (as evidenced by annual electricity use in all low intervention households). This is not unprecedented. Fjeldsoe et al[4] undertook a meta-analysis of the efficacy of behaviour change SMS service in the field of public health. In two untargeted SMS trials, the one that sent two generic tips a week (similar to Switched on Homes) achieved no change in their desired medical behaviour (Logan, 2007 cited Fjeldsoe et al, 2009). The barrier between receiving information in a manner that is convenient and acting on information may be due to willingness to act. The most common answers in the low intervention group were that they were aware of monitoring but not changing their behaviour in response to the monitoring or they tried "a bit" (Figure 46). This suggests that being involved in a trial did not create a sense of expectation in the participants that they would take responsibility for trying to reduce their electricity use. With the addition of a further behaviour change treatment (personalised feedback), the test 1 group was slightly more likely to try and engage in saving electricity. It is noticeable that the test 2 group reported they had tried significantly more than the other groups, indicating that technology might have played a role in motivating behaviour change. The low intervention group (that did not receive personalised feedback); more often reported that they forgot they were being monitored than the other groups. This could be explained by the absence of personalised feedback, the low intervention group received no information that arose from their monitored data.

[4]Behavior Change Interventions Delivered by Mobile Telephone Short-Message Service
Brianna S. Fjeldsoe, BA, Alison L. Marshall, PhD, Yvette D. Miller, PhD Am J Prev Med 2009;36(2):165–173)

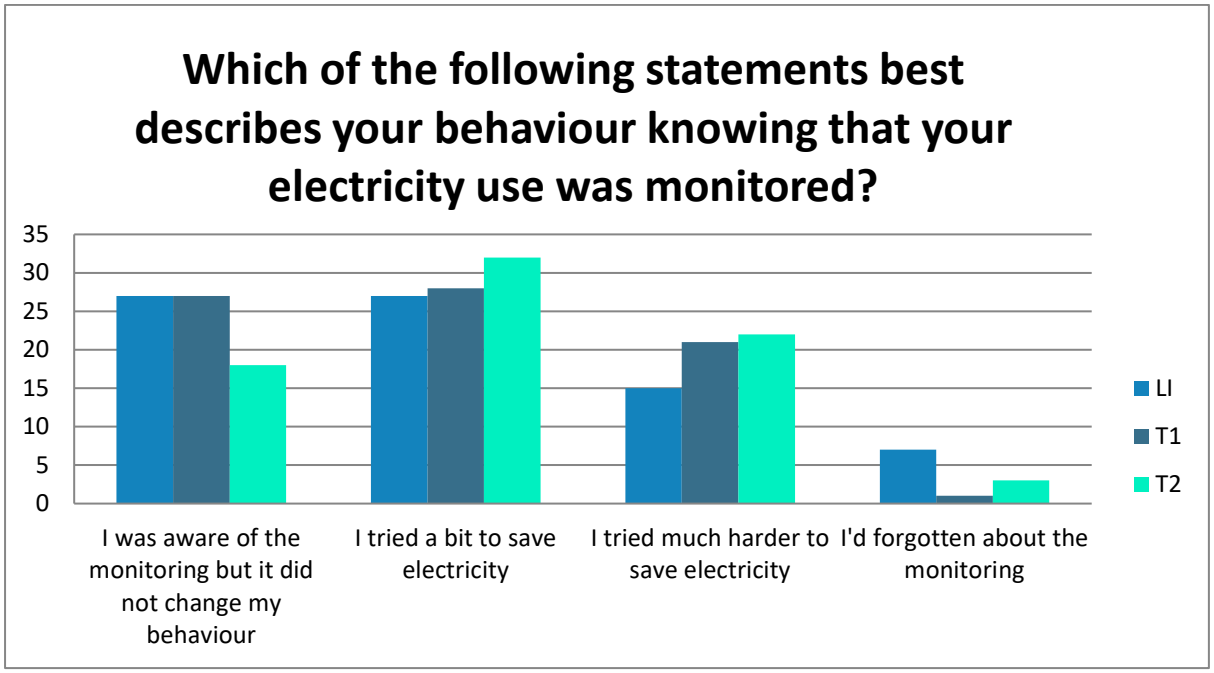


Figure 46 Participant response to monitoring equipment (n=228)

In the post-trial survey participants most frequently responded that they had tried to implement one to ten of the fifty SMS tips delivered throughout 2015 (Figure 47). This low uptake rate coupled with high convenience and enjoyment, indicate that the SMS communications allowed participants to dismiss tips that were not attractive to them without negatively impacting their experience. The low number of tips enacted may also indicate a low level of commitment or accountability to the program, with participants maintaining control over which tips to implement and which to ignore, reinforcing the observations of Figure 46.

Switched on Homes had a very low rate of withdrawal during the trial. This may be partially attributed to the ease of dismissing or ignoring the non-invasive trial approaches. These results suggest that SMS tips provide the consumer with a tool to make better informed decisions; however this does not necessarily result in significant changes to electricity consumption.

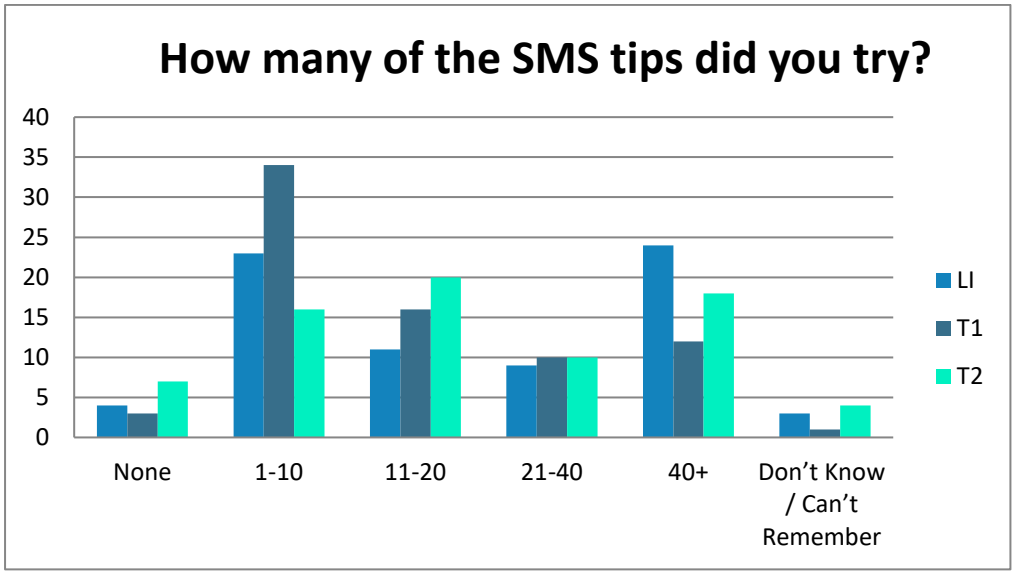


Figure 47 Tallied responses to the 2016 survey question "Overall, approximately how often did you try out any of the Energysmart tips sent by SMS" (low intervention = 74, test 1 = 76, test 2 = 75)

The most frequent survey response was to try fewer than 20% of the tips provided (1 to 10 tips). The second most frequent response was that participants tried over 80% of the tips provided (40+ tips). This indicates a core of "committed savers" who remained engaged throughout the year-long program. Based on the number of SMS tips "tried", the most engaged group is the low intervention group and the least engaged is the test 1 group (Figure 48). This may indicate that the interaction between personalised feedback and SMS tips was negative, and that respondents may be less likely to try tips if they are received in conjunction with feedback. Among the test groups, the low intervention group experienced the biggest change in motivation to be energy efficient (Table 38), with no households reporting they were not motivated at the end of the trial (5% were not motivated before the trial).

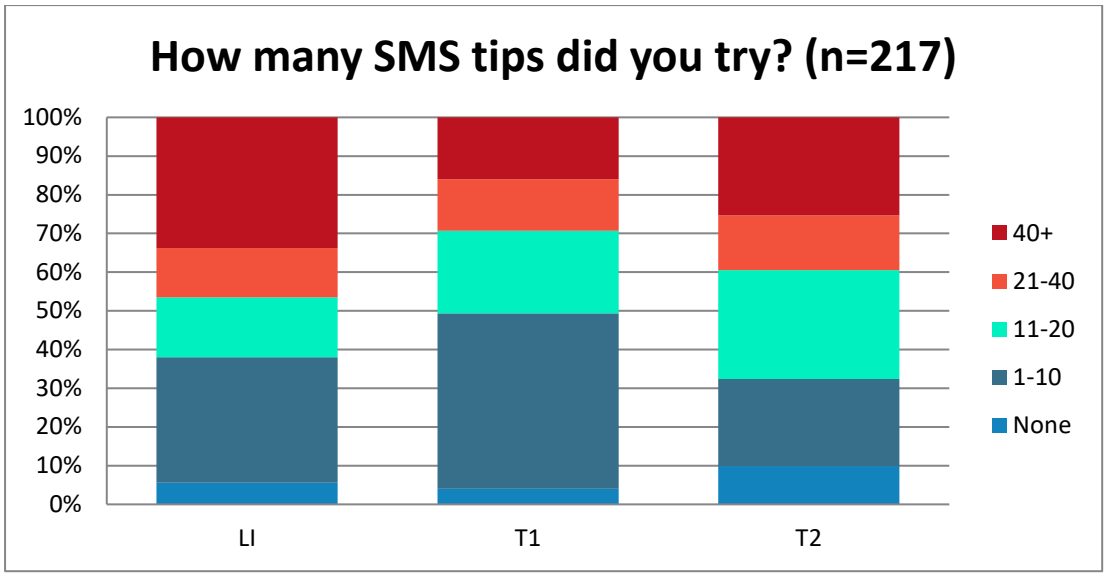


Figure 48 The maximum number of tips tried by each test group, as reported in the 2016 survey to the question "Overall, approximately how often did you try out any of the Energysmart tips sent by SMS" (low intervention = 71, test 1 = 75, test 2 = 71).

Feedback about the behaviour change tips delivered via SMS was mixed. An open form response to the 2016 survey question “do you have any other comments or feedback for me to pass on to the Switched on Homes team” included (sic):

- *50% of the advices were useful and the other 50 % were more addressed to teenagers than adults*
- *A lot of the suggestions were common knowledge*
- *All of the things they suggested were very good and some of them they hadn't thought of before and now much more aware of what to do.*
- *Already pretty savvy but good reminder, should educate younger people about energy efficiency*
- *Done a good job. Text messages really good information.*

A full list of responses to the open ended question is available in Appendix 5. The responses suggest that while the SMS tips were pitched at an appropriate level for some households, for others the information provided was too simplistic. Based on the survey responses received in 2014 (Attitudinal and behavioural responses), the population recruited to Switched on Homes reported an interest in energy efficiency before their involvement in the trial. For this audience, that was already interested in energy efficiency (Table 36), the easy to enact tips trialled in Switched on Homes may not be new information and households may have already been enacting some tips prior to the trial. Based on the uptake rate of SMS, it appears that information based communication campaigns do not effectively reduce electricity consumption in populations already engaged in energy efficiency, even when a behaviour change component is added (as is the case in the test 1 group). This lesson may also be broadly applicable to low income populations, who may have already implemented cost-free methods (such as behaviour change) to control their electricity bills. The results of average electricity users participating in Switched on Homes (Table 24) indicate that for the broader population, SMS behaviour change may be more effective than recorded in Switched on Homes.

The annual electricity use profile of the low intervention group (Figure 22) shows that the group decreased their electricity consumption in relation to their baseline for most of autumn (weeks 10 - 23). This indicates that there may be more willingness or ability in the low income population to change behaviour in the shoulder seasons (autumn and spring) than in peak seasons (summer and winter). Figure 25 shows that the low intervention group follows similar trends to the other groups until July, at which point the low intervention group begins to increase electricity consumption. This deviation suggests that behaviour change tips on their own might not be motivating over long periods of time, and households may have lost interest in enacting tips in the second half of the trial year. Future programs should consider that running behaviour change campaigns of limited duration more frequently may be more successful than ongoing campaigns.

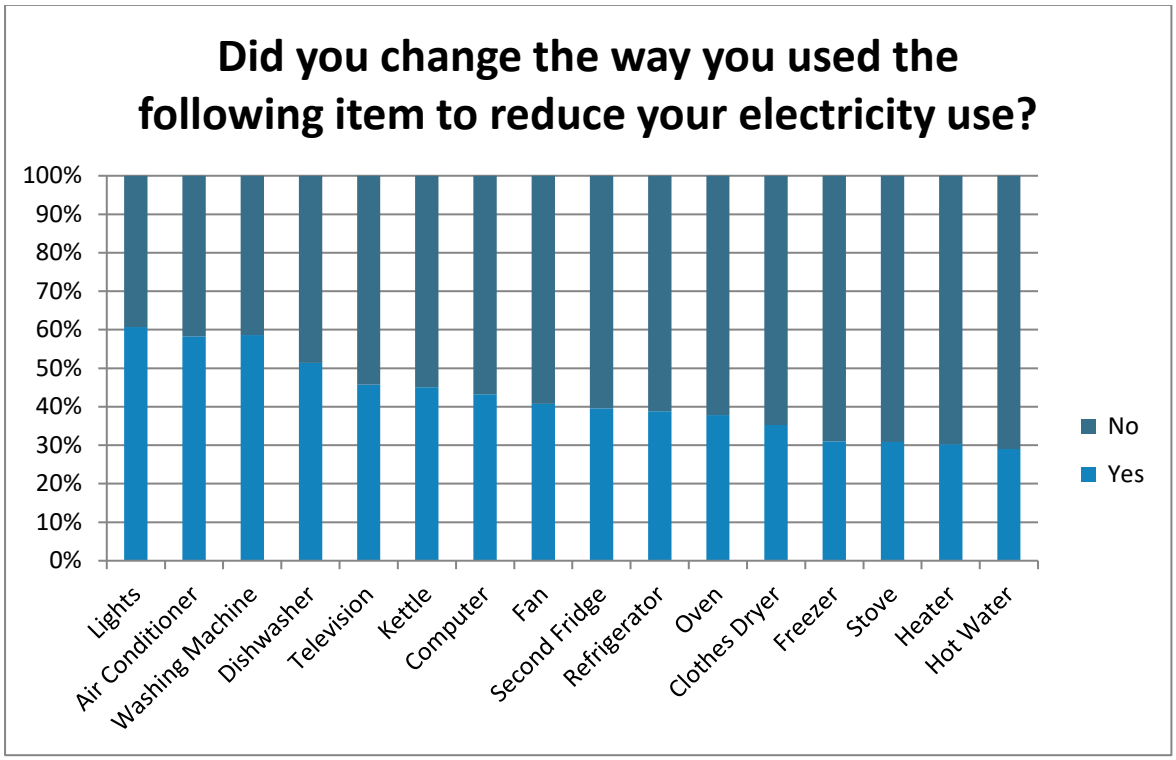


Figure 49 Answer to the 2016 survey questions "When you received Energysmart tips via SMS did you change the way you used the following items in an effort to reduce your electricity use?" (n=202, households who did not own the appliance excluded).

The end of trial survey asked households which tips they acted on to reduce electricity use. Figure 49 shows that the response to changing use of heaters and air conditioners was mixed. Despite electricity consumption increasing in 2015 summer, relative to the baseline (Figure 25), households indicated that they had tried to change their air-conditioner use (57% of households). Conversely, the results of the control group in the trial area (Table 21) shows that electricity demand in households decreased in summer (January – February) relative to 2014. While the discrepancy in summer behaviour between the control and test groups was not determined by Switched on Homes, this may indicate that in low income households electricity consumption in peak periods will likely grow in future years and peak electricity times may take up a larger proportion of low income households electricity bills.

In the winter peak period, not as many households attempted to change behaviours related to heating, with heaters and hot water systems respectively the least enacted tips. This may be interpreted as a resistance to changing patterns around warmth and more willingness to be engaged in energy efficient cooling. This could also be related to the high cost of running air-conditioners and public awareness around managing electricity demand in summer. There is some ambiguity in the wording of this question, as air-conditioners may also function as heaters and the survey did not distinguish between these uses.

Outside of heating and cooling there was a demonstrated willingness to change use of dishwashers and washing machines; however this likely encompasses using appliances more efficiently, as well as deferring use in peak times. There was less than 40% uptake rate of tips relating to kitchen

appliances (stoves, freezers, ovens and refrigerators), indicating that this is a more difficult category of appliances to facilitate change in use.

Lessons learned

Over 20,000 SMS were delivered through the Switched on Homes messaging system. Using a SMS delivery platform allows all messages to be delivered nearly simultaneously, quickly generates reports to monitor distribution and carries a relatively low cost (7c per SMS was paid during Switched on Homes).

Table 45 Benefits of SMS communications

Benefits of SMS communications	
Low market saturation	While more and more businesses are using SMS communications to reach their clients, the saturation is still quite low and SMS may still be perceived as a personal communication method.
Low time commitment	Compared to other methods of communication (mail, email, phone call and face to face conversation) SMS carries less time commitment for recipients.
Low accountability	Technology based communication has a low level of accountability compared to interactions with another person. This may allow households to make the choices best suited to them. This benefit is to the householder, but may disadvantage energy efficiency service providers.
Instant access	SMS shares the benefits of email of being delivered at a controlled time and available anywhere but SMS may be checked more regularly than email.
Regular scheduling	Participants knew when their next tip would arrive and could check their phone.
High market penetration	Access to mobile phones is high in the general population. A mainly senior demographic was engaged through Switched on Homes. This demographic were able to receive SMS competently, however many households reported less ability to reply to SMS.
Accessible	SMS is accessible to many demographics. The short, sharp communications in SMS are accessible for low literacy and culturally and linguistically diverse participants.

Email communications share many of the benefits of SMS and email delivery of energy efficiency tips was requested by some participants during the trial. Post trial community survey results reveal email to be a preferred communication channel to SMS. However, due to the established market position of email there is a high volume of automated email services already available and communications may be more easily filtered out, ignored or receive less attention. Widespread accessibility of mobile phones but low use in marketing means SMS communications are an underutilised communication channel in the current market.

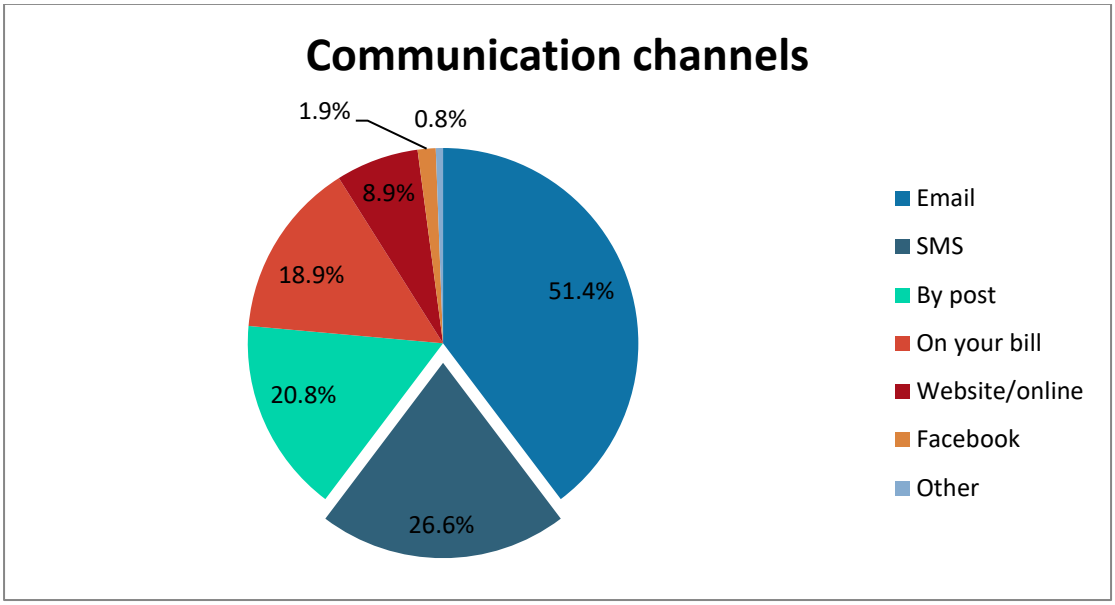


Figure 50 Replies to 2016 post-trial survey question (multiple response) "In which of the following ways would you like to receive energy efficiency information" as a percentage of total respondents. (n =259)

Consortium members previous reluctance to utilise SMS for communications has focused on the concern that SMS communications would lead to some community members being excluded, particularly elderly who are perceived as having low technological literacy. Switched on Homes engaged primarily senior citizens (average age of participant was 65.6 years old)and found that all participants except one were able to access their SMS messages, dispelling the myth that SMS communications exclude the senior demographic. This is supported by recent research by Experian Marketing Services[5] that found that 94% of people over the age of 70 use SMS at least once a week. Additionally, 41% of people aged over 65 years report checking SMS as the first thing they do when they look at their phone[6], indicating that SMS is highly accessible.

[5] Millennials come of age ConsumerSpeak series (An Experian Marketing Services White Paper) http://www.experian.com/assets/marketing-services/reports/ems-ci-millennials-come-of-age-wp.pdf

[6] Mobile Consumer Survey 2015 – The Australian Cut Life's smarter than you think (Deloitte) http://landing.deloitte.com.au/rs/761-IBL-328/images/deloitte-au-tmt-mobile-consumer-survey-2015-291015.pdf?mkt_tok=3RkMMJWWfF9wsRokvaTIe%2B%2FhmjTEU5z16e8sXqSwhIkz2EFye%2BLIHETpodcMT8RqNr%2FYDBceEJhqyQJxPr3CKtEN09dxRhLgAA%3D%3D

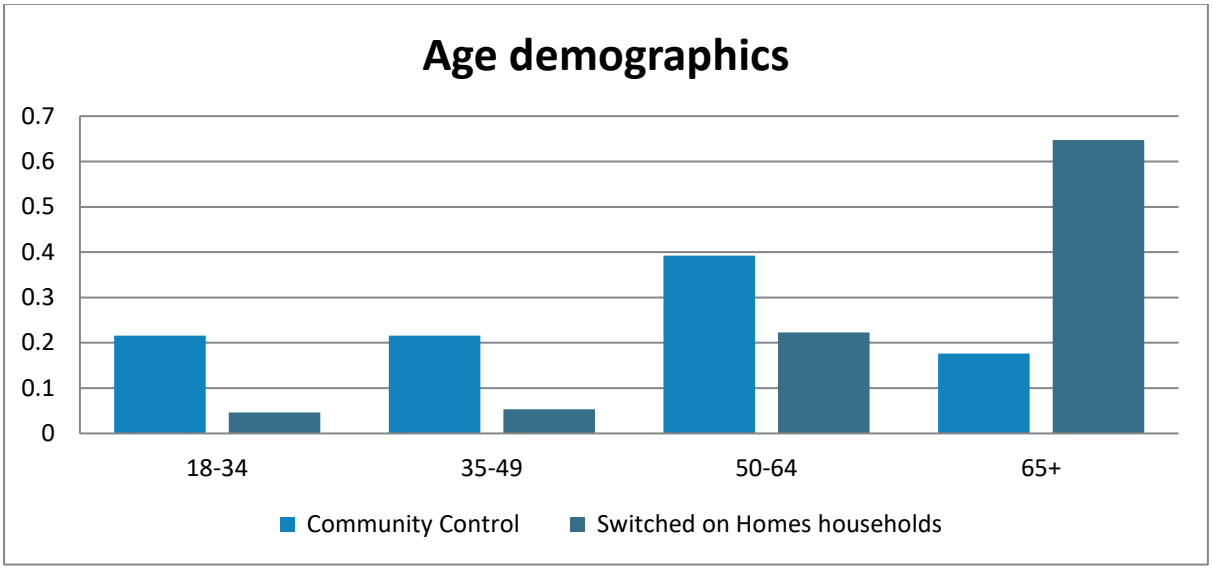


Figure 51 Age demographics of the community control survey and Switched on Homes participants, as a proportion of total sample

A comparative community survey was undertaken at the same time as the Switched on Homes survey in 2016 and the results differed. The results of the preferred communication channel in the community survey (Figure 52) showed that e-newsletter is the preferred communication channel for both Switched on Homes participants and the wider community. Table 44 explores some of the reasons that email is a preferred, but potentially less effective, communication channel. SMS communications was not as popular in the wider community (preferred communication channel for 12%) as in the Switched on Homes group (27%). Interestingly, the community survey reached a younger demographic than Switched on Homes (Figure 51), indicating that concerns about excluding senior citizens by engagement through technology was unfounded, as Switched on Homes participants preferred SMS over the community at large. This may be interpreted as either a bias in recruitment or it may be that after exposure, receptiveness to SMS is improved.

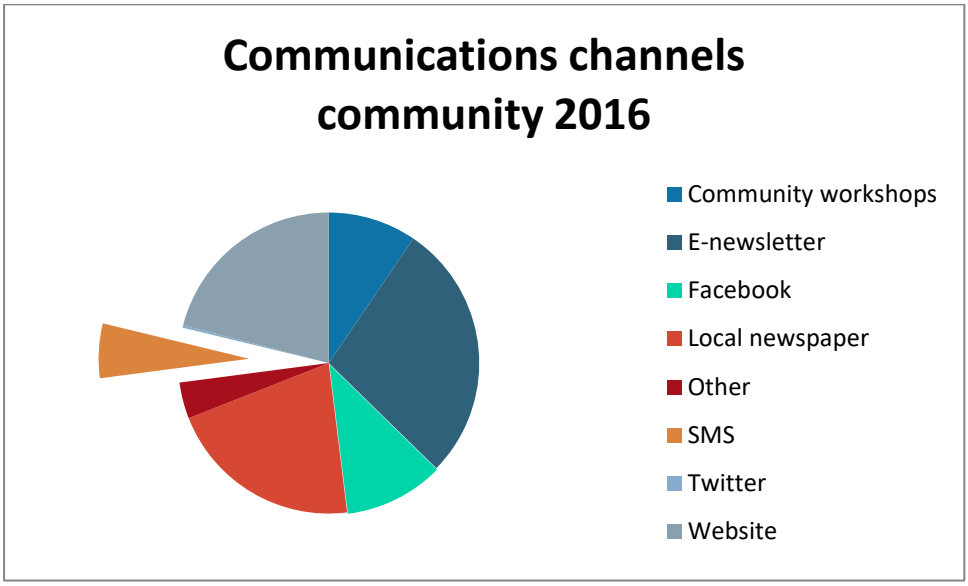


Figure 52 Community survey preferred communication channels (n=206)

There were some issues that are believed to be unique to SMS communications, over other forms of communication (Table 46). Using an SMS delivery system requires more testing than a similar system for email distribution, however once testing was completed few issues with SMS were encountered.

Table 46 Challenges of SMS communications.

Challenges of SMS communication	
Risk of cost to participant	Participants need to be aware that if they receive messages overseas, they may incur additional fee from their mobile provider. No complaints were received about this during Switched on Homes.
Delivery issues	Some households did not regularly receive messages, despite the SMS system showing that had been sent. The majority of these households belonged to a single telecommunications provider, indicating that not all services on the market are equally compatible with SMS communication systems.
Testing time required	The Switched on Homes SMS communication was quite buggy for the first 6 weeks, many of these problems were confined to one network or household and were resolved on a case by case basis, leading to additional cost and time compared to other digital communication channels (emailing, blogging or updating social media).
Short, snappy messaging required	SMS is only suited to communications that can be delivered in brief. Switched on Homes has demonstrated that a lot of information can be conveyed in a short space, but this requires adapting communication techniques.
One-way communication	A small subset of participants regularly responded via text to the SMS tips and the project team encountered requests for both more detailed information and a platform for participants to interact with each other. To maintain integrity of the experimental design neither request was actioned until conclusion on the trial.

The popularity with participants and ease of continued roll out has led to the Switch your thinking program offering SMS tips as an ongoing service. Switch your thinking already has an established e-newsletter system and has added SMS as a distinct, but complimentary communication channel.

Case study – Low intervention group

Carla* and her husband are in their 60s and live in an older home with a small solar-PV system installed.

Carla was allocated to the low intervention group and received energy efficiency tips by SMS once a week. Carla and her husband loved receiving the SMS and have signed up to continue to receive monthly tips as part of the Switch your thinking program. Participation in Switched on Homes resulted in Carla and her husband reducing their air-conditioner use and only turning it on when they needed to. The couple were also much more diligent about turning off lights and appliances before they left a room. Carla installed a power timer on her second fridge and she and her husband were delighted to see their electricity use drop and their solar credits grow.

*Names changed to protect privacy.

Personalised feedback

Personalised feedback delivered via SMS through Switched on Homes did not result in statistically significant changes in electricity consumption compared to the baseline period. The test 1 group increased their electricity consumption relative to the baseline year by 0.2% (discussion of Table 19), while during the same time the control group decreased electricity consumption by 1.5% (Table 21). Average electricity consumers within Switched on Homes test 1 group decreased electricity consumption by 3.9% (Table 24), which is slightly more than the control average. The annual electricity consumption results, in conjunction with the survey responses, create a complex picture indicating that the results of personalised feedback are mixed.

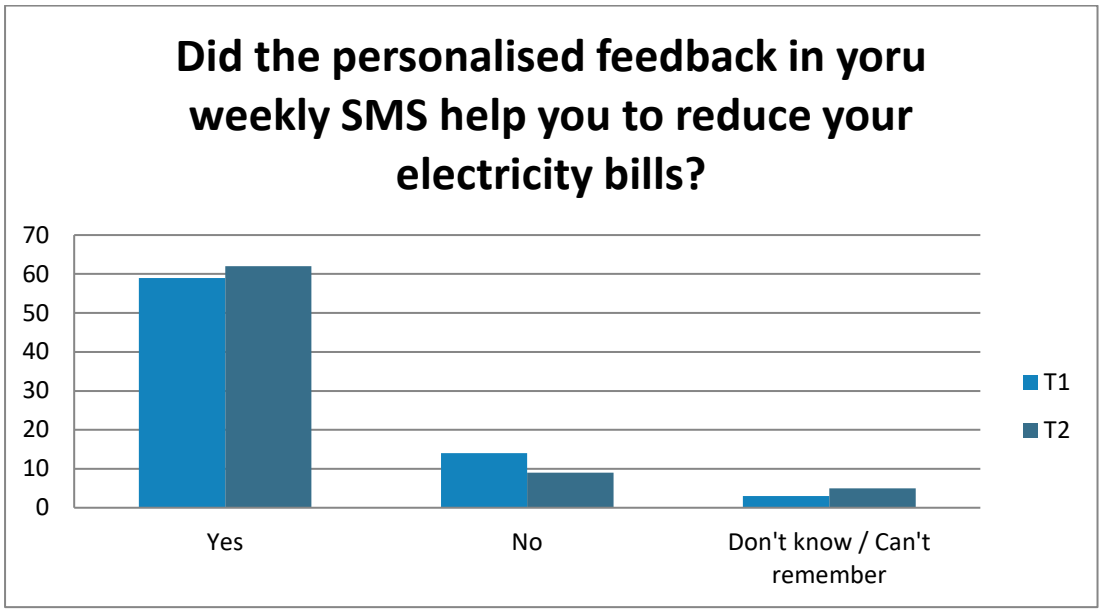


Figure 53 Response to the 2016 survey "did the personalised feedback in your weekly SMS help you to reduce your electricity bills" (n = 139, test 1 = 76, test 2 = 76)

The participant experience of personalised feedback was positive overall. A total of 78% of test 1 and 82% of test 2 participants reported that they believed personalised feedback helped them reduce their electricity bills. The effect of personalised feedback is not apparent in the comparison of annual electricity consumption, which showed a slight, but not significant, increase in electricity use in the test 1 group. The survey response highlights the high value that consumers place on access to information. Future programs should not focus on personalised feedback as a tool for reducing electricity consumption. It may instead play a role in engaging and retaining households in energy efficiency activities. Anecdotally, demand for personalised feedback was high and quite emotive. Appendix 5 contains the survey response feedback, which includes unsolicited feedback from households receiving personalised feedback suggesting that they would have liked more detail. A 2006 study undertaken by Oxford University[7] found that feedback was necessary to make energy savings but on its own is insufficient as consumers need help interpreting their feedback. The short

[7] the effectiveness of feedback on energy consumption a review for DEFRA of the literature on metering, billing and direct displays (Environmental Change Institute, University of Oxford) http://www.usclcorp.com/news/DEFRA-report-with-appendix.pdf

format of SMS provides very little room for contextual information, and based on survey feedback this may have contributed to the failure to meaningfully engage the test 1 group in energy saving.

The SMS tips were tried less often by the test 1 group than either the low intervention or test 2 groups, indicating that the personalised feedback may play a role in demotivating, or reducing action in participants (Figure 48). This also indicates that adding personalised feedback to tips did not make participants more likely to act on the tip. As well as being less likely to enact SMS tips the test 1 group was also the only group to report an increase in "no motivation" during the trial (Table 38). Neither of these responses were observed in the test 2 group, where voltage optimisation was in place as well as personalised feedback, so it is not conclusively personalised feedback that resulted in these outcomes (see test 1 group case study).

Figure 53 shows that only slightly more participants in the test 2 group reported that personalised feedback assisted them to reduce their electricity consumption during the trial. This may indicate that the difference in electricity consumption between the test 1 and 2 groups is mostly the result of the voltage optimisation unit, not a difference in response to the personalised feedback itself. The difference in willingness to try energy efficiency tips is not explained by the presence of personalised feedback alone. Table 47 explores some of possible reasons that personalised feedback did not decrease electricity consumption.

Table 47 Possible shortcomings of personalised feedback

Personalised feedback is ineffective for households with low electricity demand	Personalised feedback in households with low electricity use may highlight to households the low cost of their electricity use and result in increased consumption.
Personalised feedback periods selected by SoHo were ineffective	Determining the correct period for personalised feedback is a balance between longer periods (highlights expense at the cost of specificity) and shorter periods (highly specific but may trivialise expense). The optimal period may need to be highly tailored to prove useful.
Personalised feedback is not effective in SMS format	The power of personalised feedback may lie in delivering it face to face and creating accountability. Additionally, SMS does not include contextual information or provide additional information, which may be an important factor in converting personalised feedback into action.
Normative feedback was not used in personalised feedback.	Quantitative feedback comparing participant's electricity consumption to each other or averages was not included in personalised feedback. Weak injunctive norms such as, 'Congratulations your electricity is X% less than last month' were employed, but these statements may need to use stronger language to be effective. Appendix 1 contains personalised feedback templates.

The results of the 2016 survey showed that households receiving personalised feedback (in the test 1 and test 2 groups) reported less frequently that they "did everything relating to energy efficiency" (Table 38), increased financial control (Table 41) and increased control over electricity use (Table 42) compared to the control and low intervention groups. More households that received personalised feedback disagreed with the statement "energy efficiency was too much hassle" after the trial than before, and it appears the more interventions the household received the more likely they were to disagree with this statement (Figure 59). However, motivation did decrease in the test 1 group while other test groups experienced increased motivation (Table 38), and this group was less likely to attempt SMS tips (Figure 48) and on average did not save electricity. This complex, and seemingly contradictory, series of results may indicate that personalised feedback is an educational tool, but does not result in behaviour change.

Despite personalised feedback having a mixed effect on motivation, it did enable households to reduce electricity consumption relative to the baseline in autumn and spring in the second half of 2015, when SMS tips alone did not result in any decrease in electricity consumption (Figure 23). While the low intervention group started increasing electricity consumption relative to the baseline in June, the test 1 group did not. This indicates that the participants receiving only SMS tips lost interest over time but that there is longer engagement when personalised feedback is included.

While the test 1 group did not significantly change their electricity consumption in 2015 relative to 2014, Figure 23 indicates that much of the increase in electricity consumption relative to the baseline occurred in the first 4 weeks of the trial, prior to the delivery of personalised feedback (personalised feedback did not commence until 26 January 2015). It is unlikely that if these weeks were excluded that personalised feedback would result in significantly decreased electricity consumption compared to the baseline; it is an uncontrolled factor in this analysis.

Case study – Test 1 group

Hugh* and his wife are in their 70s. They live in a retirement village in a new home with a small solar-PV system installed.

Hugh was allocated to the Test 1 group and received personalised feedback and energy efficiency tips by SMS.

Hugh's household consumed an average of 4 kWh per day in 2014 (the baseline year). This increased to 5 kWh a day during 2015 (the trial year).

Hugh enjoyed being part of Switched on Homes and reported that it increased his awareness around electricity consumption. Participation led to him changing his lightbulbs to more efficient compact fluorescent globes.

During the trial Hugh also recognised changes that he could make to improve his energy efficiency but chose not to. One example is in early 2015 Hugh received a small used second fridge that he keeps on his patio. Hugh and his wife really enjoy their coffee and use the fridge to keep the milk cold, so they have decided it is worth the extra electricity consumption and cost. Hugh spoke with other people in his retirement village that were also part of Switched on Homes and they reflected his ideas and all agreed that the program "had made us more aware of their electricity consumption – but didn't necessarily change our habits".

*Names changed to protect privacy

Voltage Optimisation

The test 2 group (the only group that received a voltage optimisation unit) were the only group to significantly decrease their electricity use during 2015, mean consumption in this group declined by 8.6% compared to their baseline.

The number of SMS tips enacted by participants in the test 1 group (see SMS) indicates that personalised feedback might have a weak demotivating effect which reduces responsiveness to the SMS tip campaign. The test 1 group did not reduce their electricity consumption relative to baseline in 2015. Unlike the test 1 group, the test 2 group, that received the same treatments as the test 1 group plus a voltage optimisation unit, were able to reduce their electricity consumption. This difference is at least in part attributable to the operation of the voltage optimisation unit, although there may also be a positive interaction between the role of technology and the other trial approaches (personalised feedback and SMS tips). Figure 53 shows slightly more test 2 participants than test 1 participants felt that personalised feedback reduced their electricity bills and Figure 48 shows test 2 households enacted more SMS tips. This suggests that additive effects of technology and behaviour change interactions are weak, but the voltage optimisation did marginally improve the perspective of personalised feedback.

While 65% of test 2 participants reported at the end of the trial that they felt the voltage optimisation unit had decreased their electricity bills (Figure 54), 82% of test 2 participants felt that personalised feedback helped decrease their electricity bills (Figure 53). While the proportion of electricity reduction in the test 2 group caused by voltage optimisation and personalised feedback cannot be definitively separated, it seems that the role of personalised feedback has been overestimated by participants. As the test 1 group did not achieve electricity savings through personalised feedback alone, any decrease in electricity consumption in the test 2 group is more likely caused by voltage optimisation. The mixed response to voltage optimisation and underestimation of its effect is likely due to their unestablished position on the consumer market and consequent lack of community awareness.

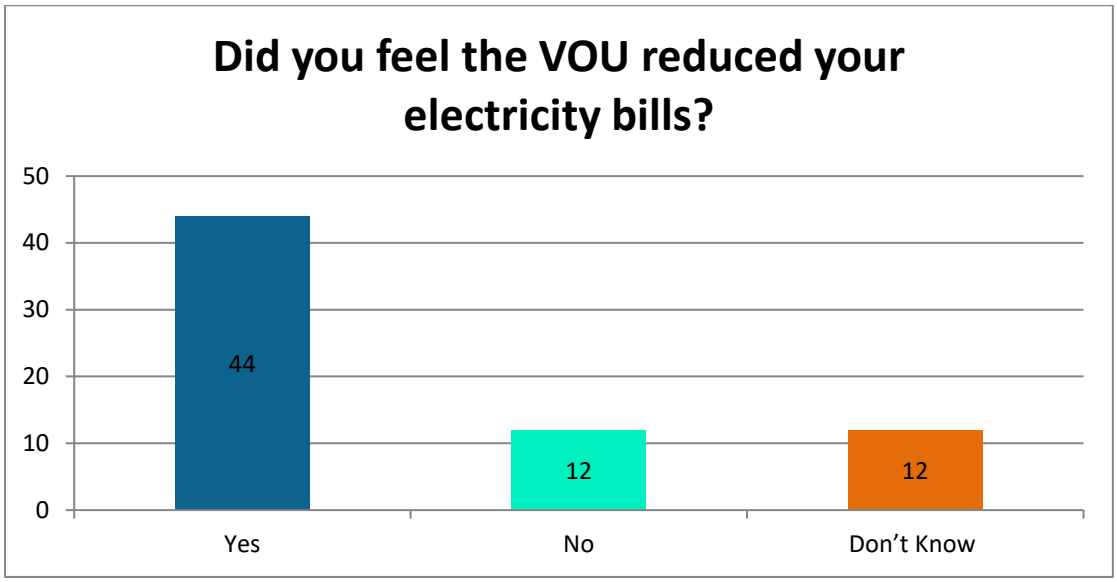


Figure 54 Test 2 group responses to the 2016 survey questions "Do you feel the voltage optimisation unit reduced your electricity bills?" (n=68).

Switched on Homes was the first trial of the residential use of voltage optimisation units in Australia. The savings rendered by the voltage optimisation units are both site specific (depending on the original voltage to the site) and dependent on household appliance mix. The results of Switched on Homes indicate that a case-by-case approach to residential installation of voltage optimisation units is required, also recommended by the manufacturer. Further analysis is required to assess how many homes would be able to reduce electricity consumption meaningfully in an untargeted roll-out. Based on the results provided in this report it can be assumed that the appliance mix of Switched on Homes participants is moderately responsive to voltage optimisation, regardless of voltage supply at the site.

Table 48 Appliance mix in test 2 participants of Switched on Homes (n=68)

Appliance	Percentage of test 2 households with this appliance
Lights	100%
Refrigerator	100%
Television	100%
Air conditioner	97%
Washing machine	97%
Freezer	94%
Kettle	94%
Computer	90%
Oven	81%
Fan	79%
Stove	71%
Hot water system	69%
Heater	65%
Second refrigerator	48%
Dishwasher	47%
Clothes dryer	43%

Interestingly, an analysis of a subset of households without solar-PV showed that this subgroup saved less electricity through voltage optimisation, decreasing annual electricity use by 2.7%, compared to the larger decrease in the total group. There is no reason to suspect that this difference is based on voltage at the site or appliance mix, due to the random assignment of households. Likewise there is no theoretical basis that would explain the voltage optimisation units improving the output of solar-PV. This suggests that an additional interaction may occur in households with solar-PV.

A possible explanation for this result is that households with solar-PV may be more motivated to save electricity. This is an unexpected outcome, as households with solar-PV have lower than mean electricity consumption (comparing the mean consumption per group in Table 18 and Table 22) and feed-in tariffs contribute to further lowering their bills, so these households are less financially motivated to save electricity than households without solar-PV. This would suggest that households with solar-PV would respond to campaigns that are not focused on financial benefits of reducing electricity consumption and instead focus on co-benefits, like delaying building additional electricity infrastructure or environmental benefits. Measuring gross electricity use in households with solar-PV

is outside the scope of Switched on Homes. If mean gross electricity consumption is higher in households with solar-PV, then there is actually more scope for these households to decrease electricity consumption than is apparent in this analysis. Future studies, including households with solar-PV, could examine their motivations and use gross electricity consumption as an assessment tool, rather than net consumption which was recorded by Switched on Homes. Based on this result it appears that including households with solar-PV in future energy saving initiatives and programs is worthwhile and reductions to their electricity consumption may be realised.

Case study – Test 2 group

Faye* and her husband are in their 50s and were allocated to the Test 2 group. They had a Voltage Optimisation Unit installed at their property at the beginning of 2015 and received energy efficiency tips and personalised feedback by SMS every Monday evening.

Faye and her husband had experienced frequent power surges to their property ever since moving in five years ago. The problem was quite severe and resulted in them having to replace light globes about every six weeks. Faye also reports that they have replaced almost every major appliance (fridge, freezer, TV) since moving in. After the Voltage Optimisation Unit was installed they noticed the surges stopped completely and they only needed to change one light globe in 2015.

In addition to the benefits of the VOU, Faye also appreciated the SMS tips and looked forward to them every Monday. Faye's household were already quite energy efficient, but still found the program very useful.

*Names changed to protect privacy

Peak load and time of use responses

Three peak load messages were sent during Switched on Homes to measure the ability and willingness of low income households to shift electricity use outside of peak times. Western Australians are currently able to access two electricity tariffs, a flat rate tariff (no financial penalties for using power during peak time) and a time of use tariff (includes peak, off-peak and shoulder periods). A total of 96% of Switched on Homes participants currently use the flat rate tariff (A1) and are not driven by a price incentive to reduce electricity use during peak times. This is representative of the general population as reportedly only 10% of residential customers in Perth purchase the available time off use product. This is of particular interest to Switched on Homes as future policies in Western Australia could result in the introduction of mandatory time of use tariffs, with unknown effect on the community.

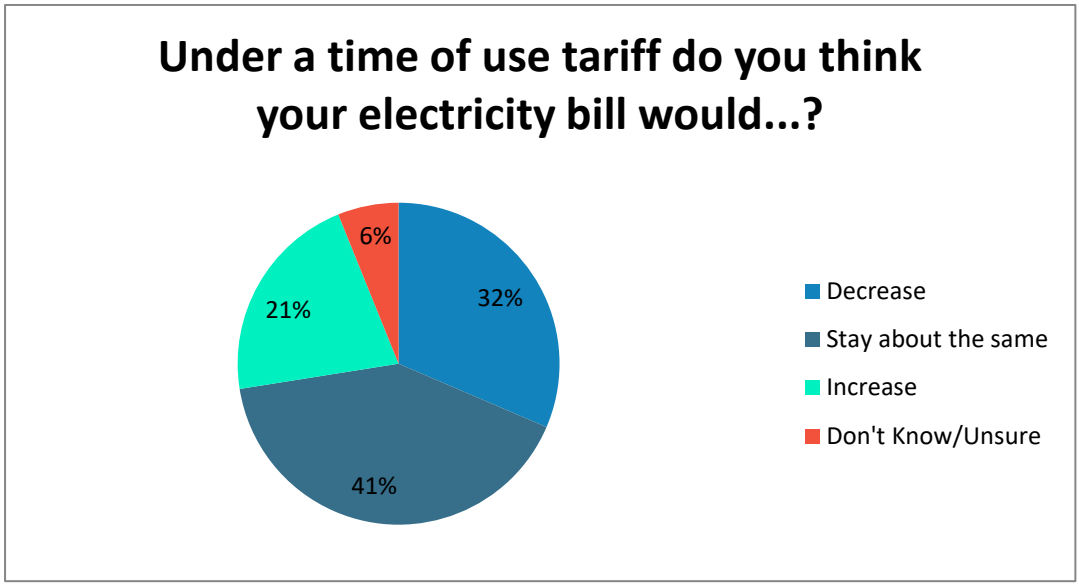


Figure 55 2016 survey responses (low intervention, test 1 and test 2 groups) to the question "Under a time of use tariff, do you think your electricity bill would…" (n=229)

The Switched on Homes survey in 2016 asked participants their opinions on how a time of use tariff would impact their electricity bill and well-being. A total of 73% of respondents stated that they thought their electricity bills would stay the same or decrease under a time of use tariff. A similar percentage agreed that their well-being would also stay the same, indicating the majority participants felt they would not be disadvantaged or unable to adapt to a time of use tariff.

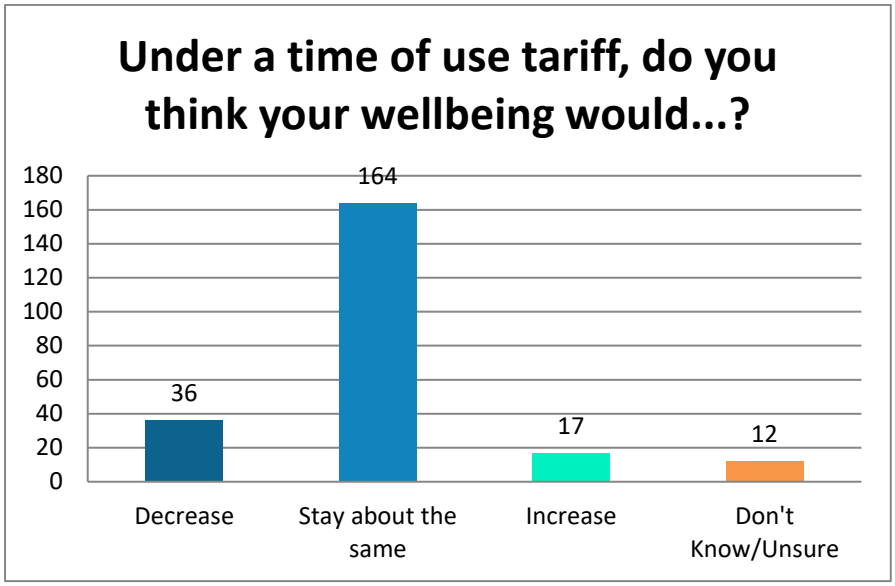


Figure 56 2016 survey responses to the question "under a time of use tariff, do you think your wellbeing would…" (n=229 in the low intervention, test 1 and test 2 groups)

To observe participants ability to respond to one-off requests to reduce their electricity consumption during grid peak load events, three SMS requests were sent out during periods of high electricity use. Table 49 details the SMS content, deployment details and results observed.

Table 49 Peak load messages generated mixed results.

Peak load message	Content	Deployment	Result
1	Switched on Homes - Perth is using a lot of power today! To do your bit please minimise your power use between now and 8pm. Try cooking with gas, turning your AC to 24 degrees or better yet use a fan.	Scheduled to coincide with peak electricity demand, extremely hot weather (25 February 4:30PM)	Peak message one resulted increased mean consumption in the four hours post-deployment Presence/absence of solar-PV did not affect the number of households responding over a four hour period In one hour after SMS deployment 45% of households without solar-PV responded
2	Switched on Homes - Did you know a lot of Perth's electricity infrastructure is built to accommodate power use between 4-8pm? Do your bit by turning on your dishwasher, washing machine or pool pump after 8pm.	Scheduled to coincide with peak use of electricity in winter, cold weather (9 August 4:00PM)	In the 4 hours post-deployment electricity consumption increased by 90-458% This indicates that the low income population, mostly represented by the elderly and health care card holders in Switched on Homes, are not responsive to shifting power use

			during cold weather 95% of households with solar-PV increased electricity consumption over the 4 hour period following SMS deployment
3	Switched on Homes - Perth is using a lot of power today! To do your bit please switch off unnecessary appliances, reset your air conditioner to 24 degrees or above, slip into something cool and open your windows to catch the breeze after the sun sets.	Scheduled to coincide with peak electricity demand, extremely hot weather (23 December 4:00PM)	Peak message three resulted in over half of households without solar-PV reducing electricity use in the one hour after SMS deployment 12% of households with solar-PV and 26% of households without solar-PV reduced electricity use for the entire 4 hour period The response indicates an ability to decrease electricity consumption in hot weather

Electricity demand post-deployment of peak messages indicates an inability to respond to winter peak demands and mixed ability to respond to summer peak demands.

Three interesting effects were noticed in the response to peak load messages.

1. Households without solar-PV reduced their electricity use more often after each successive exposure, indicating an ability to respond to time of use signals
2. Households with solar-PV were less responsive with each successive exposure, indicating that households with solar-PV may be unaware of the role they play in peak demand events
3. Seasonality seemed to play a role in determining response

Seasonality would not influence the difference in response to peak messages one and three, however different responses were observed. These differences could be attributed to:

- Peak message three occurred during school holidays. While not many participants have small children, a number regularly care for grandchildren after school which may affect the ability to respond differently. A RMIT study[8] found that school aged families were poorly placed to respond to peak demand due to pre-existing strong routines and this may extend to grandparent carers
- Peak message three occurred at the end of the trial year, when households had increased their energy efficiency knowledge and may have had more skills in place to reduce electricity consumption

[8] Nicholls, L and Strengers, Y (2015) – Changing Demand: Flexibility of energy practices in households with children was accessed from *apo.org.au/node/52993* on 29/02/2016

- Other weather conditions affected the ability to respond to the message (for example the time that maximum temperature occurs).

High uniformity in was noted in response to peak message two, when despite reasonably temperature weather conditions in Western Australia households struggled to respond to the peak load message. This was also observed in the strong correlation with lower maximum temperatures (less than 20 degrees Celsius) and electricity consumption, where there seems to be a cause and effect relationship (Figure 30). Overall, this indicates that winter electricity demand is unlikely to change in response to behaviour based campaigns.

The 2016 post trial survey respondents were positive about receiving peak load messages with 59% agreeing to the statement that they tried to respond to the peak load SMS by shifting their power use. This response was not readily observable in the electricity demand post SMS deployment (Table 26) but was clear in the number of households that reduced their electricity use somewhat in the one hour after peak load messages were deployed (

Table 28).

Table 28 indicates that over half of households were willing to decrease electricity consumption after peak message 3; however this was not maintained for the desired period of time (4 hours). This inability to respond for the full four hour peak period means that future programs might consider a rolling wave approach, asking groups to reduce power use for shorter periods sequentially. A suitable control was not available for these tests and it is possible that without the peak load message, households would have increased electricity consumption further in the post-deployment period.

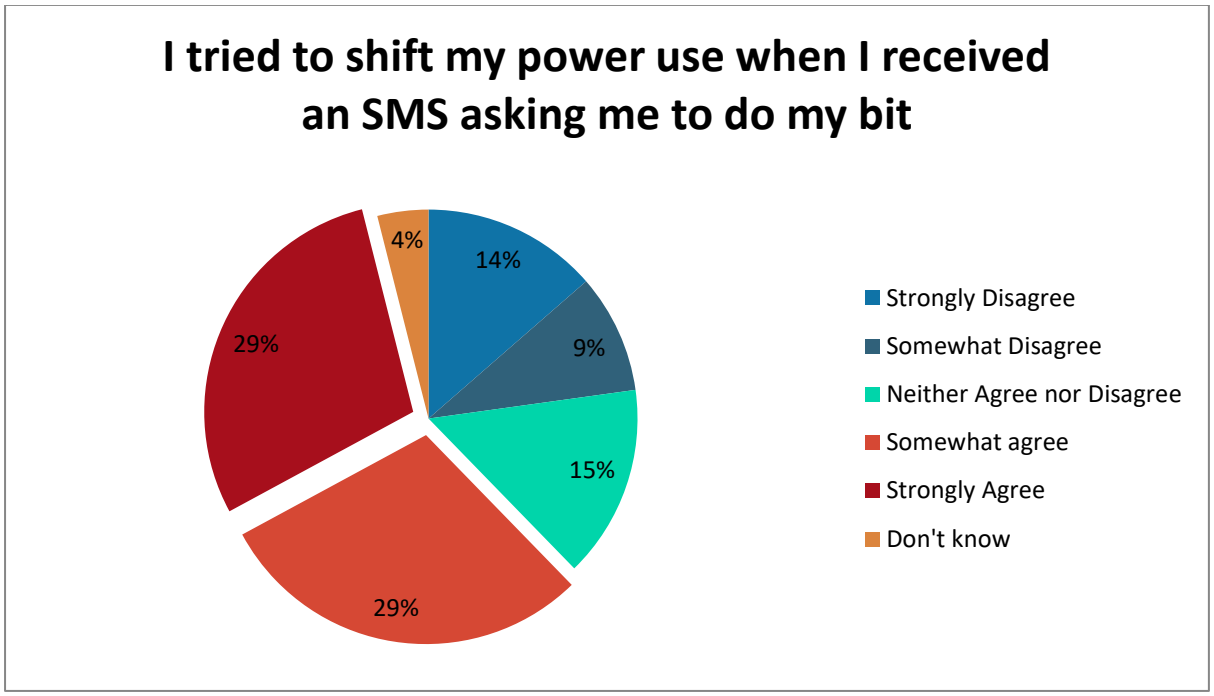


Figure 57 2016 survey responses to the question "I tried to shift my power use when I received an SMS asking me to do my bit by turning off my dishwasher, washing machine or pool pump until after 8pm" (n=228)

It is of note that while most households responded that they had been trying to decrease electricity use in peak periods, they had not actually conserved electricity. This overestimation of their ability to save electricity means that this demographic would likely be more financially disadvantaged than they predicted by a time of use tariff. Anecdotally, many people revealed during the trial that they thought they were on a time of use tariff when they were not. Switched on Homes has not explored how widespread this misconception is but it could be a result of households migrating to Western Australia from a state or country where time of use tariffs are uniformly imposed or as a result of several mass marketing campaigns focused on 'beating the peak' and media attention relating to the high cost of supplying 'peak demand'.

Attitudinal and behavioural responses

Responses to attitudinal and behavioural survey questions were measured in October 2014 and January 2016. The control group and test groups performed similarly in 2014 to most questions, which was expected based on the random assignment to households after the survey.

Based on the responses to the survey, it is possible to make some inferences about engagement in the trial and the success of the educational and personalised feedback components of Switched on Homes.

Engagement

The change in effort into energy efficiency was mixed and has limited scope. In 2016, the control group's effort into energy efficiency declined, while the test groups remained similar levels of interest to 2014. There was no obvious difference based on intervention. Interestingly, none of the tests groups significantly increased their efforts despite being involved in a trial. This may represent a high level of initial effort, or a low level of involvement in enacting energy efficiency advice provided by the trial or may indicate that participation in the trial was not considered to be an effort.

The format of the question itself poses some issues which limit the usefulness of this information. The period of effort is measured over two years and the trial only ran for one year, causing trends to be obscured. This result is considered to be a weak indication of interest in energy efficiency during the trial and immediately after the trial.

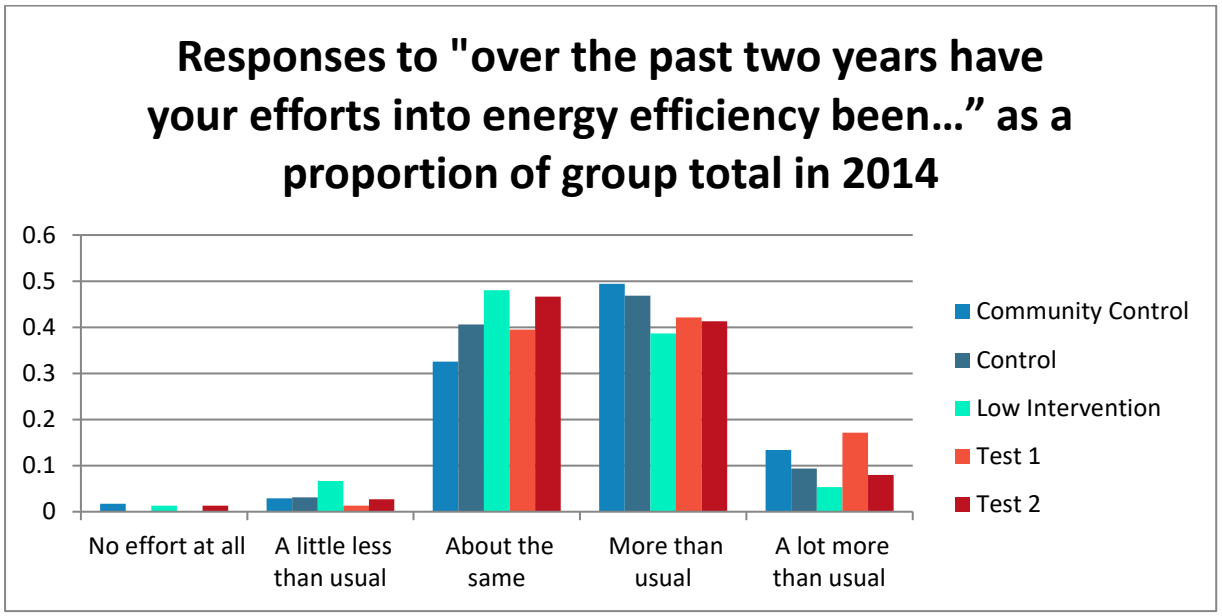


Figure 58 Responses to the 2014 survey question "In the last two years, has your effort into energy efficiency been…" as a proportion of group total.

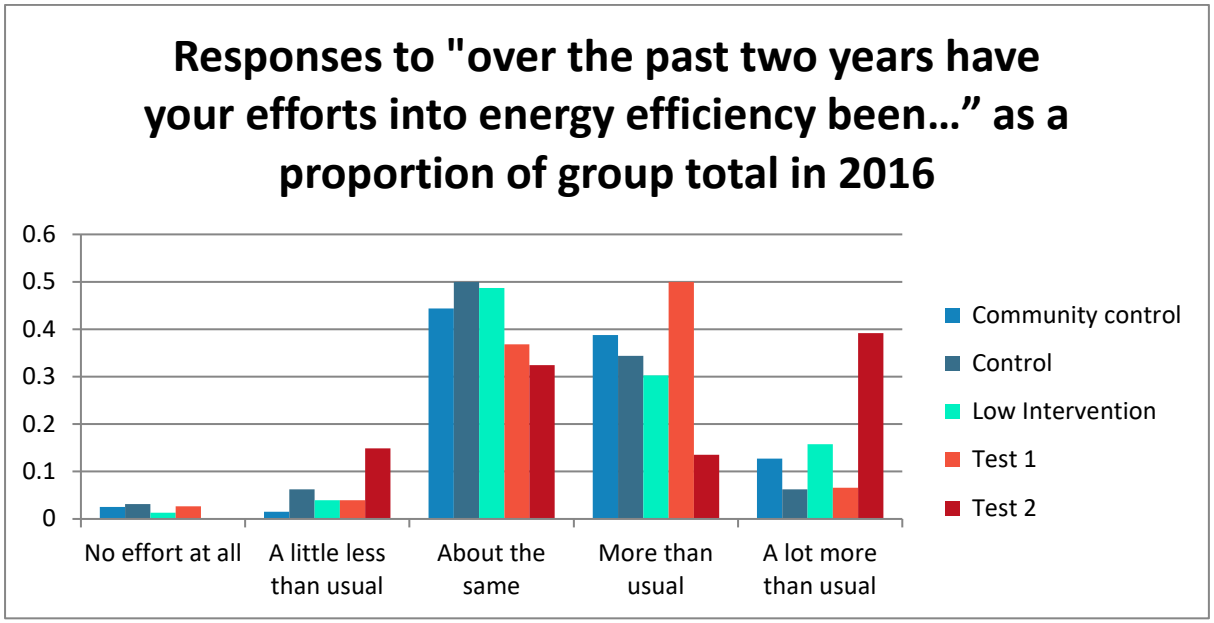


Figure 59 Responses to the 2016 survey question "In the last two years, has your effort into energy efficiency been…" as a proportion of group total.

Personalised feedback

Changing levels of motivation are considered to be a more reliable measure of trial engagement in energy efficiency than the question "in the last two years, has your effort into energy efficiency been…" During the trial period all households indicated that they were more motivated, except the test 1 group whose motivation barrier increased slightly. The low intervention group, that received only SMS tips, decreased their motivation barrier to zero in 2016. Contrasting the low intervention and test 1 group suggests that personalised feedback is demotivating, which may have impacted the number of tips tried (Figure 48) and the ability to conserve electricity.

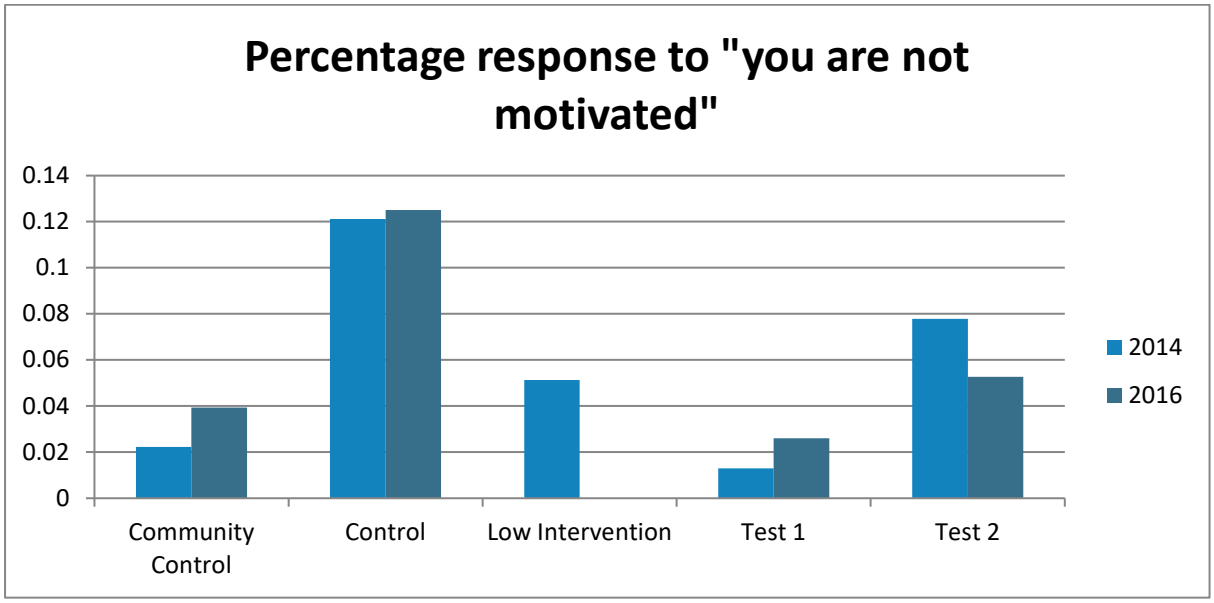


Figure 60 The proportion of each group that reported not motivated as a barrier in response to the question "Which of the following, if any, are barriers to you undertaking energy efficiency activities in your home".

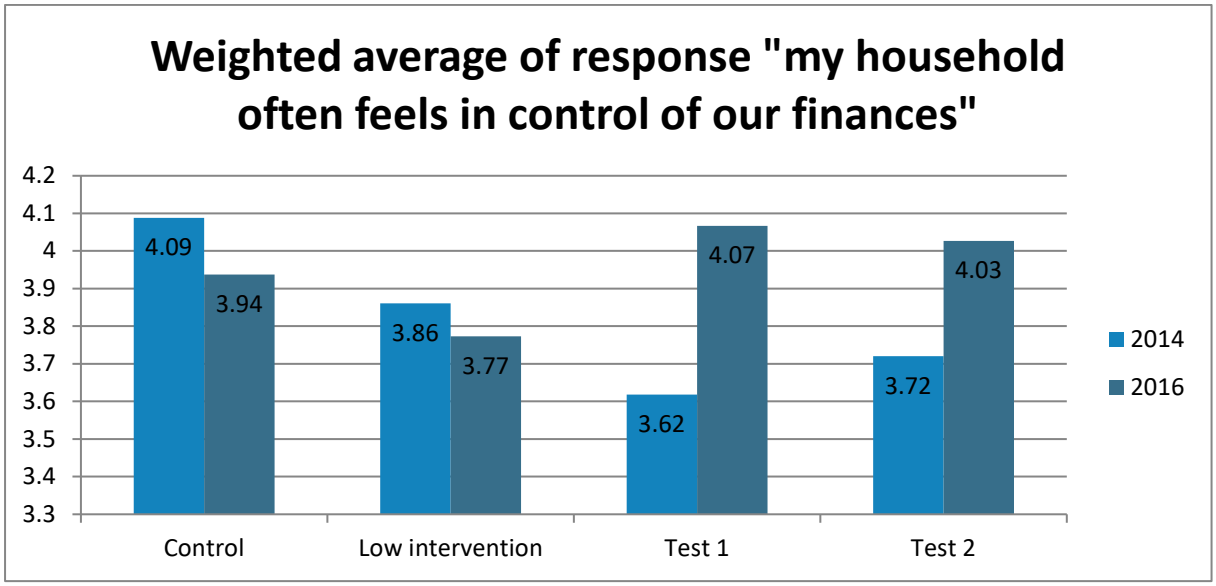


Figure 61 The weighted average in response to the question "My household often feels in control of our finances"

**Weighted average where 5 is maximum control and 1 is minimum.*

Despite the mixed impact of personalised feedback on electricity consumption, households who received personalised feedback had higher financial control overall than those who did not (Figure 61). The proportion of households that felt “in control of (their) energy use” was also higher in households who received personalised feedback (Figure 63), and were less likely to report that “energy efficiency is too much hassle” (Figure 62). Fewer attempts to enact SMS tips and decreased motivation in the test 1 group (relative to the low intervention group) collectively suggest that personalised feedback is counterproductive to reducing electricity consumption.

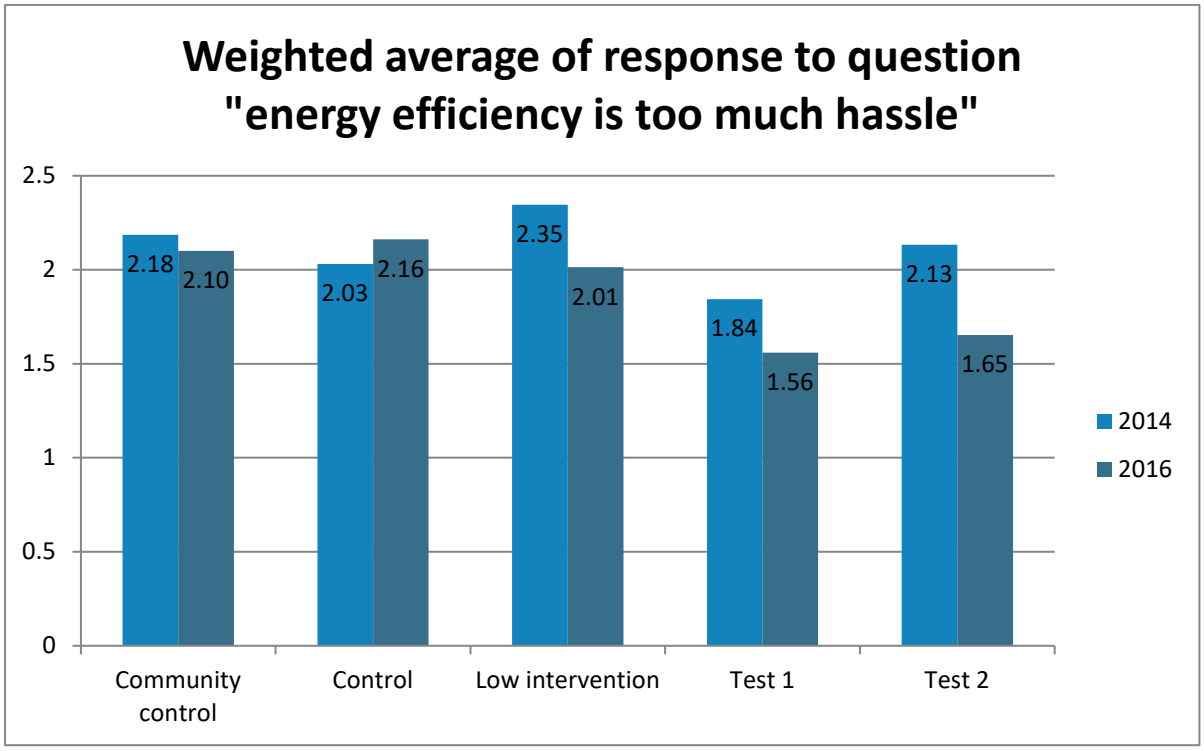


Figure 62 Weighted average of response to "energy efficiency is too much hassle"

**Weighted average where 5 is maximum hassle and 1 is minimum.*

Education

During the trial year the control group experienced a decrease in control of energy use, while all three of the trial groups increased their control. This may be an indication that the SMS tip campaign, which focused on energy efficiency education and behaviour change, might provide increased control over electricity bills. The smallest increase in control among the test groups was in the test 1 group, which indicates that the personalised feedback provided during Switched on Homes might not have been in a format that was useful or clear. The result of the control group may indicate that currently there is an increasing level of uncertainty in the community over electricity pricing and bills. This uncertainty may result in a loss of control which educational programs may address.

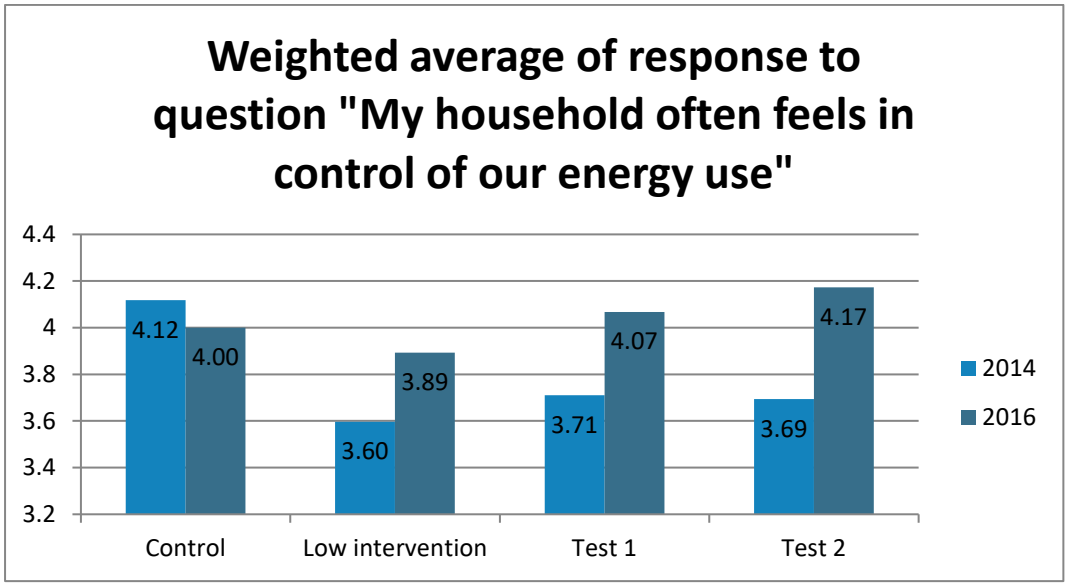


Figure 63 Weighted average of response to the statement "My household often feels in control of our energy use".

**Weighted average where 5 is maximum control and 1 is minimum.*

The proportion of respondents that did not know what else to do to become energy efficient was quite low (under 16% in 2014). In the control group this proportion stayed similar; however the test groups, particularly the low intervention and test 1 groups, decreased this barrier significantly, to fewer than 3% of total respondents. This suggests that the educational component of Switched on Homes was successful although households may not have enacted the tips. The test 2 group reported almost no change in knowledge during the trial, the reason for this discrepancy with other groups is unknown.

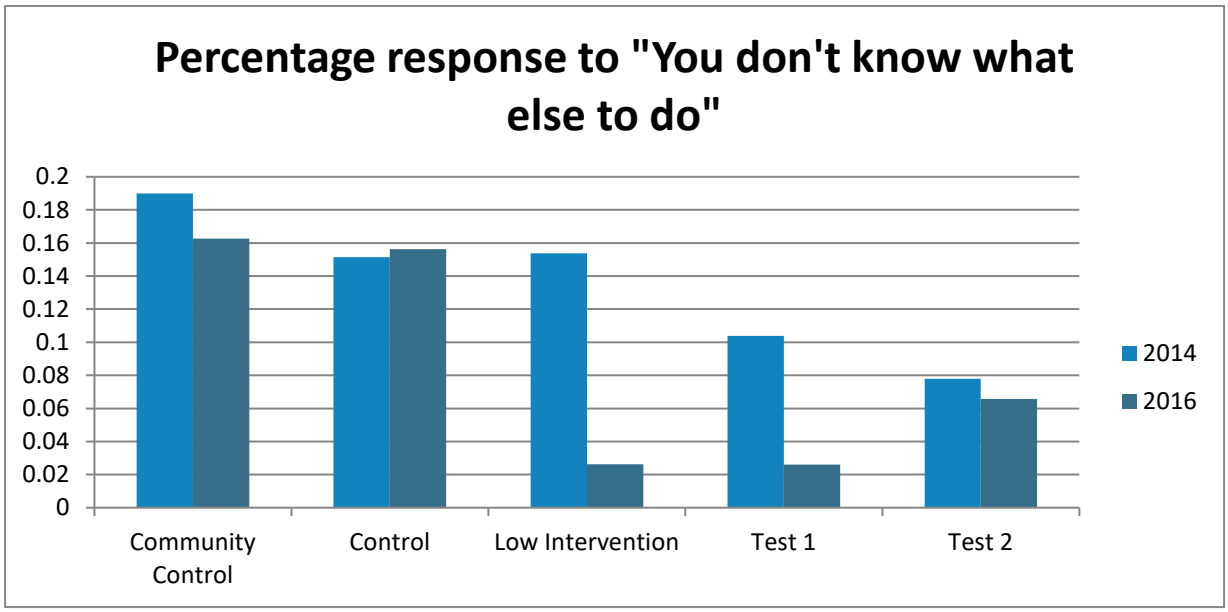


Figure 64 Proportion of respondents by test group that reported "don't know what else to do" in response to the question "Which of the following, if any, do you feel are barriers to you undertaking energy efficiency activities in your home?"

Another indication of education outcomes was the significant increase of households reporting they had no barrier to energy efficiency between 2014 and 2016. Marked changes were observed in all groups, including the control. However the proportional increase from the baseline was highest in the groups which received personalised feedback in conjunction with energy efficiency tips.

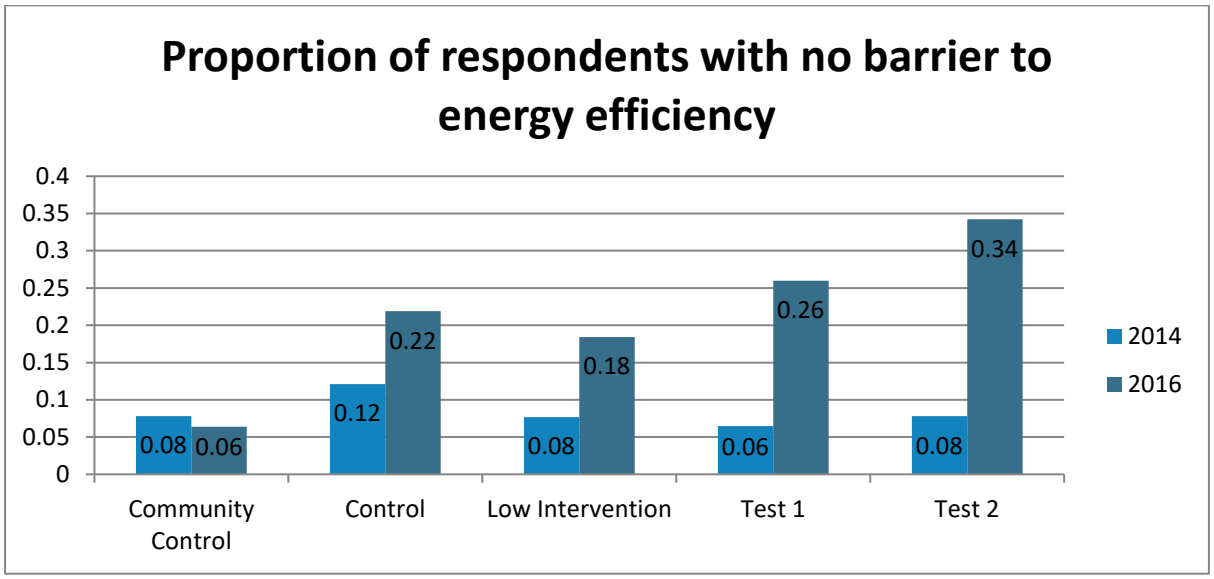


Figure 65 The proportion of respondents by test group that reported "none" in response to the question "Which of the following, if any, do you feel are barriers to you undertaking energy efficiency activities in your home".

Demographics

All households exhibited a high degree of control over their finances both prior to the trial and afterwards. While financial control was high in Switched on Homes test households, the cost of energy efficient appliances was considered to be a barrier to 20% of participants. This may be representative of the senior citizen population, the largest demographic in Switched on Homes that carefully monitor household finances and have a fixed income. In this respect, the financial control experienced by low income households engaged in Switched on Homes is not considered to be representative of the low income population in general. A community survey undertaken with the same attitudinal questions found that 48% of the community thought the cost of energy efficiency was too high, despite likely having more disposable income that the Switched on Homes demographic.

The largest barrier for all groups (excluding the community control) was the perception that they "already did everything". The frequency of reporting this barrier declined after Switched on Homes, particularly in response to personalised feedback. Additionally, households in the low intervention and test 1 groups less frequently reported that they "didn't know what else to do" at the end of the trial and this barrier was far less frequently reported than in the community control (2.6% of low intervention and test 1 households, as opposed to 16.3% of the community control). These responses indicate that Switched on Homes was successful as an educational campaign and further education around energy efficiency is required in the community.

The aim of Switched on Homes to recruit time poor households has not been realised, only four of 257 households stated time as a barrier to energy efficiency. A similar proportion considered time to be a barrier in 2016.

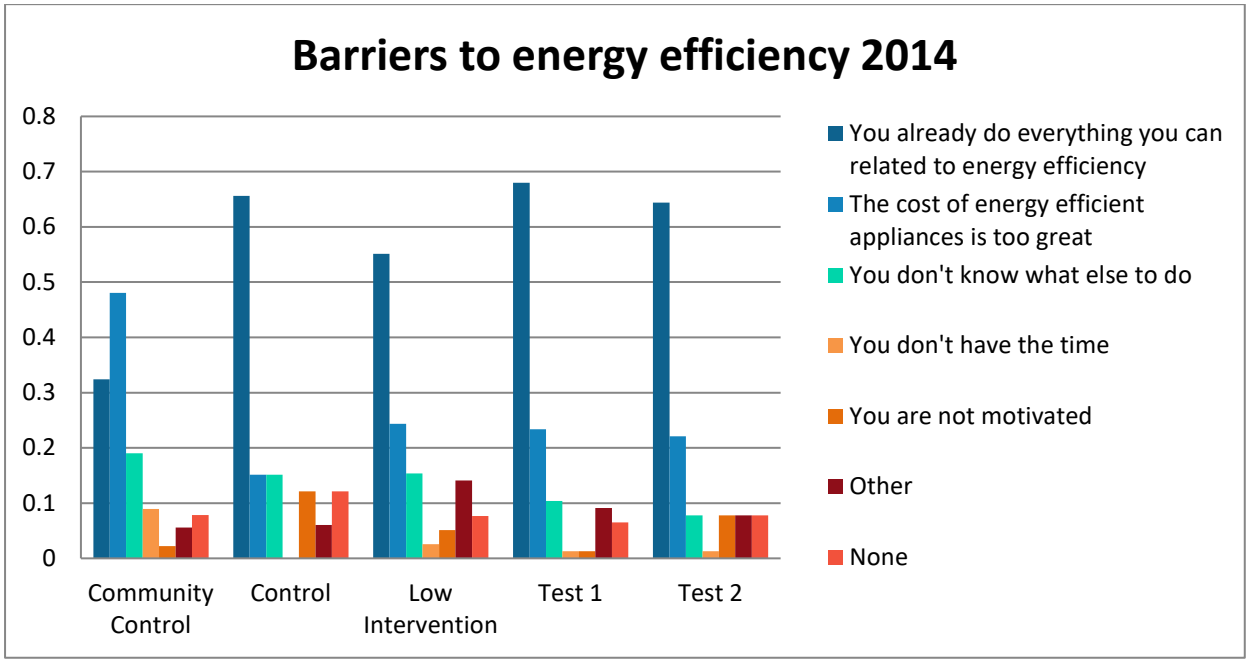


Figure 66 Responses to the 2014 question "Which of the following, if any, do you feel are barriers to you undertaking energy efficiency activities in your home?" (Multiple answers permitted)

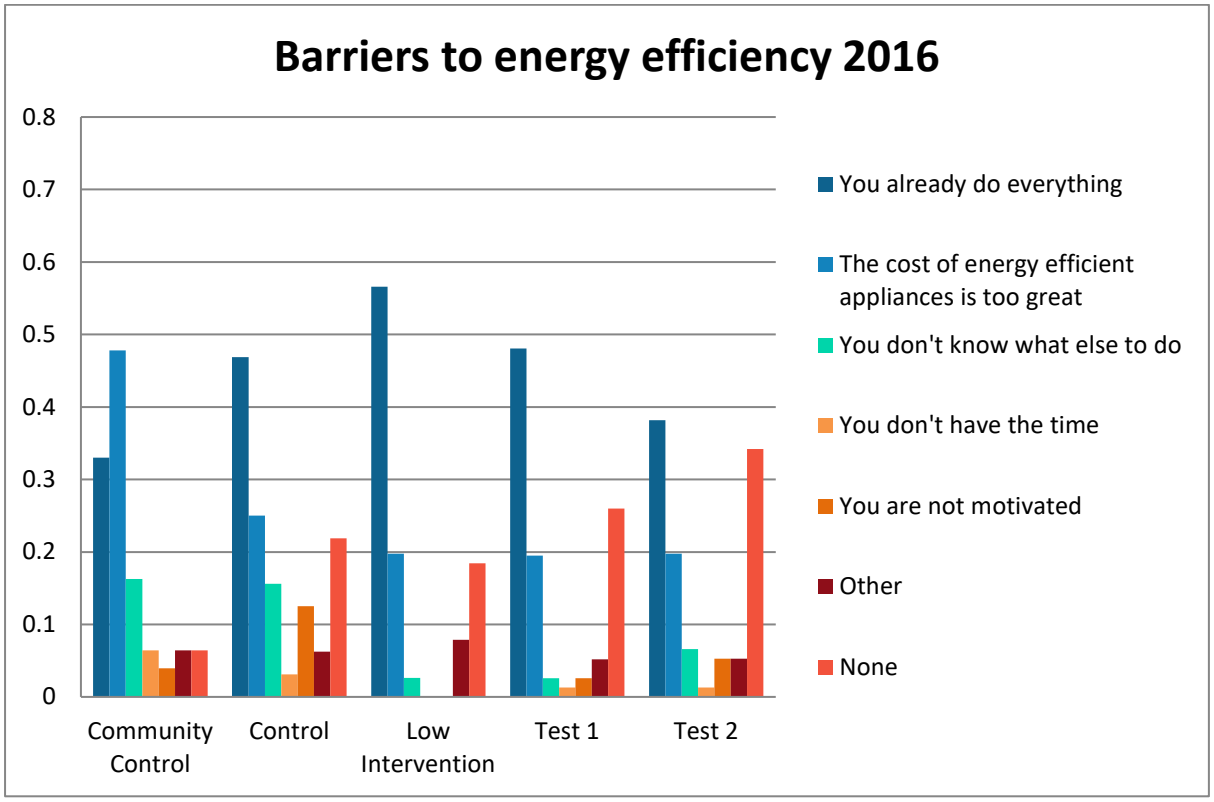


Figure 67 Responses to the 2016 question "Which of the following, if any, do you feel are barriers to you undertaking energy efficiency activities in your home?" (Multiple answers permitted)

The response to interest in energy efficiency suggests that the statistical assumption that there was no self-selection bias is incorrect. In all test groups, pre and post-trial, the proportion of households interested in energy efficiency was above 90%, which is unlikely to be true of the wider low income or total population. Participation in the trial was optional and this may have resulted in participants with a higher interest in energy efficiency than the population as a whole. A predisposition towards energy efficiency is particularly likely given that feedback suggested that receiving gift card incentives to participate was not highly motivating. Allocation to test and control groups was completed after the 2014 survey, reflected in a similar interest level being expressed in the control group as the test groups. While there is no way to adjust the trial data for this, a control from the community was sought through a community survey. This will likely include a wider demographic than Switched on Homes and the results to these questions are likely to show a greater difference than that observed between the Switched on Homes groups.

Comfort decreased in all households during the trial period. This is unlikely to be an actual reflection of the conditions during the trial but on the day they were asked. The 2014 survey was conducted in October, which is quite temperate. The 2016 survey was conducted in January, which is normally the hottest month of the year in Perth. The influence of seasonality on the response means that this result should not be considered comparable in 2014 and 2016. The reasonably high proportion of respondents that agreed their home was often too hot or cold to be comfortable, even in October, suggests poor thermal performance of housing stock and that increasing energy efficiency of heating and cooling appliances might be important in responding to the energy needs of Western Australians. The results of the post-2000 housing subset (Table 34) indicate that newer housing is performing more energy efficiently, particularly in summer, and the principals embodied in new builds should be extended as retrofits to established homes.

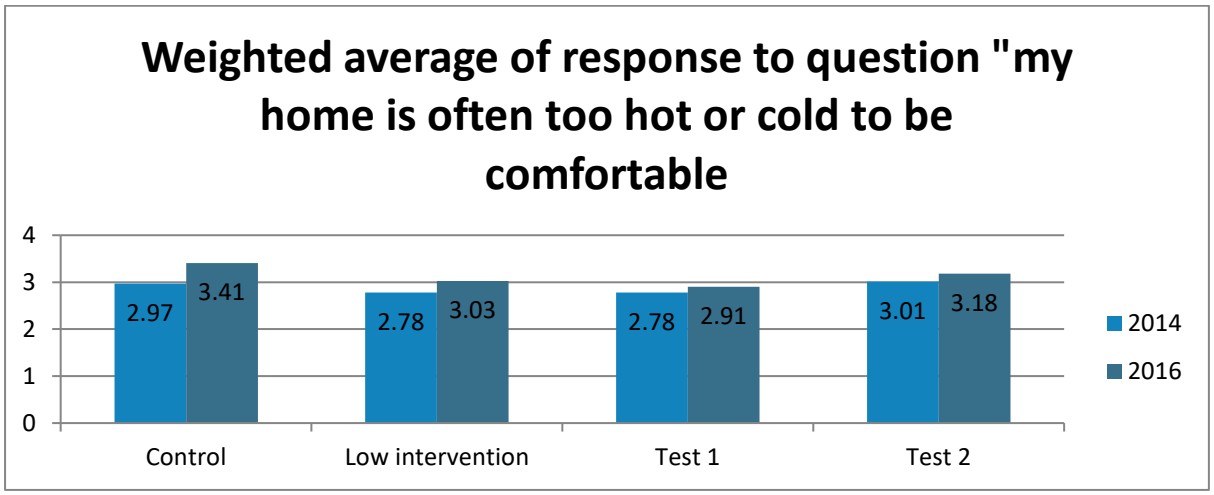


Figure 68 Weighted average of households response to the statement "the temperature at home is often too hot or cold to be comfortable".

**Weighted average where 5 is maximum comfort and 1 is minimum.*

Effects of seasonality and future climate

Comparison of baseline and trial years

During 2015 Perth experienced an extremely hot and dry year, including record warmth in June, September and October. The mean maximum temperature was the equal highest recorded at Perth Metro and monthly mean maximum temperatures were above average across most sites in most months. Future years are likely to bring similar weather conditions, including more hot weather and warmer, shorter winters. Annual mean minimum temperatures were also above average across Perth in 2015.

Comparing the baseline and trial years it appears 2015 was slightly hotter and drier than the preceding baseline year (Table 50), but on an annual level the change to maximum and minimum temperatures are minor and the control group decreased electricity demand by 1.5% during 2015 (Table 21). In this regard, 2015 being on average warmer for the whole year, may have contributed to the lower electricity demand in the shoulder seasons of (autumn and spring).

Key weather statistics

Table 50 Key weather statistics in Perth metro area

	Maximum temperature (°C)				Minimum temperature (°C)				Rainfall	
	Mean	Difference from average	Highest record	Hottest day	Mean	Difference from average	Coldest record	Coldest day	Rank	Fraction of annual average
Jandakot Aero 2015	25.4	+0.8	43.7	5 Jan	12.0	+0.6	-1.5	9 Jul	very low	79%
Jandakot Aero 2014	25.2	+0.7	43.2	11 Jan	12.1	+0.7	0.1	15 Jun	low	83%*

Adapted from http://www.bom.gov.au/climate/current/annual/wa/archive/2015.perth.shtml and http://www.bom.gov.au/climate/current/annual/wa/archive/2014.perth.shtml

Four weather factors were measured for correlation with electricity consumption, namely maximum temperature, minimum temperature, 9AM humidity and 3PM humidity. Of these factors only maximum temperature showed evidence of correlation, with electricity consumption increasing at both high and low maximum temperatures. At low maximum temperatures there was less variation in the response and a close fit to the trend line, indicating that future predictions of electricity consumption relating to low maximum temperature might be quite accurate. There was a much greater variation in the electricity requirements at higher maximum temperatures. This suggests that predictions of residential electricity demand at high maximum temperatures may be less accurate, and also highlights the difficulty in providing programs and policies to address this phenomenon, as the range of responses is already wide. As observed in the Switched on Homes peak load messages, there was increased responsiveness in summer to peak demand advice. This may be positive for

future programs addressing summer demand, although the electricity demand was variable, responsiveness was high (51.2% of households without solar-PV and 16.9% of households with solar-PV reduced electricity demand in the one hour following a peak-electricity demand message).

To more closely examine the role of maximum temperature on electricity consumption, days over 30, 35 and 40 degrees Celsius were analysed separately. It was not possible to establish a direct link between temperature and electricity consumption, and it appears that several factors are at play (Figure 30), particularly an increased demand for electricity the day after high maximum temperatures. The trend between maximum temperature and electricity consumption was particularly apparent on days over 35 degrees Celsius (Figure 35), when the demand for electricity increases rapidly (for example a 3 degree Celsius increase to maximum temperature on day three resulted in 57% increase in electricity demand) and that after several days of high temperature demand is higher than before . These changes can be attributed to a decrease tolerance for continued high temperatures or increased temperature inside the home after several hot days. Outside temperature on the day is likely the greatest factor in determining electricity consumption on days over 35 degrees. A high minimum temperature is normally observed overnight on successive hot days, however a strong correlation was not observed between high minimum temperature and electricity consumption (Figure 31).

Based on the observation of Switched on Homes, it appears that 35 degrees Celsius represents a threshold at which electricity demand increases, and after which day 2's electricity consumption is influenced by day 1's temperature. This was observed several times when tracking twenty consecutive days over 30 degrees Celsius (Figure 34), for example comparing electricity consumption on day 16 to day 18 or the electricity consumption on day 4 compared to day 6. Isolated days hotter than 35 degrees Celsius appear to have a greater impact on electricity consumption than prolonged periods of weather over 30 degrees Celsius. This may also explain the decline in control group electricity consumption in 2015, despite overall hotter temperatures (Table 50).

Interestingly, Switched on Homes participants increased their consumption in the first weeks of the trial (January and February) relative to their baseline, while the control group decreased. As the control group was in the same geographic region, weather was unlikely to be a factor, although built form is a possible link, and previous baseline electricity consumption is another likely factor. The baseline electricity consumption in the control group in January and February was 18.3 kWh/day and 18.2 kWh/day respectively, while for Switched on Homes households it was considerably lower (for example the test 1 group consumes around 80kWh/week, or 11.4kWh/day in weeks 1-10 of the baseline year in Figure 23).

Further evidence that the low baseline set in summer 2014 might not be maintained is the fact that although the low intervention and test 1 group were receiving the same intervention in the first three weeks of the trial (personalised feedback did not commence until the beginning of week 4), during this time the low intervention group declined relative to their baseline (Figure 22) while the test 1 group increased relative to their baseline (Figure 23). One key difference is that the low intervention group had a higher baseline (approximately 100kWh/week or 14.3kWh/day) during the baseline, whereas the test 1 group was starting at a lower baseline of 11.4kWh/day. This may indicate that in some low income households, such as those in the test 1 group, there is either no or very limited scope for further reductions in electricity demand from this demographic. It may be

realistic to assume that electricity demand in this section of the population will continue to grow in peak times as air-conditioners become more affordable or more established homes are purchased with air-conditioners installed.

Weather and new housing stock

Table 34 shows that new housing stock consistently outperformed old housing stock in electricity consumption. This highlights the importance of continued access to affordable new builds. Furthermore, choice of housing stock influences the ongoing welfare of low-income households. However, current policies fall short of mandating minimum standards for the sale of established homes and rental properties.

A systematic review of energy efficiency standards in existing housing stock would halt a growing divide between the energy performance of pre and post 2000 housing stock. This may prove to be particularly valuable in a warming climate. While Table 34 shows electricity demand is lowest in spring and autumn, at these times the gap in performance between new and old housing stock is widest. On average post-2000 built houses consumed over 35% less electricity than their pre-2000 counterparts during these seasons, highlighting the potential for electricity shift outside of winter and summer periods.

The gap in performance between pre and post-2000 built houses was smallest in winter months. This is likely in part due to the design of energy efficient homes focusing on the dominant summer weather pattern, rather than winter weather; however it fits into a wider framework of observations through Switched on Homes that showed households struggled to create meaningful electricity reductions in winter months. Even the test 2 group, who consistently saved electricity compared to their baseline and had technology installed which worked equally in summer and winter, did not decrease relative to their baseline in early summer and winter (Figure 24). This indicates that the peak demand for electricity could not be addressed long term through any of the interventions trialled by Switched on Homes, although short term gains following peak demand messages were observed. Future policy and pricing should take into account the difficulty low income households have in addressing electricity use at those times and look for novel approaches to limit peak demand.

A changing electricity market

The highly seasonal demand for electricity (Table 34) and the low daily demand due to solar-PV export (Figure 26) have almost certainly begun to erode the profitability of the electricity market. The exacerbation of existing trends (low day time consumption and unrelenting peak demand) means that reform in this industry is almost certain if profitability is to be maintained. Helping low income households adapt to these changes should occur when and if changes in pricing and tariffs occur with a tailored suite of programs and policies. The attitudinal and behavioural results of this trial show that low income households are not concerned about adapting to time of use tariffs, however the Switched on Homes program did not help them shift existing habits under the same tariff structure. The current status of increased electricity prices each 1 July and flat-rate tariff structure means programs focused on maintaining or “staying steady” through minor modifications are well placed to help residents adapt to slowly changing prices and weather demands. The local government consortium members of Switched on Homes will continue to help residents through the Switch your thinking program.

Treatment group performance across the seasons

A seasonal pattern in electricity consumption was observed in all three test groups, with summer and winter peak periods and autumn and spring shoulders evident. A sustained higher demand for electricity was evident from 1 January to March 15, then December 20 to the end of the calendar year. If monitoring continued, it is assumed that a peak would occur continuously from late December to mid-March. This amounts to an increase in electricity consumption commencing a few weeks after the start of summer and continuing a few weeks after the end of summer. A smaller peak is observed in weeks 26-34, 29 June to 30 August. This aligns closely with the last two months of winter.

During the first 10 weeks of the trial (summer 2015), the community control group reduced electricity demand considerably (decreasing by 4.9% in January and 4.1% in February 2015 compared to the same time in 2014). Conversely the low intervention and test 2 groups slightly increased their electricity consumption, while the test 1 group increased considerably. The small changes in annual electricity consumption (relative to the baseline) observed in the test 1 group during the trial year appears to have swamped meaningful reductions made by this group in spring and autumn. Increased electricity consumption relative to the baseline at the beginning of the trial is at odds with the expected observation of some decrease in electricity consumption when trial treatments commenced. For the first three weeks of the trial (weeks 0-3 inclusive) personalised feedback was not delivered, and therefore could not be responsible for a rebound effect. A possible explanation for this behaviour is that low income households have delayed purchasing or using air-conditioners in previous years, but have become more reliant on air-conditioning due to the hotter weather conditions experienced in 2015.

From the beginning of autumn onward (week 11, or March 16), there is a clear trend in declining electricity use across all three test groups compared to the baseline period. While the reduction in electricity consumption during this time has not been tested for significance, there is a noticeable variation in the length of time the reduction occurs, compared to the baseline year. The test 1 group maintains a reduced consumption compared to baseline until 11 May, in the low intervention and test 2 group this span stretches to the 15 June and 6 July respectively. While the decrease in electricity use at this time of year is almost certainly seasonal, it is interesting that different test groups were able to maintain reduced electricity consumption for varying lengths of time. A simple explanation is that the low intervention group are able to enact a small but ongoing change in autumn, but the test 1 group were able to realise greater change with their personalised feedback, but could not maintain their efforts. The shorter period of time that the test 1 group maintained a reduction, may provide support for the theory that this group is demotivated, but considering their high winter consumption in 2014 this group may have higher winter demands than the other groups.

Another seasonal decrease occurs in spring, but is only observed in the test 1 and test 2 groups, indicating that the low intervention approach may have lost effect by spring time. The spring recession in electricity consumption is shorter than the autumn recession, which may be caused by a shorter milder winter decreasing consumption in autumn but an earlier summer increasing consumption in spring. The weather summary (Table 50) shows 2015 was a hotter than average year, particularly in September and October and the community control group increased electricity consumption during those months (Table 21). In this context the reduction in electricity

consumption in the groups receiving personalised feedback (test 1 and test 2 groups) appears to be significant.

The consistent performance of the voltage optimisation unit, across seasons, is noticeable from week 10 onward. Voltage optimisation appears more effective in off-peak seasons and it did little to assist in managing peak demand. In both winter and summer peak, the test 2 group that received voltage optimisation, did not depart as greatly from the baseline as the other groups. This indicates that technology with appropriate payback period is a measured and reliable way to reduce electricity bills, but it falls short of addressing peak demand. The annual usage patterns indicate that none of the trial approaches were successful in shifting peak demand permanently.

Under the climatic conditions currently experienced in Perth, it is expected that extreme hot weather (weather conditions experienced during peak messages one and three) would occur more often. The results of peak message three indicate that Western Australians are able to defer some power use outside of this peak period. The results of peak message two (Table 26), the cold weather peak, indicates that there is less ability to shift the smaller winter peak than the summer peak.

Future climates

The impact of weather conditions on electricity consumption is clear in the annual summaries of each test group (Figure 22,Figure 23 and Figure 24). Electricity consumption has a clear summer peak and recession in autumn and spring. The unseasonably warm weather experienced in Perth in June 2015 likely decreased the winter demand for electricity and extended the autumn shoulder period. Conversely, record warmth in spring resulted in early use of air-conditioners and this peak is clearly observed in week 45 (9 November 2015). Decreases in winter severity and duration are unlikely to offset the increased electricity demands of a longer, warmer spring or hotter summer. This is evidenced by the electricity consumption pattern of the low intervention group that decreased electricity consumption relative to the baseline in autumn (Figure 22), but overall increased their electricity consumption by 1% (Table 18).

Overall the test 2 group decreased electricity consumption in 2015 compared to 2014. However, for most weeks in summer the test 2 group did not decrease electricity consumption relative to the baseline. This does not indicate that the voltage optimisation unit was not working in summer, but that growth in demand exceeded the electricity reductions provided by voltage optimisation. This observation does not invalidate the annual results or cost effectiveness but it does highlight that the approaches trialled in Switched on Homes, including voltage optimisation, would not be sufficient to help households manage their electricity bills when faced with hot weather. Without a targeted and cohesive policy and program approach, periods of peak demand in summer will continue to dominate electricity pricing and demand. While “summer-readiness” may be important, launching Switched on Homes in summer was not an effective tactic. Using this knowledge for future programs, a more strategic approach might capitalise on natural recessions in electricity consumption (autumn and spring) to start building capacity for electricity reductions or desirable behaviours for the summer.

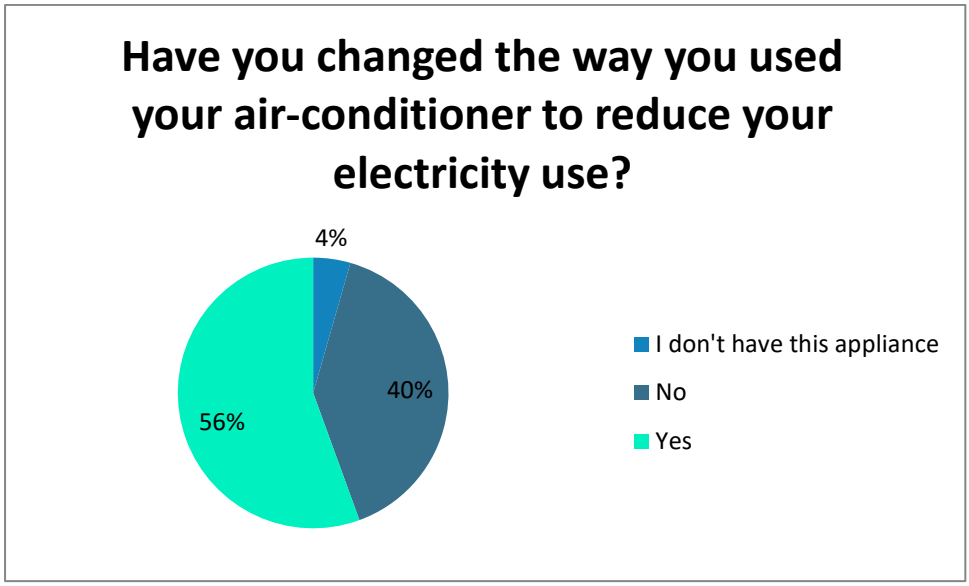


Figure 69 2016 Survey responses to the questions "When you received Energysmart tips via SMS did you change the way you used the following items (air conditioner) in an effort to reduce your electricity use? (N= 225)

During the summer period, electricity consumption increased up to 100% compared to the shoulder periods. The "peaky" nature of electricity consumption over summer is caused by the use of air-conditioners. The pre-trial survey revealed that 96% of participants own an air-conditioner (Figure 49) and this trend is unlikely to change. Results of the Switched on Homes survey showed that participants were very willing to receive tips about operating their air conditioners effectively. Future programs should build on this and focus on empowering Western Australian households to use air conditioners with more discretion and efficiency.

Communications

Outside of the trial approaches, major communications undertaken by Switched on Homes can be classified as pre-trial or post-trial. During the trial, communications were minimised to avoid interfering with trial participants and outcomes. Pre-trial communications focused on driving recruitment. Post-trial communications focus on promoting results and outcomes.

Pre-trial communications

Pre-trial communications were produced to drive recruitment. Recruitment for the trial was slower than anticipated and numerous reviews were undertaken during recruitment to assess the efficacy of approaches and messages. The lessons learned from recruitment are contained in Table 51.

Communication channels for recruitment included:

- Media releases
- Advertisements in local newspapers
- Tidy bin outdoor advertising and
- Online campaign through *Switch your thinking*
- Flyer drops to households and
- Addressed mail out to households.

A review of communication channels is contained in Methodology: Recruitment, Retention and Losses.

All three test groups were exposed to the same communication messages and channels in the pre-trial communication. Randomised assignment of households was undertaken after the trial was fully subscribed and the pre-trial survey was complete.

Table 51 Lessons learned through Switched on Homes recruitment

Benefit or barrier	Lesson learned
BENEFIT: External organisations are willing to promote programs but due to privacy concerns are not able to refer households	Recruiting five agencies to refer participants to Switched on Homes did not result in meaningful referrals. Asking charitable organisations and low income service providers to put up posters or to have flyers available was well received and resulted in more interest than a formal referral through an agency.
BARRIER: Reliance on self-reporting undermines experimental integrity	Understand what is being asked of households. A high proportion of households did not know whether their household was connected to three phase power. Over 40 households incorrectly identified their connection type and registered for the trial.
BENEFIT: Understand what motivates your audience	The community, in particular senior citizens, participated for altruistic reasons. Many households perceived that they did not need help but wanted to be part of a trial to help more

	disadvantaged community members. For this reason, gift card incentives for signing up were not self reported to be highly motivating.
BARRIER: Lengthy administrative delays weaken support	The privacy statements were produced during a protracted period of consultation. This led to a delay of up to six months between households expressing interest and receiving paperwork to register. Many households became disengaged between registering and receiving paperwork.
BENEFIT: Direct mail outs work	Mail addressed to the individual resulted in more recruitment than unaddressed mail ("To the resident"). In particular, the pensioner population felt obliged to reply to letters with a phone call, providing another interaction for recruitment. Switched on Homes was fully subscribed when the local governments involved undertook a direct mail out to their residents. Future projects would benefit from partnering with an entity with a pre-existing relationship with the client (e.g. local government, utility provider). Flyer drops are not effective. A letter enclosed in an envelope leads to more enquiries than a flyer in the mailbox.
BENEFIT: Recruit from a pre-existing group	Recruitment from two lifestyle villages accounted for 10% of all registrations. Individuals in these villages may have referred friends or neighbours that live in the village. A normalisation of the behaviour may have occurred in these sites resulting in more enrolments.
BARRIER: Media coverage	Media releases for the trial did not capture the interest of publishers and when they did, resulted in few enrolments. Similar trials should assess the impact that a media release has on recruitment before committing time to producing multiple releases.
BENEFIT: Communicate the benefits of a scientific trial	Households responded positively to volunteering for a trial, rather than for personal gain. The commitment to the scientific integrity of a trial may have contributed to a 97% retention rate during the trial year.

Post trial communications

Switched on Homes has been the flagship program of a broader sustainability education initiative – Switch your thinking. The legacy of Switched on Homes and how the program could continue to benefit residents of South East Perth has been a central theme throughout program activities.

Table 52 describes the ways Switched on Homes plans to share the trial outcomes with the community at the conclusion of the program and after the final report submission and data analysis.

Table 52 Intended post-trial communications activities

Target audience: Audience	**Key messages: Key message**	**Communication methods:**
Local governments, Energy efficiency providers, behaviour change programs, Western Australia Council of Social Services (and similar organisations), University students	• Trial methodology and results so they can learn from the Switched on Homes experience and further the research and discussion. • Key findings and recommendations	ScienceNetwork WA (media release)
		Local media (media release)
		Final report (Executive summary publicly available)
		Host a meeting of the Sustainability Officer's Networking Group
		Presentation at Energy Summer School
Partner Councils, Councillors, Management and Executive teams	• Value derived from trial for residents (results and qualitative feedback)	Final report (Executive summary publicly available)
		Councillor workshop
		Local media
Participants	• Key findings and results • Individual performance	Personalised participant report
		Final report
		Information session at residential group site
		Morning tea event
General public	• Local Governments are supporting research into energy efficiency	Local media

	• Behaviour change is a factor in home energy efficiency	Final report (Executive summary publicly available)

Media activity
Switched on Homes will distribute targeted media releases to two main audiences:

- Scientific and academic community through ScienceNetwork WA (an online science news site) and
- General public through local print, radio and television news

The first media release will focus on trial methodology, aims and outcomes, allowing the scientific and academic community to critically evaluate and learn from Switched on Homes.

The second media release will focus on the experience of the participants and program pathways that readers can pursue to increase their own energy efficiency as well as reporting on trial outcomes.

Executive summary
An executive summary of the Switched on Homes program, methodology, results and outcomes will be publicly available at switchyourthinking.com. This will give context to the participant's contribution and make the findings publicly accessible. Audiences wishing to find out more about the program can use the website to contact the Switched on Homes team.

Personalised participant report
Each Switched on Homes participant will receive a personalised report detailing their performance throughout the trial and providing them with ways to continue in their energy efficiency efforts (for example, personalised tips and an invitation to continue to receive energy efficiency tips via SMS).

Morning tea event
All participants, consortium members and program supporters will be invited to a morning tea event. Participants will have the opportunity to discuss their experiences through the trial with each other and will be warmly thanked for their contribution to the trial. The Switched on Homes team will share details and outcomes of the trial to give context to the broader program that the participants have been involved in.

Program pathway – Energy efficiency SMS
Participants will be invited to continue to receive energy efficiency SMS on a monthly basis through the Switch your thinking program. The SMS have proved extremely popular through the trial and it is a service that can be delivered to the community in a simple and cost effective way.

Switch your thinking enews
Similarly to the energy efficiency SMS, participants have been invited to subscribe to the Switch your thinking e-news. This provides an avenue for participants to continue to be involved in the local sustainability community with updates on local events and up-to-date energy efficiency information delivered to their email once a month.

Continuing energy efficiency education

Switch your thinking will continue to provide a suite of free energy efficiency education opportunities to both trial participants and the wider community. Examples of education activities include:

- DIY Home Energy Audit Kits available for loan at libraries
- free energy efficiency workshops,
- seasonal energy efficiency reminders delivered via Council newsletter
- advertising
- social media

Switched on Homes top tips booklet

Switched on Homes is producing a booklet of the energy efficiency tips provided to trial participants. This booklet has been produced as a physical reminder to trial participants and will also be provided to the control group who has not previously received the information. The Top Tips booklet will also be made available to the public on switchyourthinking.com and at Switch your thinking events and Council facilities.

Project performance

SMS

The SMSGlobal delivery platform was used to deliver SMS. The SMS delivery system required refinement which was undertaken as a trial and error approach. During the first 8 weeks of Switched on Homes there were interruptions to message delivery, mostly to customers of a single telecommunications network (approximately 12% of Switched on Homes participants). These problems were resolved by a series of manual repairs by the SMS delivery software company.

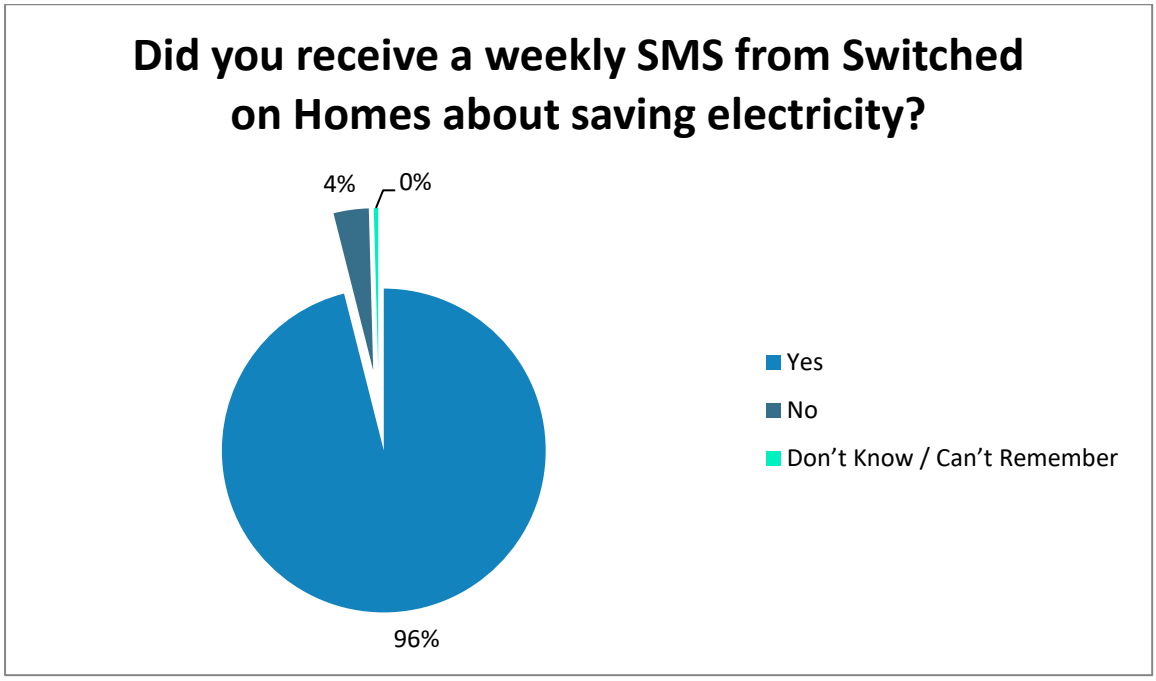


Figure 70 Response to the 2016 survey question "Throughout 2015 did you receive a weekly SMS from Switched on Homes about saving electricity?" (n=228)

Reporting software was limited to showing if a message had been sent, delivered or undelivered. This classification is from the software perspective and does not extend to network delivery issues. This resulted in difficulty identifying households that had not received messages due to their network. Switched on Homes asked households to self-report if they stopped receiving SMS messages, however there was no way to track unreported failure throughout the trial. During the post trial survey this information was captured and 97% of participants reported receiving SMS weekly during the trial. The replies of five participants who did not receive weekly SMS are recorded in Table 53.

Table 53 Responses of five participants who did not receive weekly SMS to the question "How often did you receive the SMS?"

Type of feedback	Number of respondents
Weekly since February	1
Not at all	1
Don't know / can't remember	2
About once a fortnight	1

The one household that did not receive SMS at all was reviewed and determined to be an issue relating to the user and not the technology.

Data loggers

Switched on Homes fitted Millennium Electronics 100A Energy Monitor, marketed as intelligy Power Monitoring Device and intelligy GPRS module, as data loggers. The data loggers had a specificity of +/- 5% and appear to have a lower sensitivity of 100 watts.

Most households had periods of missing data, when the data logger had transmitted a reading of 0.0 watts, but the house had likely been consuming electricity. These periods of missing data occurred at almost all sites and are attributed to data consumption during the time being small and the sensitivity and the accuracy of the equipment not being great enough to generate a reading.

Most of the issues encountered with the data loggers were in establishing a connection for transmission. When the strength of the signal was insufficient, data could not be transmitted to the information management system. Transmission would be attempted three times, before the data logger stopped transmission.

Failure to transmit data reliably was the major issue encountered with the data loggers. Aerials were retrofitted to improve transmission at 35 sites (15% of total) in the first 8 weeks of the trial. As the trial progressed the rate of failure decreased but another 10 households required retrofitted aerials. This problem was widespread enough that future programs should consider fitting aerials as standard and undertake in-situ field testing.

There was a clear pattern to the data transmission issue, 52.5% households fitted with a voltage optimisation unit required retrofitted hardware whereas only 1.9% of households fitted with a data logger required retrofitted hardware. No geographic pattern in the distribution of households requiring retrofits was recorded.

Table 54 Completeness of half hourly electricity consumption data as a proportion of total test group participants

	Completeness of data						
	100%	99%	98%	97%	96%	95%	< 95%
Low intervention	0.90	0.92	0.95	0.95	0.95	0.97	0.03
Test 1	0.95	0.96	0.97	0.97	0.97	0.97	0.03
Test 2	0.68	0.82	0.91	0.95	0.95	0.96	0.04

The percentage of intact data (recovered from households either through data transmission or manual retrieval) should be the same for households in the low intervention and test 1 groups (both fitted with only data loggers) but may be different in the test 2 group (fitted with data loggers and voltage optimisation units) if the data loggers interact with the voltage optimisation units. Table 54 shows that there was a small interaction between the data logger and voltage optimisation unit however the proportion of households with over 97% of their data intact was similar for all test

groups. Failure to transmit data did not impact the operation of the voltage optimisation unit. Most of the data was retrieved by manually visiting sites to download the data.

During the trial two data loggers malfunctioned and required replacement.

Information management system

The information management system required a testing period of approximately 6 weeks. This was scheduled to be undertaken prior to the trial starting however due to delays installing hardware, this was not possible and testing was undertaken at the start of the trial period.

Problems encountered during the testing period included:

- No personalised feedback available (insufficient baseline data to generate personalised feedback)
- Errors in calculations of personalised feedback (solar households only)
- Inability to deliver personalised feedback.

VOU

Switched on Homes installed voltage optimisation unit (single phase), manufactured by Power Intelligence.

During the trial only one VOU required servicing due to an electricity surge which exceeded the strength of the circuit breaker and broke the component.

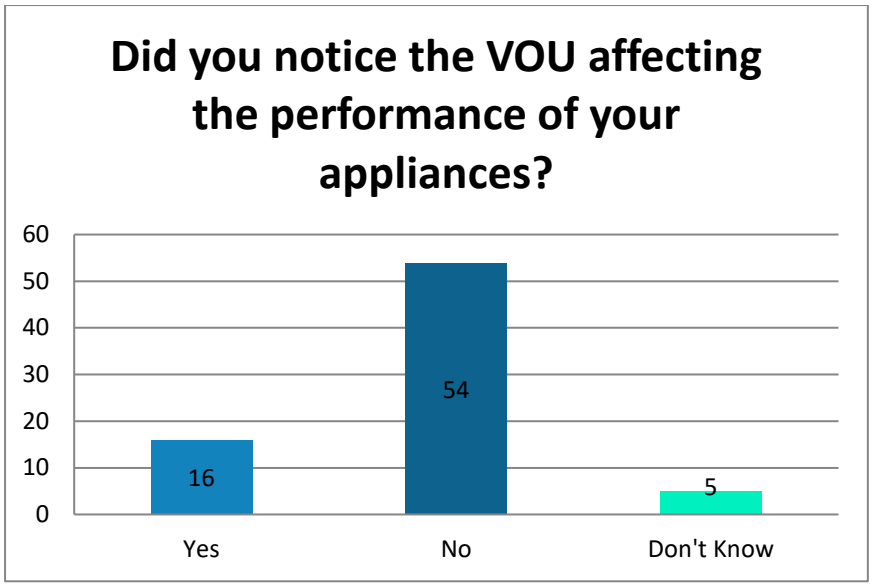


Figure 71 Participant responses to the question: Did you notice the VOU affecting the performance of your appliances? (n=75)

The 2016 post-trial survey indicated that households were happy with the performance of their VOU and 73% did not notice its operational effect on their appliances. The effects noticed on appliances were mixed, suggesting that deployment of voltage optimisation units should be undertaken on a case by case basis dependent on the appliances used in the household. Feedback on the effect of voltage optimisation units is summarised in Table 55.

Table 55 Feedback provided on the noticeable effects of voltage optimisation

Type of feedback	Number of respondents
Lights flickered or dimmed	3
Response contradictory / unclear	3
TV started on standby	1
VOU increased lifespan or efficacy of appliances	4
VOU reduced power supply to appliances	4

Budget

Switched on Homes received $800,000 funding from the Department of Industry, Innovation and Science and $20,000 funding from consortium members (excluding in-kind contributions). The project is on track to be delivered under budget. The project budget has been forecast to end in June 2016, as of 30/04/2016. The draft budget forecasts that 2.1%, of the total project budget will remain unspent, however marketing and financial auditing remains.

Table 56 Switched on Homes funds as of 30/04/2016

Expenditure Item	LIEEP funding allocated	Other contributions (cash)	Total funds expended to date	Status
Salaries for project staff*	$413,924		$404,167	Active
Purchase voltage optimisation units	$120,000		$120,000	Inactive
SMS deployment software and IMS	$73,000		$71,570	Inactive
Purchase and install data loggers	$48,000		$48,000	Inactive
Surveys	$39,826		$23,346	Inactive
Participant incentives	$38,000		$36,960	Inactive
3G connections and data packages	$36,000		$27,390	Inactive
Equipment and overheads	$10,000		$2,024	Inactive
Data analysis	$9,750		$23,500	Inactive
Independent financial audits	$4,500		$1,700	Active
Launch of program	$3,000		$2,447	Inactive
Marketing and promotion		$15,000	$15,781	Active
Replacement and repair of		$5,000	$21,914	Active

hardware				
Travel costs	$2,296			
Total	$798,296.00	$20,000.00	$798,799.00	

*Salaries for project staff are forecast for the period 30 April - 30 June 2016

The largest expense items were the staff salaries followed by the voltage optimisation units. Significant budget items, voltage optimisation units and data loggers, were delivered in budget because a consortium member provided the hardware. The chosen data loggers for Switched on Homes were discontinued and an equivalent cost solution was not readily available. Consortium member, Power Intelligence, undertook significant additional work to source and provide data loggers within the allocated budget. Without this consortium relationship, the budget for data loggers provided would not have been sufficient. Future projects should learn from this by seeking multiple quotes for major budget items before submitting the budget and not relying on single product availability.

Major works undertaken outside the budget include paying for removal of hardware and repair of drill holes left by removal. Amounting to $21,069, this work is equivalent to 2.7% of the total project funding (excluding in-kind contributions). When the original, battery powered, model of data loggers was discontinued, a mains powered model was sourced. This created an ongoing cost for the participants, as well as ongoing risk for the consortium if they failed or caused damage to property. It was determined that the data loggers must be removed, as enduring consent had not been obtained. No allocated funds were provided to undertake this work as the model originally sourced would not have required enduring consent. Funds to undertake this work have been costed to the replacement and repair of hardware budget.

Compensation for minor damage to property had also not been considered when the budget was created. Claims against the project for minor damage to property arising from electrical work (damage to a microwave, damage to a refrigerator and failure to reconnect solar-PV) were received. Although limited liability was established, the sums claimed (totalling $845) were too small to engage legal representation to dismiss the claims and too small to be claimed under insurance. Claims were settled by the City of Gosnells on behalf of the consortium and costed to the replacement and repair of hardware budget.

Underspent funds were dedicated to the statistics budget, to undertake the most robust and considered analysis possible. The initial funds allocated to statistical analysis were insufficient to meet the program objectives.

The funding application did not include funds for administrative costs, costs associated with staff recruitment and sundries. These items have been costed to the project where appropriate and assigned to the most relevant expense category.

The Switched on Homes project returned funding for the intended activity “publish an academic report”. Due to conflicting time frames this activity could not be completed. The budget has been adjusted to utilise $2,296 of the associated funds on eligible travel. The overall funding amount has therefore been reduced from $800,000 to $798,296.

Table 57 Consortium contribution by activity type, activity at 30/04/2016

Activity	Contribution	Contribution Amount	Consortium member	Status
Salaries for project staff	In-kind	$51,391	City of Gosnells	Inactive
Marketing and promotion	Cash	$10,021	Stockland	Inactive
Marketing and promotion	Cash	$5,316	City of Gosnells	Inactive
Marketing and promotion	In-kind	$10,000	Stockland	Active
Equipment and Overheads	In-kind	$82,688	City of Gosnells	Active
Installation of voltage optimisation units	In-kind	$13,284	Power Intelligence	Inactive
Data analysis	In-kind	$5,250	Power Intelligence	Active
Collecting building records	In-kind	$14,220	City of Armadale	Inactive
Collecting building records	In-kind	$2,091	Shire of Serpentine Jarrahdale	Inactive
Collecting building records	In-kind	$12,444	City of Gosnells	Inactive
Participant recruitment and communications	In-kind	$1,353	Anglicare WA	Inactive
Participant communications	In-kind	$1,350	Environment House	Inactive
Replacement and repair of hardware	Cash	$5,000	City of Gosnells	Inactive
Hardware maintenance	In-kind	$5,000	Power Intelligence	Inactive

Table 58 Total consortium contributions received at 30/04/2016

Consortium Member	Cash or in-kind	To date	Expected	Status
City of Gosnells	Cash	$10,316	$10,000	Inactive
City of Gosnells	In-kind	$146,523	$114,180	Active
City of Armadale	In-kind	$14,220	$11,880	Inactive
Shire of Serpentine-Jarrahdale	In-kind	$2,091	$11,880	Inactive
Power Intelligence	In-kind	$23,534	$35,000	Active

Stockland	In-kind	$10,000	$10,000	Active
Stockland	Cash	$10,021	$10,000	Inactive
Anglicare WA	In-kind	$1,353	$1350	Inactive
Environment House	In-kind	$1,350	$1,350	Active
Total		$219,408	$205,640	

Consortium contributions were received in full by the end of the project for all consortium members, except for the Shire of Serpentine Jarrahdale. The Shire of Serpentine Jarrahdale's in kind contribution retrieving building records was calculated on receiving 80 enrolments from this LGA, when only 12 were realised. Recruitment numbers were an unrealistic expectation due to the smaller population of the Shire compared to other local governments on the consortium. The City of Armadale and City of Gosnells in-kind contributions retrieving building records increased in response to a larger proportion of enrolments in these local governments.

Table 59 Funding from the Department of Industry, Innovation and Science

Date	Amount	Phase of project
July 2013	$100,000	Pre-activity
October 2013	$100,000	Pre-activity
July 2014	$198,000	Activities
July 2015	$198,000	Activities
March 2016	$124,000	Post-activities
May 2016	$80,000	Post-activities

Funding was tied to reporting events and staggered as shown in Table 59. The provision of $200,000 of funding in the first six months of the trial was important as it provided funds to create salaries for project staff. Due to the lengthy period required to finalise privacy documents and commence trial activities, having access to only 25% of funds pre-activity was sufficient for Switched on Homes. After this, funds were delivered annually in 25% instalments. The allocated funds were insufficient to pay for salaries and work during this time and the City of Gosnells had to extend funds to the trial with the assurance that grant funding would be received later. Finally, receiving 25% of funds after completion of trial activities recouped this money for the City of Gosnells. While this funding model places the funding body in a lower risk position, it places the consortium in a position of higher risk. The Switched on Homes consortium was fortunate that the City of Gosnells is a large enough organisation to be able to extend funds; smaller organisations would be unfairly impacted by this model.

Cost analysis

Cost benefit and cost effectiveness analysis were undertaken to determine the most cost effective and energy effective trial approaches. The following approaches and assumptions were applied to both cost analysis:

- 99.3% of funds included in the budget (Table 56) are included in the cost level analysis (Table 62)
- All trial costs (including in-kind contributions) are assigned to one of the four levels
- In-kind contributions are treated as actual costs
- The effective measure of cost benefit is the amount of money saved during the trial year compared to the baseline year for each group
- The effective measure of electricity consumption is the amount of kWh saved per household during the trial year compared to the baseline year for each group
- Level 2 (the cost of maintaining and recruiting a participant) is equal for all test groups due to the random assignment of households to trial approaches after enrolment
- Level 3 (the cost of running an organisation) is equal for the three trial approaches
- Level 4 (the cost of being involved in a trial) consists of the costs listed in Table 60
- Future programs will not undertake stringent and formal evaluation of efficacy; therefore it is appropriate to assign associated costs to level 4
- For the purposes of informing future programs the costs of levels 2 - 4 are not considered because they are fixed for any approach
- Participants who withdrew part way through the trial are considered to have an equal portion of level 2 - 4 costs and savings associated with them.

Table 60 Level 4 activities for cost and efficacy analysis

Level 4 costs
Establishing and maintaining a control group
Reporting and maintaining relationships with funding body
Collecting data for the CSIRO analysis
Evaluation of the program
Gathering and storing data required for statistical analysis
Fitting data loggers to low intervention households, which was required for comparison to other trial approaches but not delivery of SMS approach itself
Undertaking a rigorous statistical analysis

Trial approaches

Trial approaches were identified as activities differentiating the test groups, as detailed in Table 61.

Table 61 Switched on Home trial approaches

Approach	Test group	Number of households included in analysis
SMS tips	Low intervention, test 1 and test 2	240
Personalised feedback	Test 1 and test 2	160
Voltage optimisation	Test 2	80

Units of measurement

- Cost-effectiveness analysis to be calculated in kWh saved during the trial year (2015) compared to the baseline year 2014
- Cost benefit analysis kWh converted into electricity saved in $ over the trial year (2015)
- Both cost effectiveness and cost benefit will be calculated as average savings per household during the trial year

Total cost per household of trial approach

Table 62 Total cost of trial approach, including LIEEP funding and in-kind contributions.

	Number of households included in analysis	Cost of approach per household (level 1)	Cost of recruiting and retention per household (level 2)	Cost of running an organisation per household (level 3)	Cost of participating in government trial per household (level 4)	Total cost of delivering approach through SoHo per household (sum levels 1-4)
SMS tips	240	$65.68	$480.28	$826.71	$1,603.97	$2,976.64
Personalised feedback	160	$813.24	$480.28	$826.71	$1,603.97	$3,724.20
Voltage optimisation	80	$1,870.27	$480.28	$826.71	$1,603.97	$4,781.23

Please note that the sum of total costs of delivering trial approach exceed the total amount expended in the budget. This occurs as level 2, 3 and 4 costs are incurred only once per household, but are counted per treatment in the Table 62 for a comparative analysis.

Cost effectiveness analysis

Table 63 Cost per saving kWh for test groups, including LIEEP funding and in-kind contributions.

	kWh saved per household	Level 1	Level 2	Level 3	Level 4	Total ($/kWh)
SMS tips*	92.86	$0.71	$5.17	$8.90	$17.27	$32.06

Personalised feedback	0	$813.24	$480.28	$826.71	$1,603.97	$3,724.20
Voltage optimisation	314.56	$5.95	$1.53	$2.63	$5.10	$15.20

*Please note change in median consumption was used to calculate the SMS tips cost benefit.

The cost effectiveness analysis undertaken compared average annual electricity use per group in 2014 to 2015. The results are based on the data presented in Table 18 Key statistics of annual electricity use per group in 2014 and 2015. The change in average electricity use was determined to be the most appropriate measure for a cost analysis. The results indicate that the only trial approach to result in reduced average electricity consumption is voltage optimisation, which cost $5.95 for each kWh electricity saved. The total cost of voltage optimisation (which includes recruiting a participant and being part of a trial) was $15.20. The low intervention (SMS education group) and test 1 group (personalised feedback) increased average electricity consumption marginally in the trial year and thus were excluded from analysis. The low intervention group did exhibit a decrease in median electricity consumption, and based on this result cost analysis was undertaken in Table 63. SMS messages cost $0.71/kWh to administer, however when administrative costs were added the cost increased to $32.06/kWh. As a mean result was used for the voltage optimisation and a median was used for the SMS tips it is not possible to compare the cost effectiveness of these interventions to each other.

As the analysis was based only over the trial period (a single calendar year) it is expected that the cost effectiveness ratio of the voltage optimisation would be more favourable to trial approaches in a multi-year analysis. This is due to the ongoing electricity reductions from operating the voltage optimisation unit, which has a multi-year lifespan and operation period. Households in behaviour change programs are expected to maintain or reduce their electricity reductions after the program ends, as the effects of behaviour change may weaken over time. Thus, in the long run, the voltage optimisation unit is likely to increase in efficacy while the other approaches are unlikely to realise increases in electricity use outside the trial year. A payback period for the voltage optimisation unit is discussed in the cost benefit analysis.

There are two short comings in the analysis which cannot be addressed by the Switched on Homes trial.

1. There is no suitable control. The community control (Table 21) indicates that households in the trial area decreased electricity consumption by 1.5% in trial year. However, due to the much higher average use of the community control (14.64kWh/day) compared to Switched on Homes participants (10.41kWh/day) it is not suitable to undertake a comparison based on kWh saved.
2. There is no way to separate the effects of the interactions in the different test groups. Specifically this means that in the test 2 group (for example) there is no way to separate the savings generated from personalised feedback from voltage optimisation or the SMS tip. Further statistical analysis is required to address these short comings.

Cost benefit analysis

Table 64 Cost per dollar saved for test groups, including LIEEP funding and in-kind contributions

	$ Savings per household	Level 1	level 2	Level 3	Level 4	Total ($ spent / $ saved)
SMS tips*	$23.35	$2.81	$20.57	$35.41	$68.69	$127.48
Personalised feedback	$5.44	$149.49	$88.29	$151.97	$294.85	$684.60
Voltage optimisation	$72.61	$25.76	$6.61	$11.39	$22.09	$65.85

*Median change in electricity consumption used for analysis of SMS tips

The cost benefit analysis undertaken compared mean annual savings per group in 2014 to 2015. The results are calculated based on the data presented in Table 44 Summary of annual electricity cost use in 2014 and 2015.

Unlike the cost effectiveness analysis, which shows only the test 2 group decreasing electricity consumption, the cost benefit analysis shows that two treatments resulted in decreased electricity costs. The test 1 (personalised feedback) group, that increased electricity consumption in the trial year, were able to decrease electricity costs, resulting in a cost benefit ratio of $141.49 cost incurred per dollar saved. The saving in electricity cost, but not consumption, is likely due to the exclusion of households using a time of use tariff from the cost analysis. The test 2 group had the lower cost benefit ratio, for every dollar saved $25.76 was spent. This clearly indicates that based on cost analysis voltage optimisation is the most effective trial approach.

The low intervention group did not decrease electricity costs in 2015 relative to 2014 and are excluded from the comparison. As noted in Table 63, the median electricity consumption for the low intervention group did decrease, and this has been used to undertake a cost benefit analysis, which is not comparable to the mean change in the test 1 and test 2 groups discussed above. The SMS tips cost $2.81 to administer for each dollar saved. This is the lowest cost and best cost benefit ratio of the three approaches trialled. The total cost of the SMS tips is high and administrative and recruitment costs put the total cost of delivering this service to $127.48 per dollar saved.

As per the reasoning outlined in the cost effectiveness analysis, benefits of the voltage optimisation would increase over time, whereas the other groups would decrease or stay stable. The voltage optimisation unit is expected to have a payback period greater than one year based on the multi-year operation, and so a cost benefit analysis conducted over only one year underestimates the true cost benefit of this approach. Based on the costs measured in Table 64, and the initial purchase price of the voltage optimisation units for the Switched on Homes trial ($1,500) the payback period for the voltage optimisation unit is 20.6 years. While this is high, voltage optimisation is a new technology and the initial purchase price may decrease with increased market saturation.

The same limitations of the current statistical analysis apply for the cost benefit analysis as the cost effectiveness analysis. One additional limitation is present in the current cost benefit analysis.

1. Electricity costs incurred by households are calculated assuming the cost of selling 1kWh of electricity is equal to the cost of buying 1kWh, which is not true in the current electricity market.

Performance of households without solar-PV

Analysis of electricity consumption data returned different results for households without solar-PV (non-solar households) compared to all households. Appendix 4 shows that the most effective intervention for non-solar households, resulting in both electricity reductions and cost savings, was SMS tips. The cost effectiveness and cost benefit analysis of only households without solar-PV is included as Appendix 4.

Co-benefits not captured in cost analysis

Co-benefits resulting from trial approaches not captured as savings or kWh reductions include:

- Increased knowledge about energy efficiency (Figure 64 and Figure 65) and control of electricity use (Table 58) was observed in all test groups. This will allow participants to continue to control their electricity use after the trial
- Improved comfort is possible in all test groups. Attitudinal and behavioural responses contain a before and after analysis of comfort and explains why this was not accurately determined by the trial
- Increased financial control in the test 1 and test 2 groups are evident, likely as a result of personalised feedback (Figure 61)
- Retention of voltage optimisation units in 43 households, which will reduce operational costs of appliances post trial (as evidenced by this cost analysis)
- Increased lifespan and decreased cost of replacing appliances and equipment in some households fitted with voltage optimisation units. The case study of the test 2 group (see Voltage Optimisation) and feedback recorded in Table 55 support this conclusion
- Retention in post-trial energy saving initiatives (129 / 201 participants surveyed joined the Switch your thinking e-newsletter at the end of the trial to continue to receive energy saving advice)
- Connection to an ongoing energy efficiency program (Switch your thinking). Some participants have indicated in their survey that they learned a lot and would be happy to be involved in future projects. Participants are currently being invited to enrol to receive energy saving SMS through Switch your thinking
- Improved knowledge of energy efficiency actions leading to savings past project completion. Participant comments contained in Appendix 5 and the discussion of SMS approach contain indications of increased knowledge
- Participant enjoyment. Anecdotally and in the responses contained in Appendix 5 participants enjoyed receiving text messages and being part of the trial
- Participants reported sharing text messages and information with other people in the community. This trickledown effect could potentially increase the awareness of energy efficiency in the community and reduce social exclusion in the participants

- Emissions reductions resulting from reductions in electricity use

Other notes

Trial approaches were only in place for one full calendar year and the cost analysis is conducted over this time. When considering the results of this cost analysis, it is of note that payback periods for trial approaches vary and are expected to exceed one year. It is anticipated that installing technology, in this case a VOU, would result in savings exceeding investment over a period of several years, which is not highlighted by this analysis. Similarly setting up the information management system for personalised feedback had a one-off cost ($25,050) in addition to the ongoing annual cost (based on the 2015 running cost) of $36,200 (ex-GST). One off costs, like recruiting a participant, would also have a better payback in a long running program.

Consortium and energy efficiency business benefits

The Switched on Homes consortium included three local governments (The City of Gosnells, City of Armadale and Shire of Serpentine Jarrahdale), one energy efficiency business (Power Intelligence), one industry member (Stockland), one NGO (Anglicare WA) and one community association (Environment House). In addition to work undertaken by consortium members, major contracts were awarded to Australian businesses through competitive quoting. Western Australian energy efficiency consultancy, Greensense, won the contract to create and design the information management system and Millennium Electronics Pty Ltd were engaged to assist with data capture.

Switch your thinking and local governments

Based on an initial analysis of results, which indicated SMS communications were cost effective in delivering electricity reduction, Switch your thinking started sending monthly energy efficiency tips by SMS to registered community members in February 2016. This is a new service offered by Switch your thinking that had not been planned prior to Switched on Homes. A total of 48 people had registered to receive SMS tips in the first six weeks of marketing. This opportunity has been offered to Switched on Homes participants, as a pathway of continued involvement, as well as to the wider community. The communities serviced by Switch your thinking include areas lower than 1000 on the SEIFA index. The delivery of energy efficiency information by SMS is an opportunity to continue to reach low income households, while extending the reach of the program to the wider community.

The consortia were provided with data and feedback during the trial revealing higher than expected technological literacy and willingness in the cohort of senior citizens. The popularity and convenience of SMS has impressed the local governments involved in Switched on Homes. The Switch your thinking team are encouraging local governments to build on the understanding gained in Switched on Homes and offer SMS based services. SMS based engagement also appeared to be popular to vulnerable participants (elderly, those with hearing or speech impairments and the culturally and linguistically diverse) who displayed reluctance to answer phone calls.

Power Intelligence

Through Switched on Homes, Power Intelligence designed and rolled out a residential voltage optimisation unit providing the opportunity to review its efficacy in a randomized test group of 80 households. This process will inform Power Intelligence's launch to the residential Australian market and provide opportunities for them to test and refine their product.

Stockland

Stockland is Australia's largest diversified property group and was involved in Switched on Homes from conception. During the trial, Stockland's Western Australian communications and community activation departments have developed a strong interest in promoting residential energy efficiency. In 2014 Stockland engaged event planners (p3 Events) and Switch your thinking to deliver energy efficiency workshops at five residential estates across the Perth metropolitan area. These workshops focused on assisting new home owners to discover opportunities to employ energy saving habits to reduce their utility bills. Stockland is currently growing their Sienna Wood community, keeping new builders informed about energy efficiency through their quarterly newsletters and planning workshops.

Environment house

Environment House have provided impartial advice and the benefit of their extensive on the ground experience to Switched on Homes. Throughout the trial Environment House have been exploring new and innovative ways to bring the community and energy efficiency experts together. The results of Switched on Homes will inform the design and direction of their services, and demonstrates Environment House's ability to provide high quality energy efficiency programs.

Greensense

During 2015, Greensense was internationally recognised and also underwent significant changes. A major international IT consultancy, Gartner, awarded Greensense "cool vendor status" following a review of the Switched on Homes information management system. This was an unintended but welcome benefit of Switched on Homes. During the trial, Greensense was acquired by ERM Power (the second largest electricity retailer to commercial and industrial properties in Australia), expanding the audience that their services will reach.

Lessons learned from the consortium

Lesson 1: Consortium organisational structure

Throughout the program, it became clear that the organisational structure of the consortium was sub-optimal. In particular, suppliers should have been managed as contractors rather than consortium members. This shift in organisational structure would have provided additional flexibility and control to the project team. It would have also ensured appropriate management agreements and structures were in place.

The organisational structure of the consortium (developed as part of the expression of interest and finalised while applying for funding) was adhered to with the exception of the withdrawal of the defunct Future Energy Alliance. Due to the tight timeframes and uncertainty at this stage of the project, roles and responsibilities of each consortium member were not fully explored or documented. Revision of the structure and roles and responsibilities should have been conducted once funding was awarded.

Nesting the Switched on Homes project team within the pre-established Switch your thinking program created opportunities to implement lessons learnt and continue to provide energy efficiency education to participants post trial. However, it also may have contributed to reduced organisational wide engagement of local government partners.

Lesson 2: Consortium engagement and communication

As discussed above, roles and responsibilities of each consortium member were poorly documented at the commencement of Switched on Homes, while this provided a high degree of flexibility it also led to confusion and sub-optimal outcomes.

The governance and communication structures, created by the project team and characteristic of local government proved impractical. In particular the memorandum of understanding, terms of reference and bi-yearly meetings provided limited value to non-government members and did not assist in meaningful consortium engagement.

High value contributions from consortium members, for example Stockland's participant recruitment efforts and Environment House's contribution to participant reports, were characterised by informal communication and strong relationships between the project coordinator and consortium member staff. Formal communication and governance structures did not facilitate high value input from consortium members, nor did they assist consortium members to derive value from their involvement in the project.

Recommendations

Future program administration

1. **Partner with organisations with existing community connections**

Engaging with low income households is challenging and the lessons learned through Switched on Homes were extensive. Across the LIEEP program there has been discussion about community champions. The experience of Switched on Homes is that, while this is almost certainly beneficial, establishing new, trusted relationships is difficult. Future programs should consider who they can include in their consortium that is already engaging the target demographic.

2. **Involve the target demographic in program development**

Preliminary surveys to understand how to reach the target demographic and then how they wish to receive energy efficiency information would be a worthwhile use of time and resources. Intercept surveys in areas where recruitment is taking place or online surveys (if recruitment is intended online) would provide a good idea of the barriers that might be encountered while engaging the existing demographic. Barriers to receiving and acting on communications are likely to vary significantly between demographics (for example, many Switched on Homes participants were able to receive SMS but were not confident in using the same technology to send a response).

3. **Be open and honest with potential consortium members to determine the right fit at the start of the program**

Consortiums should be carefully considered in terms of what value the consortium member can add to the program and what value the program brings to consortium members. There is a challenge in engaging industry on the consortium and how to create value for these members. Early and frank conversations should be undertaken clearly outlining the motivations and benefits to both parties.

Future program content

Use of SMS

4. **Consider SMS as an effective tool for communication and education**

Switched on Homes highlights the potential to engage the population and the senior demographic through SMS. SMS has proved a valuable tool for communicating and engaging the Switched on Homes participants, who highly valued SMS for convenience and amenity. This technology has the ability to be up-scaled and distributed across wide geographic areas at a low cost. While SMS is more expensive (7 cents per message) than email and social media campaigns (both available for free), there is low market saturation and messages are likely to receive more attention than a similar email or social media campaign.

Switched on Homes found that 43% of households meaningfully reduced electricity consumption during the trial year. As Switched on Homes households had below average electricity prior to commencing the trial (10.6kWh a day compared to a metro average of 15.2kWh per day) behaviour change tips might have been difficult to implement. When a subset of 21 households who had

average electricity consumption was examined (Table 24) an average saving of 5.78% was recorded in response to SMS messages. Coupled with the low cost of delivery, this makes SMS messaging an attractive field to undertake further studies and programs.

The results of Switched on Homes recruitment (flyers and newspapers were not successful recruitment pathways) and telephone surveys (telephone calls were routinely ignored) suggest low income demographic are losing trust in these traditional communication channels because they are saturated by marketing. There is a unique opportunity in the current market for SMS communications. Relying on technology as a form of engagement results in unique opportunities and challenges for future programs. While the time spent on administration per participant is low and deliverable costs are low, there may also be a smaller change in behaviour compared to traditional communication channel. Switched on Homes suggests SMS would be a welcome addition from utilities or as an education campaign from any sector.

Personalised feedback

5. **Personalised feedback is more useful for education than behaviour change.**

Switched on Homes found personalised feedback was desirable, and households believed strongly it helped control their electricity bills (Figure 53). However, in an untargeted trial like Switched on Homes, which attracted households with below average electricity consumption, it did not result in electricity reductions. Overall, households receiving personalised feedback reported improved financial control (Figure 61) and control over their electricity use (Figure 63) and improved attitudes towards energy efficiency (Figure 62). Due to the comparatively high cost associated with a highly personalised service future programs should consider targeting personalised feedback and only providing it to households who need increased financial control or education.

Education content

6. **Support householders to make energy efficient choices around heating and cooling their homes.**

A total of 48% of households surveyed in the community reported that the cost of energy efficiency appliances was a barrier to them being energy efficient. Interestingly, the low income demographic of Switched on Homes did not report to this as often, despite their decreased income. This highlights two potential needs. Firstly, ambitious and continuous improvement of minimum standards should be maintained for high use appliances, such as heating and cooling. There will always be a section of the community that will not invest any additional funds in purchasing energy efficient appliances, and the minimum standards should be set with these households in mind. Secondly, the difference in response may indicate that the current star-rating scheme is not well understood or does not portray the cost benefits of investing in energy efficient appliances well. Future marketing for consumers and industry around the star-rating scheme should be considered.

Interestingly, although response to peak load messages was encouraging, it was not enough to halt or reverse increasing demand in peak times. During peak demand times it appears that behaviour based changes are insufficient to manage load demand, even if the majority of people do the right thing. For example, in the one hour after peak message three over 51% of households decreased

their electricity consumption (which is considered to be unusual in a time when demand is normally increasing) , but overall electricity consumption in the group still increased. This highlights the need for appliances that contribute heavily to peak demand, such as air-conditioners, to have rigorous minimum standards. It also highlights the impact that peak demand response programs could have if rolled out on a community level.

7. Start by building an energy saving habit in an off peak period

Heating and cooling homes is a large consumer of energy and seasonal demand results in large fluctuations of electricity demand and electricity bills. Participants showed an interest and willingness to respond to suggestions to improve efficiency, particularly around air-conditioning and summer peak. Participants also demonstrated an ability to reduce energy use through behaviour change during autumn and spring, where temperatures were not extreme. Future programs should build on this by creating strong messages around heating and cooling and aim to extend periods of reduced energy consumption by delaying the use of artificial heating and cooling. Programs launching in autumn and spring could build confidence and habits in times when electricity use is more flexible. This objective should be supported by future policy around energy efficient homes (discussed below).

8. Encourage households to invest in energy efficiency technology

Switched on Homes was the first trial of residential voltage optimisation in Australia, and the technology proved to result in a significant decreases in energy consumption. Future programs should continue to trial new technologies and the government should play a role in encouraging households to invest in energy efficiency technology through easing transition of energy efficiency products to the market, and incentivising consumers to purchase proven technology through schemes or co-funding.

9. Employ different approaches and messages for households with Solar-PV

Switched on Homes results showed that households with solar-PV responded in a consistently different manner to households without solar-PV. Overall the response to behaviour change and participation in peak load management was lower in households with solar-PV. This may be caused by confusion over whether advice is applicable to their home, split incentives if advice is at odds with their feed-in tariff and disbelief that their household is contributing to peak load. Future programs should specifically target or address communications to households with solar-PV.

Policy

10. Future policy should support improved energy standards in homes

Examining the electricity consumption of households built post-2000 and pre-2000 (Table 35) there was an immediate and apparent difference in electricity demand. This difference was most stark in warmer seasons. In order to ensure that the established housing market maintains value and comfort relative to newer builds, it is recommended that minimum energy efficiency standards or features are introduced for existing homes. This is especially important in rental properties, where currently neither the owner nor the occupant has a strong incentive to undertake energy efficiency upgrades.

In a warming climate, it is likely that the more established homes will fall further behind in their comfort, and as Switched on Homes has shown that maximum temperature plays a large role in electricity consumption, poor summer performance in these households will put ongoing additional demand on the electricity grid.

11. Do not pursue mandatory time of use pricing in Western Australia.

The demographic engaged in Switched on Homes indicated an ability and willingness to adapt to peak demand and time of use pricing. While the participants expressed these attitudes, they overestimated their success in averting power consumption at peak times. This suggests that mandatory time of use pricing is not required to increase uptake in Western Australia and that mandatory pricing would not benefit participants. Currently, reprograming meters to access the time of use tariff costs $66 (higher costs occur if the meter needs to be replaced) which creates a financial barrier to people joining. If this barrier was removed, the results of Switched on Homes indicate that more households may be willing to try a time of use tariff.

Appendix 1

SMS schedule

Date	Time	Weekly efficiency advice message	Personalised message template
05-Jan-15	7pm	Energysmart tip – If you use an air conditioner with a temperature setting run it at 24°C or warmer.	0
12-Jan-15	7pm	Energysmart tip – A large screen TV (used 7 hours a day) can use more energy than a family sized fridge. Try to reduce viewing hours & ensure it is turned off at the wall when not in use.	0
19-Jan-15	7pm	Energysmart tip – Check the settings on your water heater. Instantaneous / continuous flow systems should be set at 50°C while storage & solar systems at 60°C for maximum efficiency & safety.	0
26-Jan-15	7pm	Energysmart tip – Washing your clothes using hot water can use 10 times more energy than a cold wash. Use the coolest temperature possible on your washing machine.	PM4
02-Feb-15	7pm	Energysmart tip – As the holiday season wraps up switch off your spare fridge or freezer. Use the newest most efficient model & protect fridges from heat/sun.	PM3
09-Feb-15	7pm	Energysmart tip - Ceiling and pedestal fans cost less than $0.02 per hour to run and are the most energy efficient way to cool your home. Try to cool with a fan whenever possible.	PM2
16-Feb-15	7pm	Energysmart tip – TVs, computers & gaming consoles can create a lot of heat. Reduce use of these devices to save power & to stay cool.	PM5
23-Feb-15	7pm	Energysmart tip - Dry with a dish rack, not the dishwasher! Use the eco setting on your dishwasher and lightly dry with a tea towel or allow your dishes to drain naturally.	PM1
02-Mar-15	7pm	Energysmart tip – Keep cool this summer by using fans & opening secure windows at night instead of using your air conditioner.	PM3
09-Mar-15	7pm	Energysmart tip – Manually turn off your sensor lights during the day.	PM4
16-Mar-15	7pm	Energysmart tip – Stop vampire power in its tracks – switch off all appliances at the wall & cut your electricity use by up to 10%.	PM1
23-Mar-15	7pm	Energysmart tip – If your air conditioner has adjustable louvres, adjust them towards the ceiling when cooling & towards the floor when heating (as cool air falls & hot air rises).	PM5
30-Mar-15	7pm	Energysmart tip – Saving hot water, saves energy too. Reduce hot water use by; only doing a full sink or load of dishes, washing clothes in cooler water & switching your bath for a short shower.	PM4
06-Apr-15	7pm	Congratulations, you're a quarter of the way through Switched on Homes! We encourage you to try the tips we send each week, but don't forget to stick with them after the week is over! You can control your electricity bill and help the environment by making lasting changes.	0
13-Apr-15	7pm	Energysmart tip – Disconnect chargers from the wall & only plug in when your device needs to be recharged. This saves energy & extends the life of your devices.	PM3

20-Apr-15	7pm	Energysmart tip – Use a microwave instead of your stove or oven to reheat your food. This will cut energy use & save time.	PM2
27-Apr-15	7pm	Energysmart tip – Avoid overloading your fridge & freezer, leave about 20% free space around your food for air circulation.	PM5
04-May-15	7pm	Energysmart tip – Screensavers don't save power! Power down your computer when it isn't in use & turn off the screen when taking a short break.	PM3
11-May-15	7pm	Energysmart tip - Only fill your kettle with cold water, and only the amount you need.	PM1
18-May-15	7pm	Energysmart tip – Food safety recommends your fridge is set between 3°C - 5°C. Every degree cooler uses 5% more energy, or an additional estimated $5 per degree per year.	PM5
25-May-15	7pm	Energysmart tip – Reduce heater use; make a rule such as only turning it on when the temperature falls below 18°C.	PM4
01-Jun-15	7pm	Energysmart tip - Remove and reduce forgotten power users from your bathroom. Turn off heat lamps, limit hairdryers & unplug any electric toothbrushes.	0
08-Jun-15	7pm	Energysmart tip - If you need heating overnight try an electric blanket rather than a heater. Don't forget to unplug your electric heater when it's not in use!	PM3
15-Jun-15	7pm	Energysmart tip – If your heater has a temperature setting, keep it set below 20°C for maximum efficiency.	PM2
22-Jun-15	7pm	Energysmart tip – If you have a solar hot water system consider showering during the day or early in the evening to reduce the need for 'boosting'.	PM1
29-Jun-15	7pm	Energysmart tip – As the weather gets cooler remember to shut your curtains at night, you can lose up to 40% of your home's heat through unprotected glass.	PM4
06-Jul-15	7pm	Congratulations, you're half way through Switched on Homes! Electricity use normally increases in July; if you're staying steady or decreasing you're doing really well. Thanks for volunteering; your participation makes a difference.	PM3
13-Jul-15	7pm	Energysmart tip – The average desktop computer can cost more than $150 a year in running costs. Try to shut down & unplug the computer whenever you're not using it.	PM5
20-Jul-15	7pm	Energysmart tip – It is the number of watts not the number volts on a light fitting that tells you how much power the light uses. The higher the wattage the more power used.	PM1
27-Jul-15	7pm	Energysmart tip – If you have more than one TV use the smaller one for everyday viewing like the news.	PM4
03-Aug-15	7pm	Energysmart tip – Try having a hot drink, putting on warm socks & using a heat pack before switching on the heater.	PM3
10-Aug-15	7pm	Energysmart tip – Food safety recommends your freezer is kept between -15°C & -18°C. Every degree cooler uses 5% more energy or $5 per degree per year.	PM2
17-Aug-15	7pm	Energysmart tip – Using a toaster instead of your electric grill to toast bread uses about 75% less energy.	PM5
24-Aug-15	7pm	Energysmart tip – Did you know a clothes dryer can use up to $95 of electricity per year? If you need to use a clothes dryer, spin clothes well or part dry them on the washing line first.	PM4

31-Aug-15	7pm	Energysmart tip – Heating water can be costly & uses lots of energy. Reducing the time you take in the shower by 4 minutes could save $85 per year. Set a timer on your mobile phone to prompt you.	PM1
07-Sep-15	7pm	Energysmart tip – DVD players, VCRs & external hard drives left plugged in can each use $40 of electricity per year. Switch them off at the wall when not in use.	PM3
14-Sep-15	7pm	Energysmart tip – If you use a clothes dryer use the medium setting instead of high: it takes a little longer but uses less energy and is less damaging to your clothes.	PM5
21-Sep-15	7pm	Energysmart tip – Clean your rangehood or exhaust fan/s regularly so they run efficiently.	PM4
28-Sep-15	7pm	Energysmart tip – Switch off your mobile phone & other devices at the wall when they've finished charging.	PM2
05-Oct-15	7pm	Energysmart tip – Did you know that generally a laptop computer uses less energy than a desktop?	PM3
12-Oct-15	7pm	Energysmart tip – Check your fridge has a tight door seal. If a piece of paper sandwiched between the seal & the door stays in place your seals are okay.	PM1
19-Oct-15	7pm	Energysmart tip – Use your kettle instead of the stove to boil water.	PM5
26-Oct-15	7pm	Only 10 weeks left of Switched on Homes! Thanks for your participation. Be prepared for your electricity bills to increase as the weather warms. To stay in control keep practicing what you've learnt through Switched on Homes.	0
02-Nov-15	7pm	Energysmart tip – Invest in a power board so you can easily turn off hard to reach appliances. Power boards with multiple switches allow you more control. Unplug extra appliances like DVD players.	PM3
09-Nov-15	7pm	Energysmart tip – The weather is warming! Set a personal goal to delay the date you switch on your air conditioner & use a fan instead.	PM1
16-Nov-15	7pm	Energysmart tip – Why not switch off your hot water system when you go on holiday? When you return heat & store the water above 60°C for at least 35 min before use (heating may take a few hours).	PM4
23-Nov-15	7pm	Energysmart tip – Locate fridges & freezers in cool areas (away from hot garages, sheds or verandas) & out of direct sunlight to reduce their electricity use.	PM2
30-Nov-15	7pm	Energysmart tip – Newer TVs come with ECO viewing options. Explore your settings & turn off the 'quick start' option & 'movie mode' as they use extra power.	PM4
07-Dec-15	7pm	Energysmart tip – As the days lengthen & the weather warms up enjoy evening outdoor BBQs & picnics to avoid creating heat in your kitchen & save on cooling.	PM3
14-Dec-15	7pm	Energysmart tip – Cooling yourself is more energy efficient than cooling your whole home. Try to cool yourself with a cold glass of water or cold shower & delay turning on the air conditioning.	PM1
21-Dec-15	7pm	Energysmart tip – Use an electric fry pan, pressure cooker or microwave as an energy efficient & cool alternative to your traditional electric oven.	PM5
28-Dec-15	7pm	Energysmart tip – Turn off your second fridge when you go away. Leaving the second fridge on could cost you $230 per year.	PM4

Personalised message templates

Message ID	Message text	Length (characters)
PM1	Your electricity use (increased/decreased) by xx% over the last week. Over a year this would add up to approximately $xx.	110
PM2	Did you know you normally use $xx of electricity each week while you are asleep (11pm-6am)?	91
PM3	(Motivational table, text range) You used xx units of electricity last month, which is around $Xx (more /less) than the previous month.	115
PM4	You used xxx units of electricity last week, equivalent to xx% (more/less) than your average weekly usage.	99
PM5	Normally you used the most electricity on Thursdays (xx units), and last week you used YY units on that day.	108

Ad hoc messages

AHM1	Welcome to Switched on Homes! Every Monday around 7pm you'll receive an Energysmart electricity reduction tip via SMS. We encourage you to try as many of the tips as possible. If you need to contact us please call 9397 3207. Thanks for volunteering, let's work together to decrease your electricity bills in 2015!	1/01/2015
AHM2	Switched on Homes - Perth is using a lot of power today! To do your bit please minimise your power use between now and 8pm. Try cooking with gas, turning your AC to 24 degrees or better yet use a fan.	25/02/2015
AHM3	Switched on Homes - Did you know a lot of Perth's power infrastructure is built to accommodate power use between 4-8pm? Do your bit by Turing on your dishwasher, washing machine or pool pump after 8pm.	9/08/2015
AHM4	Switched on Homes - Electricity prices increase from today. The price per unit has increased XX% and the daily supply charge is also up. Stay in control by implementing our Energysmart tips. Remember 1 unit is 1 kWh.	1/07/2015
AHM5	Switched on Homes - Perth is using a lot of power today! To do your bit please switch off unnecessary appliances, reset your air conditioner to 24 degrees or above, slip into something cool and open your windows to catch the breeze after the sun sets.	23/12/2015
AHM6	Switched on Homes - Thanks for participating in Switched on Homes. This is the last SMS you'll receive, but we'll call to complete a 10 minute survey with you in the new year.	31/12/2015

Appendix 2

Pre-trial survey

Introduction
Hello. I am [NAME OF INTERVIEWER] calling you today about the Switched on Homes trial. We would like to conduct the telephone survey with you, which will take about 18 minutes to complete. Are you able to complete the survey with us now?

1 ○ Yes ➔ **Read Introduction B**
2 ○ No ➔ **What would be a better time to call you to do the interview?**
2a ○ Day: _____
2a ○ Time: _____
95 ○ Other SPECIFY _____

Introduction B
The information in this survey is necessary so that the program can provide you with detailed feedback on your energy use and so that the program is able to test if the trial measures have been successful.

After completing this phone survey, you will be sent another $25 Woolworths voucher.

The information we collect from you today will be confidential and only used for the purpose of the program as described in the consent forms provided to you in the registration pack.

Are you ready to begin?

1 ○ Yes ➔ **Skip to Section A**
2 ○ No ➔ **What would be a better time to call you to do the interview?**
2a ○ Day: _____
2a ○ Time: _____
95 ○ Other SPECIFY _____

Most questions have multiple choice answers, so choose which answer best describes you or your household.

ANSWERS TO POSSIBLE OBJECTIONS:

SELLING SOMETHING – AECgroup is a research firm; we are not tele-marketing or selling any product or making any offers. We work to the professional code of behaviour of the Australian Market and Social Research Society, which is our industry professional body.

CONFIDENTIALITY - Once information processing has been completed, please be assured that your name and contact details will be removed from your responses to this survey. However, for the period that your name and contact details remain with your survey responses, which will be approximately six months, you will be able to contact us to request access to or correction of your information.

Section 1: Details about your house and appliance use

Q1. Which of the following type(s) of power sources do you use in your house? **[READ LIST]** MULTIPLE RESPONSE	1 ☐ Electricity 2 ☐ Mains gas 3 ☐ Bottled 4 ☐ Wood 5 ☐ Solar➔ **ASK Q2** 95 ☐ Other SPECIFY _____
If YES to SOLAR in Q1 Q2. Does your house have a solar panel system that generates electricity? SINGLE RESPONSE	1 ○ Yes 2 ○ No 99 ○ Don't Know / Can't Remember
If YES to SOLAR in Q1 Q3. What is the size of your system in kilo watts? SINGLE RESPONSE	1 ○ _____ kilo watts 99 ○ Don't Know / Can't Remember
If YES to SOLAR in Q1 Q4. Which of the following best describes the feed-in tariff you receive from the State Government? SINGLE RESPONSE	1 ○ 40 cent feed-in tariff 2 ○ 20 cent feed-in tariff 3 ○ None; no feed-in tariff received from the State Government 99 ○ Don't Know / Can't Remember
Q5. Which of the following type(s) of **cooling** appliances/products do you use in your house? IF NEEDED: Please indicate the ones you have as I read the list. **[READ LIST]** MULTIPLE RESPONSE	1 ☐ Ducted reverse cycle air conditioning through the whole house 2 ☐ Wall mounted reverse cycle air conditioning in a single room or several rooms (also known a split system) 3 ☐ Older style air conditioner that is a box in the wall or window 4 ☐ Portable air conditioner 5 ☐ Whole house evaporative cooler 6 ☐ Portable evaporative cooler 7 ☐ Ceiling fan/s 8 ☐ Pedestal fan/s 95 ☐ Other SPECIFY _____ 97 ☐ None of these
Q6. Which of the following type(s) of	1 ☐ Ducted reverse cycle heating through the

heating appliances/products do you use in your house? IF NEEDED: Please indicate the ones you have as I read the list. **[READ LIST]** MULTIPLE RESPONSE	whole house 2 ☐ Wall mounted reverse cycle heating in a single room or several rooms (also known as a split system) 3 ☐ Electric fan heater 4 ☐ Oil heater or column heater 5 ☐ Ducted gas 6 ☐ Flued gas (fixed on wall) 7 ☐ Portable gas heater 8 ☐ Wood stove 95 ☐ Other SPECIFY _____ 97 ☐ None of these
Q7. Which of the following **best describes** the type of hot water system used in your house? **[READ LIST]** SINGLE RESPONSE	1 ○ Electric heat pump 2 ○ Electric storage 3 ○ Electric instantaneous 4 ○ Gas storage 5 ○ Gas instantaneous 6 ○ Solar hot water 99 ○ Don't Know / Can't Remember
Q8. Does your house have insulation? SINGLE RESPONSE	1 ○ Yes 2 ○ No ➔ **SKIP TO Q11** 99 ○ Don't Know / Can't Remember ➔ **SKIP TO Q11**
If YES to INSULATION in Q8 Q9. In which of the following area(s) is the insulation? **[READ LIST]** MULTIPLE RESPONSE	1 ☐ Ceiling 2 ☐ Walls 3 ☐ Floor 99 ☐ Don't Know / Can't Remember
If YES to INSULATION in Q8 Q10. Which of the following type(s) of insulation do you have in your house? IF NEEDED: Please indicate the ones as I read the list. **[READ LIST]** MULTIPLE RESPONSE	1 ☐ Batts 2 ☐ Loose fill 3 ☐ Foil 95 ☐ Other SPECIFY _____ 97 ☐ None of these 99 ☐ Don't Know / Can't Remember
Q11. Now regarding the colour of the roof of your house. Which of the following best describes the colour of your roof?	1 ○ Light in colour 2 ○ Intermediate in colour 3 ○ Dark in colour

[READ LIST] SINGLE RESPONSE	99 ○ Don't Know / Can't Remember
Q12. Which of the following type(s) of **window covering(s)** do you have in your house? IF NEEDED: Please indicate the ones you have as I read the list. **[READ LIST]** MULTIPLE RESPONSE	1 ☐ Blinds (vertical or horizontal) 2 ☐ Curtains 95 ☐ Other SPECIFY _____ 97 ☐ No coverings
Q13. Which of the following best describes the **type of glass** on your windows? **[READ LIST]** SINGLE RESPONSE	1 ○ Standard Single glaze 2 ○ Double glaze 3 ○ Tinted 95 ○ Other SPECIFY _____ 99 ○ Don't Know / Can't Remember
Q14. Now thinking about the light bulbs in your house, please indicate approximately how many of each of the following types of bulbs do you think you have in your house including outside and inside lights? **[READ LIST]** **[Note: if '0' leave blank. If 'unknown' enter 999]**	1 ○ Number of **incandescent light** bulbs: _____ NOTE: These are the old type of light globes. 2 ○ Number of **halogen downlights** bulbs: _____ 3 ○ Number of **compact fluorescent light** bulbs: _____
Q15. How many fridges in your household are less than 6 years old, and how many are more than 6 years old?	1 ○ Number of fridges less than 6 years old: _____ 2 ○ Number of fridges more than 6 years old: _____
Q16. Now thinking about the computers, please indicate approximately how many of each of the following do you think you have in your house? **[READ LIST]** **[Note: if '0' leave blank. If 'unknown' enter 999]**	1 ○ Number of **desktop computers**: _____ 2 ○ Number of **laptop computers**: _____ 3 ○ Number of **servers**: _____
Q17. Are any of the computers left on all day?	1 ○ Yes 2 ○ No

SINGLE RESPONSE	
Q18. Now thinking about the home entertainment items, please indicate approximately how many of each of the following do you think you have in your house? **[READ LIST]** **[Note: if '0' leave blank. If 'unknown' enter 999]**	1 ○ Number of TVs: _____ 2 ○ Number of DVD players/recorders: _____ 3 ○ Number of Game consoles: _____ 4 ○ Number of Set top boxes: _____ 5 ○ Number of VCRs: _____ 6 ○ Number of Audio equipment/sound systems: _____
Q19. Now thinking about the laundry, please indicate approximately how many of each of the following do you think you have in your house? **[READ LIST]** **[Note: if '0' leave blank. If 'unknown' enter 999]**	1 ○ Number of **Front loading** washing machine: _____ 2 ○ Number of **Top loading** washing machine: _____ 3 ○ Number of **Clothes dryer**: _____
Q20. On average how many times per week do you do a load of laundry using **warm water**? SINGLE RESPONSE	1 ○ _____ times per week 99 ○ Don't Know / Can't Remember
Q21. On average how many dryer loads do you do per month? SINGLE RESPONSE	1 ○ _____ per month 99 ○ Don't Know / Can't Remember
Q22. Do you have a private pool or spa attached to your home? SINGLE RESPONSE	1 ○ Yes 2 ○ No ➔ **SKIP TO Q24**
If YES to Pool/Spa in Q24 Q23. For your pool/spa, how many hours per day do you run your pump/s ….?	1 ○ In Summer: _____ hours per day 2 ○ In Winter: _____ hours per day

Q24. Do you have any other appliances not already mentioned which you think contribute a lot to your power bill?	1 ○ Yes (Please Specify_____) 2 ○ No
Q25. Has there been a significant change to your house in the last 12 months, such as an extension to the house, or replacement of a major appliance? A major appliance includes the hot water system, a fridge, freezer or washing machine?	1 ○ Yes (Please Specify_____) 2 ○ No ➔ **SKIP TO Q28**
Q26. Do you feel that the changes you made have led to…?	1 ○ An increase in energy use 2 ○ About the same energy use 3 ○ A decrease in energy use
Q27. What month did you complete this change?	1 ○ _____ Month

We have now completed Section 1 of the survey and will move onto the next section. Section 2 is about your opinions on energy efficiency.

Section 2 - your opinions on energy efficiency

Q28. In the last two years, has your effort into energy efficiency been… SINGLE RESPONSE	1 ○ A lot more than usual 2 ○ More than usual 3 ○ About the same 4 ○ A little less than usual 5 ○ No effort at all 99 ○ Don't Know/ Unsure
Q29. Which of the following, if any, do you feel are barriers to you undertaking energy efficiency activities in your home? [READ LIST] MULTIPLE RESPONSE	1 ☐ You already do everything you can related to energy efficiency 2 ☐ The cost of energy efficient appliances is too great 3 ☐ You don't have the time 4 ☐ You don't know what else to do 5 ☐ You are not motivated 95 ☐ Other SPECIFY _____ 99 ☐ None

Q30. Now I'll read out some statements. Please choose how much you agree or disagree with the statements from the following options: strongly disagree; somewhat disagree; neither agree nor disagree; somewhat agree; strongly agree.…

		Strongly Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Strongly Agree	
A	The temperature at home is often	1 ○	2 ○	3 ○	4 ○	5 ○	

	too hot or cold for me to be comfortable						
B	My household often feels in control of our energy use	1 ○	2 ○	3 ○	4 ○	5 ○	
C	My household often feels in control of our finances	1 ○	2 ○	3 ○	4 ○	5 ○	
D	Energy efficiency is too much hassle	1 ○	2 ○	3 ○	4 ○	5 ○	
E	Energy efficiency means I have to live less comfortably	1 ○	2 ○	3 ○	4 ○	5 ○	
F	My quality of life will decrease when I reduce my energy use	1 ○	2 ○	3 ○	4 ○	5 ○	
G	Energy efficiency will restrict my freedom	1 ○	2 ○	3 ○	4 ○	5 ○	
H	Energy efficiency is not very enjoyable	1 ○	2 ○	3 ○	4 ○	5 ○	
I	I am interested in energy efficiency	1 ○	2 ○	3 ○	4 ○	5 ○	

We have now completed section 2 of the survey. We have about 6 minutes to go. The final section asks questions about you and other members in your house. For this section we are just ticking boxes, so we should be able to move through it reasonably quickly.

Section 3 - Members of your Household

Q31. Which of the following best describes your housing status? Is your house: SINGLE RESPONSE	1 ○ Owned outright 2 ○ Mortgaged 3 ○ Rent/buy scheme 4 ○ Rental property 5 ○ Shared equity 6 ○ Life tenure 7 ○ Rent free 95 ○ Other Specify _____
Q32. How many people usually reside in your house? SINGLE RESPONSE	1 ○ _____ Number of people 99 ○ Don't Know / Can't Remember
REPEAT Q33 SERIES FOR ALL PEOPLE IN THE HOUSEHOLD **COLLECT INFORMATION FOR ALL PEOPLE WHO ARE REGULAR INHABITANTS OF THE HOUSE**	

Q33a. Now thinking about the oldest person in the household, what is their age? SINGLE RESPONSE	1 ○ _____ Age of the person 99 ○ Don't Know / Can't Remember
Q33b. and their gender? SINGLE RESPONSE	1 ○ Male 2 ○ Female
Q33c. And what is their highest level of education? SINGLE RESPONSE	1 ○ Not of school age 2 ○ Primary school 3 ○ High school - Year 10 4 ○ High school - Year 12 5 ○ TAFE 6 ○ Tertiary 7 ○ Unknown
REPEAT Q33 SERIES FOR ALL PEOPLE IN THE HOUSEHOLD **COLLECT INFORMATION FOR ALL PEOPLE WHO ARE REGULAR INHABITANTS OF THE HOUSE**	
Q34. Is English the main language spoken in your household? SINGLE RESPONSE	1 ○ Yes ➔ **SKIP TO Q36** 2 ○ No
Q35. What is the main language spoken in your household?	1 ○ _____ Please Specify (Must be consistent with ABS code) 99 ○ Don't Know / Can't Remember
Q36. Does anyone in your household identify as Indigenous or Torres strait islander? SINGLE RESPONSE	1 ○ Yes 2 ○ No ➔ **SKIP TO Q38**
Q37. Please indicate which you or they identify as? SINGLE RESPONSE	1 ○ Aboriginal 2 ○ Torres Strait Islander 3 ○ Both Aboriginal and Torres Strait Islander
Q38. Now back to you as the main participant. Were you born in Australia? SINGLE RESPONSE	1 ○ Yes ➔ **SKIP TO Q40** 2 ○ No
Q39. In what country where you were born? SINGLE RESPONSE	1 ○ _____ Please Specify (Must be consistent with ABS code) 99 ○ Don't Know / Can't Remember

Q40. What was your main employment status for the last 12 months? SINGLE RESPONSE	1 ○ Employed - Full time (36hrs +) 2 ○ Employed - Part time (<36hrs) 3 ○ Employed – away from work (for example on maternity or sick leave) 4 ○ Unemployed – looking for full-time work 5 ○ Unemployed – looking for part-time work 6 ○ Retired 7 ○ Conducting unpaid work (carer/home duties) 8 ○ Unable to work 9 ○ Studying 95 ○ Other (Please Specify_____)
Q41. Which of the following range of incomes best fits your level of **annual household income**? SINGLE RESPONSE	1 ○ Negative income 2 ○ Nil income 3 ○ $1 - $10,400 4 ○ $10,400 - $15,600 5 ○ $15,600 - $20,800 6 ○ $20,800 - $31,200 7 ○ $31,200 - $41,600 8 ○ $41,600 - $52,000 9 ○ More than $52,000 99 ○ Don't Know / Can't Remember
Q42. Do you currently identify your household as any of these…? **[READ LIST]** MULTIPLE RESPONSE	1 ☐ Senior 2 ☐ Single parent household 3 ☐ Single person household 4 ☐ New home owner 5 ☐ Student 6 ☐ Renter 7 ☐ CALD (culturally and linguistically diverse) 8 ☐ Migrant 95 ☐ Other SPECIFY _____ 97 ☐ None of these

Quality Check

That concludes the survey. Just one more question and some information for you.

As part of our quality assurance procedures 1 in 20 of survey respondents are contacted to confirm their responses. Would it be ok for AEC market research to contact you about the responses you have given today?	1 ☐ Yes ➔ RECORD NAME _____ AND NUMBER _____ 2 ☐ No

On behalf of City of Gosnells, thank you for participating in this survey.

Should you wish to confirm the authenticity of this survey please contact either:

City of Gosnells:Jessie Parrish, (08) 9397 3207

AEC*group*: Priya Narsey, (08) 6555 4940

Post-trial survey

Introduction

Hello, I am [NAME OF INTERVIEWER] calling today to complete the survey for the Switched on Homes energy efficiency trial. This is the voluntary electricity reduction program being run by City of Gosnells, City of Armadale and Shire of Serpentine Jarrahdale. Your feedback is confidential and will be used to assess the program and provide feedback. For completing the survey with us today, you will receive a $25 Woolworths Gift Card. Is now a good time?

1	○ Yes ➔ **Skip to Section A**
2	○ No ➔ **What would be a better time to call you to do the interview?**
2a	○ Day: _____
2a	○ Time: _____
95	○ Other SPECIFY _____

Most questions have multiple choice answers, so choose which answer best describes you or your household.

ANSWERS TO POSSIBLE OBJECTIONS:

SELLING SOMETHING – AECgroup is a research firm; we are not tele-marketing or selling any product or making any offers. We work to the professional code of behaviour of the Australian Market and Social Research Society, which is our industry professional body.

CONFIDENTIALITY - Once information processing has been completed, please be assured that your name and contact details will be removed from your responses to this survey. However, for the period that your name and contact details remain with your survey responses, which will be approximately six months, you will be able to contact us to request access to or correction of your information.

Section A – Ask All ONLY (280 households)

Section 1: Details about your house and appliance use

Q1. In 2015, did your household install or upgrade a solar panel system that generates electricity? SINGLE RESPONSE	1 ○ Yes 2 ○ No ➔ **SKIP TO Q3** 99 ○ Don't Know / Can't Remember ➔ **SKIP TO Q3**
If YES to SOLAR in Q1 Q2. What is the size of your system in kilo watts? SINGLE RESPONSE	1 ○ _____ kilo watts 99 ○ Don't Know / Can't Remember

Q3.	Has there been a significant change to your house in the last 12 months, such as an extension to the house, or replacement of a major appliance? A major appliance includes the hot water system, a fridge, freezer or washing machine?	1 ○ Yes (Please Specify_____) 2 ○ No ➔ **SKIP TO Q5**
Q4.	Do you feel that the changes you made have led to…? SINGLE RESPONSE	1 ○ An increase in energy use 2 ○ About the same energy use 3 ○ A decrease in energy use

Section 2 - your opinions on energy efficiency

Q5.	In the last two years, has your effort into energy efficiency been… SINGLE RESPONSE	1 ○ A lot more than usual 2 ○ More than usual 3 ○ About the same 4 ○ A little less than usual 5 ○ No effort at all 99 ○ Don't Know/ Unsure
Q6.	Which of the following, if any, do you feel are barriers to you undertaking energy efficiency activities in your home? [READ LIST] MULTIPLE RESPONSE	1 ☐ You already do everything you can related to energy efficiency 2 ☐ The cost of energy efficient appliances is too great 3 ☐ You don't have the time 4 ☐ You don't know what else to do 5 ☐ You are not motivated 95 ☐ Other SPECIFY _____ 99 ☐ None

Q7. Now I'll read out some statements. Please choose how much you agree or disagree with the statements from the following options: strongly disagree; somewhat disagree; neither agree nor disagree; somewhat agree; strongly agree….

		Strongly Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Strongly Agree	Don't Know
A	The temperature at home is often too hot or cold for me to be comfortable	1 ○	2 ○	3 ○	4 ○	5 ○	9 ○
B	My household often feels in control of our energy use	1 ○	2 ○	3 ○	4 ○	5 ○	9 ○
C	My household often feels in control of our finances	1 ○	2 ○	3 ○	4 ○	5 ○	9 ○
D	Energy efficiency is too much hassle	1 ○	2 ○	3 ○	4 ○	5 ○	9 ○

E	Energy efficiency means I have to live less comfortably	1 ○	2 ○	3 ○	4 ○	5 ○	9 ○
F	My quality of life will decrease if I reduce my energy use	1 ○	2 ○	3 ○	4 ○	5 ○	9 ○
G	Energy efficiency will restrict my freedom	1 ○	2 ○	3 ○	4 ○	5 ○	9 ○
H	Energy efficiency is not very enjoyable	1 ○	2 ○	3 ○	4 ○	5 ○	9 ○
I	I am interested in energy efficiency	1 ○	2 ○	3 ○	4 ○	5 ○	9 ○

Q8. A time of use tariff is when electricity is more expensive during peak times (like during the day and in the evenings) and cheaper during off peak periods (like at night between the hours of 9pm and 7am). Under a time of use tariff, do you think your **electricity bill** would…..? SINGLE RESPONSE	1 ○ Increase 2 ○ Stay about the same 3 ○ Decrease 99 ○ Don't Know/ Unsure
Q9. A time of use tariff is when electricity is more expensive during peak times (like during the day and in the evenings) and cheaper during off peak periods (like at night between the hours of 9pm and 7am). Under a time of use tariff, do you think your **wellbeing** would…..? SINGLE RESPONSE	1 ○ Increase 2 ○ Stay about the same 3 ○ Decrease 99 ○ Don't Know/ Unsure

Section 3 – Information Sources

Q10. In which of the following ways would you like to receive energy efficiency information [READ LIST] MULTIPLE RESPONSE	1 ☐ Email 2 ☐ Facebook 3 ☐ On your bill 4 ☐ By Post 5 ☐ Via SMS 6 ☐ Website/online 95 ☐ Other SPECIFY _____ 99 ☐ I would not like to receive energy efficiency information

Q11. Would you like to join the Switch your thinking email list to hear about other energy efficiency and community sustainability projects? SINGLE RESPONSE	1 ○ Yes ➔ **Collect Email Address** 1a ○ email address _____ 2 ○ No
Q12. Do you have any other comments or feedback for me to pass onto the Switched on Homes team? PROBE COMPLETELY	_____ _____ _____ _____

Section B – PROCEED For Low Intervention, Test 1 and Test 2 groups ONLY (236 households)

ALL OTHERS SKIP TO QUALITY ASSURANCE QUESTION

Section 4: Perceived Impact

Q13. During 2015 do you think Switched on Homes has been responsible for …? SINGLE RESPONSE	1 ○ A Decrease in your electricity use 2 ○ An increase in your energy use 3 ○ Has not altered your energy use 99 ○ Don't Know/ Unsure

Q14. On a 1 – 5 scale, where 1 is 'strongly disagree' and '5' is 'strongly agree', how true are the following statements…

		Strongly Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Strongly Agree	Don't Know
A	I tried to shift my power use when I received an SMS asking me to do my bit by turning on my dishwasher, washing machine or pool pump after 8pm.	1 ○	2 ○	3 ○	4 ○	5 ○	9 ○
B	Participating in Switched on Homes improved my knowledge about energy efficiency and actions I could take in my home	1 ○	2 ○	3 ○	4 ○	5 ○	9 ○

Section 5: Program Performance

Q15. Throughout 2015 did you receive a weekly SMS from Switched on Homes about saving electricity?	1 ○ Yes ➔ **SKIP TO Q17** 2 ○ No ➔ **CONTINUE** 99 ○ Don't Know / Can't Remember ➔ **SKIP TO Q17**
Q16. How often did you receive the SMS? SINGLE RESPONSE	1 ○ Weekly since February 2 ○ About once a fortnight 3 ○ Not at all 99 ○ Don't Know / Can't Remember
Q17. If you were in a similar program again, how often would you like to receive a SMS message? SINGLE RESPONSE	1 ○ Once a week 2 ○ Once a fortnight 2 ○ Once a month 3 ○ Once a season 4 ○ Only when being asked to turn off appliances between 4 and 8pm due to high demand 5 ○ Never 99 ○ Don't Know / Can't Remember

Section 6: Feedback on Program

Q18. During Switched on Homes did you find the weekly SMS convenient?	1 ○ Yes 2 ○ No 99 ○ Don't Know / Can't Remember
Q19. Which of the following statements best describes your behaviour knowing that your electricity use was being monitored: SINGLE RESPONSE	1 ○ I tried much harder to save electricity 2 ○ I tried a bit to save electricity 3 ○ I was aware of the monitoring but it did not change my behaviour 4 ○ I'd forgotten about the monitoring 99 ○ Don't Know / Can't Remember
Q20. How often did you look at each Energysmart tip sent by SMS? SINGLE RESPONSE	1 ○ Never 2 ○ Looked at each one once 3 ○ 2 – 3 times 4 ○ More than 3 times 99 ○ Don't Know / Can't Remember
Q21. Overall, approximately how often did you try out any of the Energysmart tips sent by SMS? SINGLE RESPONSE	1 ○ Between one and ten times 2 ○ Between 11 and 20 times 3 ○ Between 21 and 40 times 4 ○ I tried all of the tips 5 ○ I did not try any of the tips 99 ○ Don't Know / Can't Remember
Q22. When you received Energysmart tips via SMS did you change the way you used the following	

	items in an effort to reduce your electricity use?			
		Yes	No	I don't have this appliance
A	Fridge	1 ○	2 ○	3 ○
B	Freezer	1 ○	2 ○	3 ○
C	Second Fridge	1 ○	2 ○	3 ○
D	Stove	1 ○	2 ○	3 ○
E	Dishwasher	1 ○	2 ○	3 ○
F	Oven	1 ○	2 ○	3 ○
G	Kettle	1 ○	2 ○	3 ○
H	Washing Machine	1 ○	2 ○	3 ○
I	Clothes Dryer	1 ○	2 ○	3 ○
J	Hot water	1 ○	2 ○	3 ○
K	Air Conditioner	1 ○	2 ○	3 ○
L	Fan	1 ○	2 ○	3 ○
M	Heater	1 ○	2 ○	3 ○
N	Computer	1 ○	2 ○	3 ○
O	Television	1 ○	2 ○	3 ○
P	Lights	1 ○	2 ○	3 ○

Section B.1 – PROCEED For Test 1 and Test 2 groups ONLY (158 households)

ALL OTHERS SKIP TO QUALITY ASSURANCE QUESTION

Q23. Did the personalised feedback in your weekly SMS help you to reduce your electricity bills? SINGLE RESPONSE	1 ○ Yes 2 ○ No 99 ○ Don't Know / Can't Remember

Section C – PROCEED FOR test 2 groups only (78 households)

ALL OTHERS SKIP TO QUALITY ASSURANCE QUESTION

Section 7: Feedback on the Voltage Optimisation Unit

Q24. Did you notice the Voltage Optimisation Unit affecting the day to day performance of your appliances? SINGLE RESPONSE	1 ○ Yes ➔ **CONTINUE** 2 ○ No ➔ **SKIP TO Q26** 99 ○ Don't Know / Can't Remember ➔ **SKIP TO Q26**
Q25. How was the performance of your appliance impacted?	_____ _____ _____ _____
Q26. Do you feel the Voltage Optimisation Unit reduced your electricity bills? SINGLE RESPONSE	1 ○ Yes 2 ○ No 99 ○ Don't Know / Can't Remember

Quality Check

Thank you for your time today, this completes the survey. The Switched on Homes team will be in contact with you shortly to finalise any outstanding details and provide your household with a personal electricity report.

Just one more question and some information for you.

As part of our quality assurance procedures 1 in 20 of survey respondents are contacted to confirm their responses. Would it be ok for AEC market research to contact you about the responses you have given today?	1 ☐ Yes ➔ RECORD NAME _____ AND NUMBER _____ 2 ☐ No

Please feel free to contact the Switched on Homes directly on 9397 3207 if they have any other feedback, questions or concerns.

On behalf of City of Gosnells, thank you for participating in this survey.

Should you wish to confirm the authenticity of this survey please contact either:

City of Gosnells:Jessie Parrish, (08) 9397 3207

AEC*group*: Priya Narsey, (08) 6555 4940

Appendix 3

Community survey 2014

Switch your thinking **Community Survey**

Thanks for taking the time to complete the ***Switch your thinking*** community survey. Your responses will be valuable in determining the current impact and future direction of our program.

The survey will take approximately five minutes to complete.

Responses will remain anonymous. At the end of the survey, you have the option to enter your details to go into the draw to win one of two home sustainability prize packs valued at $250. Your details will only be used to contact you if you are the winner and will not be linked with your responses in the survey. Once you have completed the survey, please return it to us in the reply paid envelope provided.

1) a. Have you seen this logo before?

☐ Yes ☐ No (skip to Question 2)

b. Which of the following does the logo relate to?

☐ Energy efficiency / greenhouse gas reduction

☐ Automotive accessories

☐ Catching public transport

☐ Don't know

2) a. Does your house have a solar panel system that generates electricity?

☐ Yes ☐ No (skip to Question 3)

b. What is the size of your system in kilowatts (kW)?

☐ 1 ☐ 1.5 ☐ 2 ☐ 2.5 ☐ 3 ☐ 3.5 ☐ 4 or more ☐ Unsure

3) Please tick the topics that are of interest to you (tick your favourite three):

☐ Climate change

☐ Making my business greener

☐ Sustainable building and renovations

☐ Saving electricity

☐ Saving water

☐ Environmentally friendly gardening

☐ Waste reduction (recycling, composting and worm farming)

☐ Environmentally friendly cleaning

4) In the last two years, your effort into energy efficiency has been:

☐ A lot more than usual

☐ More than usual

☐ About the same

☐ A little less than usual

☐ No effort at all

☐ Don't Know/ Unsure

5) Which of the following, if any, do you feel are barriers to you undertaking energy efficiency activities in your home?

☐ You already do everything you can related to energy efficiency

☐ The cost of energy efficient appliances is too great

☐ You don't have the time

☐ You don't know what else to do

☐ You are not motivated

☐ Other: Please specify_____

☐ None

6) Please choose how much you agree or disagree with these statements

	Strongly Disagree	*Somewhat Disagree*	*Neither Agree nor Disagree*	*Somewhat Agree*	*Strongly Agree*
I know what uses the most energy in my home	☐	☐	☐	☐	☐
Energy efficiency is too much hassle	☐	☐	☐	☐	☐
My quality of life will decrease when I reduce my energy use	☐	☐	☐	☐	☐
I am interested in energy efficiency	☐	☐	☐	☐	☐

7) Please tick the options that would motivate you to adopt more environmentally friendly behaviours (tick your favourite three)

☐ If there were greater financial incentives

☐ If all my friends were doing it

☐ If it was more convenient

☐ If I knew what to do

☐ If there was greater local leadership

☐ If there was an increase in utility prices

☐ I am not interested in adopting more environmentally friendly behaviours

☐ Other: Please specify_____

8) What is the most convenient way for you to receive information about sustainable living / energy efficiency? (tick your top three responses)

☐ SMS or text message

☐ Community workshops

☐ Advertising in my local newspaper

☐ Facebook

☐ Twitter

☐ Website

☐ E-newsletter

☐ Other: Please specify_____

9) What program or services would you like *Switch your thinking!* to deliver in the future?

☐ Online learning modules

☐ Personal face-to-face consultations

☐ Advertising campaigns

☐ Community workshops

☐ In home advice

☐ School programs

☐ Website

☐ Other: Please specify_____

10) Are you male or female?

☐ Male ☐ Female

11) What is your age group:

☐ 18 or younger ☐ 18-24 ☐ 25-34 ☐ 35-49 ☐ 50- 65 ☐ 65+

12) How many people usually reside in your house?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ More than 6

13) Which suburb do you live in?

_____

If you wish to be entered into the draw to win one of two home sustainability prize packs valued at $250, please fill in your details and return your completed survey to us, using the enclosed reply paid envelope.

Name: _____

Address: _____ Postcode

Email: _____

Daytime phone number (to notify you if you win):

_____

☐ Please add me to your mailing list so I can find out more about how to save energy, water and waste and reduce my household's greenhouse gas emissions (please tick)

Community survey 2016

Switch your thinking Community Survey

Thanks for taking the time to complete the **Switch your thinking** Community Survey. Your responses are valuable in determining the current impact and future direction of our program.

The survey will take approximately five minutes to complete.

Responses will remain anonymous. At the end of the survey, you have the option to enter your details to go into the draw to win a home sustainability prize pack valued at $250. Your details will only be used to contact you if you are the winner and will not be linked with your responses in the survey. Once you have completed the survey, please return it to us in the reply paid envelope provided.

1) **a. Have you heard of Switch your thinking before?**

☐ Yes ☐ No (skip to Question 2)

b. Which of the following does Switch your thinking relate to?

☐ Energy efficiency / greenhouse gas reduction

☐ Automotive accessories

☐ Catching public transport

☐ Don't know

2) **a. Does your house have a solar panel system that generates electricity?**

☐ Yes ☐ No (skip to Question 3)

b. What is the size of your system in kilowatts (kW)?

☐ 1 ☐ 1.5 ☐ 2 ☐ 2.5 ☐ 3 ☐ 3.5 ☐ 4 or more ☐ Unsure

3) Please tick the topics that are of interest to you (tick your favourite three):

☐ Climate change

☐ Making my business greener

☐ Sustainable building and renovations

☐ Saving electricity

☐ Saving water

☐ Environmentally friendly gardening

☐ Waste reduction (recycling, composting and worm farming)

☐ Environmentally friendly cleaning

4) In the last two years, your effort into energy efficiency has been:

☐ A lot more than usual

☐ More than usual

☐ About the same

☐ A little less than usual

☐ No effort at all

☐ Don't Know/ Unsure

5) Which of the following, if any, do you feel are barriers to you undertaking energy efficiency activities in your home?

☐ You already do everything you can related to energy efficiency

☐ The cost of energy efficient appliances is too great

☐ You don't have the time

☐ You don't know what else to do

☐ You are not motivated

☐ Other: Please specify_____

☐ None

6) Please choose how much you agree or disagree with these statements

	Strongly Disagree	*Somewhat Disagree*	*Neither Agree nor Disagree*	*Somewhat Agree*	*Strongly Agree*
I know what uses the most energy in my home	☐	☐	☐	☐	☐
Energy efficiency is too much hassle	☐	☐	☐	☐	☐
My quality of life will decrease when I reduce my energy use	☐	☐	☐	☐	☐
I am interested in energy efficiency	☐	☐	☐	☐	☐

7) Please tick the options that would motivate you to adopt more environmentally friendly behaviours (tick your favourite three)

☐ If there were greater financial incentives

☐ If all my friends were doing it

☐ If it was more convenient

☐ If I knew what to do

☐ If there was greater local leadership

☐ If there was an increase in utility prices

☐ I am not interested in adopting more environmentally friendly behaviours

☐ Other: Please specify_____

8) What is the most convenient way for you to receive information about sustainable living / energy efficiency? (tick your top three responses)

☐ SMS or text message

☐ Community workshops

☐ Advertising in my local newspaper

☐ Facebook

☐ Twitter

☐ Website

☐ E-newsletter

☐ Other: Please specify_____

9) What program or services would you like Switch your thinking to deliver in the future?

☐ Online learning modules

☐ Personal face-to-face consultations

☐ Advertising campaigns

☐ Community workshops

☐ In home advice

☐ School programs

☐ Website

☐ Other: Please specify_____

10) Are you male or female?

☐ Male ☐ Female

11) What is your age group:

☐ 18 or younger ☐ 18-24 ☐ 25-34 ☐ 35-49 ☐ 50- 65 ☐ 65+

12) How many people usually reside in your house?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ More than 6

13) Which suburb do you live in?

_____

If you wish to be entered into the draw to win one of two home sustainability prize packs valued at $250, please fill in your details and return your completed survey to us, using the enclosed reply paid envelope.

Name: _____

Address: _____ Postcode

Email: _____

☐ Please add me to your mailing list so I can find out more about how to save energy, water and waste and reduce my household's greenhouse gas emissions (please tick)

Daytime phone number (to notify you if you win):

_____

Appendix 4

Cost analysis of households without solar-PV

This analysis of a subgroup group of households has been undertaken for two reasons.

1. To assess the impact of different trial approaches on households without solar-PV generation
2. To undertake analysis enabling a discussion of real world costs. Due to the variability of feed in tariffs available for households producing electricity through solar-PV (varying from $0.08 - $0.48/kWh depending on the date of solar-PV installation) the price paid to the consumer was outside of the scope of cost analysis. This impacts the cost effectiveness analysis, as we assume that 1 kWh sold is equal in cost to one kWh purchased, which is a simplification to aid statistical analysis and not the real world case.

The results of annual electricity consumption for households without solar-PV (Table 16 and Table 22) indicates that households responded different to the program based on the presence or absence of solar-PV and is the basis of a further investigation into cost effectiveness.

Methods

Only households without solar-PV systems in the low intervention, test 1 and test 2 groups are included in this analysis. The methods for undertaking this analysis are the same as the analysis of all households included in Cost analysis. The same limitations also apply, namely:

At this stage of statistical analysis there are three major short comings with the analysis.

1. The data used is a subset (households without solar-PV) of the total data.
2. There has been no analysis of a suitable control group which would indicate whether electricity consumption in 2014 and 2015 are comparable.
3. There is no way to separate the effects of the interactions in the different test groups. Specifically this means that in the test 2 group (for example) there is no way to separate the savings generated from personalised feedback from voltage optimisation and SMS tips. Further statistical analysis is required to address these short comings.

Trial approaches

As per the cost analysis included in the report, the trial approaches were identified as activities differentiating the test groups, as detailed in Table 65.

Table 65 Switched on Homes trial approaches

Approach	Test group	Number of households included in analysis
SMS tips	Low intervention, test 1 and test 2	240
Personalised feedback	Test 1 and test 2	160
Voltage optimisation	Test 2	80

Units of measurement

- Cost-effectiveness analysis to be calculated in kWh saved during the trial year (2015) compared to the baseline year 2014
- Cost benefit analysis kWh converted into electricity saved in $ over the trial year (2015)
- Both cost effectiveness and cost benefit will be calculated as savings per household during the trial year

Results

A mean, median, maximum, minimum and standard deviation was calculated for each group in 2014 and 2015. The change in usage is calculated individually for each household as 2015 use minus 2014 use. Using the annual change values the change in usage mean, standard deviation, median, maximum and minimum are calculated.

Table 66 Summary of key statistics of annual electricity cost in households without solar-PV

Group	Variable	N	Mean	Std Dev	Minimum	Median	Maximum
Low Intervention	Cost in 2014	45	$1,319.50	$596.71	$297.01	$1,275.01	$3,097.65
	Cost in 2015		$1,257.56	$570.21	$291.20	$1,241.23	$2,891.70
	Change in Cost		-$61.94			-$43.64	
Test 1	Cost in 2014	36	$1,166.42	$670.80	$243.74	$1,005.99	$3,167.86
	Cost in 2015		$1,173.97	$613.98	$268.06	$1,001.85	$2,935.40
	Change in Cost		$7.55			$8.38	
Test 2	Cost in 2014	33	$1,193.67	$642.32	$442.99	$1,000.83	$3,459.61
	Cost in 2015		$1,158.94	$661.68	$385.80	$1,009.43	$3,554.57
	Change in Cost		-$34.73			-$23.85	

An analysis of households without solar-PV generated the key statistics shown in Table 22 and Table 66. Compared to the whole of group results (Table 18 Key statistics of annual electricity use per group in 2014 and 2015.), the treatments had different cost outcomes depending on whether the household had solar-PV. Table 66 excludes one household on a time of use tariff from the analysis that was included in Table 18. Table 22 and Table 69 both show that both the low intervention and test 2 groups were able to reduce mean costs and electricity consumption.

Total cost per household of trial approach

Table 67 Total cost of trial approach, including LIEEP funding and in-kind contributions.

	Number of	Cost of	Cost of	Cost of	Cost of	Total cost

	households included in analysis	approach per household (level 1)	recruiting and retention per household (level 2)	running an organisation per household (level 3)	participating in government trial per household (level 4)	of delivering approach through SoHo per household (sum of level 1 to 4)
SMS tips	240	$65.68	$480.28	$826.71	$1,603.97	$2,976.64
Personalised feedback	160	$813.24	$480.28	$826.71	$1,603.97	$3,724.20
Voltage optimisation	80	$1,870.27	$480.28	$826.71	$1,603.97	$4,781.23

The total cost per household remains the same as the analysis of all households. There is no recognisable difference in the cost of administering any level of the program based on the presence or absence of solar-PV.

Cost effectiveness analysis

Table 68 Cost per saving kWh for households with solar-PV by test group, including LIEEP funding and in-kind contributions.

	kWh saved per household	Level 1	Level 2	Level 3	Level 4	Total ($/kWh)
SMS tips	246.27	$0.27	$1.95	$3.36	$6.51	$12.09
Personalised feedback	0	$813.24	$480.28	$826.71	$1,603.97	$3,724.20
Voltage optimisation	131.52	$14.22	$33.77	$24.48	$65.53	$138.00

The cost effectiveness analysis undertaken compared mean annual electricity use per group in 2014 to 2015. Table 68 shows that the most effective trial approach is SMS tips (low intervention), followed by voltage optimisation (test 2). The personalised feedback group (test 1), that increased electricity consumption in the trial year (Table 22), were recorded as zero savings. SMS tips had a cost of $0.27 per kWh saved, however total cost of delivering this method through Switched on Homes was $12.09 per kWh. This indicates that an existing organisation rolling out SMS tips without stringent evaluation would be able to extend this approach at a relatively low cost per kWh abated. At a current market cost of $0.251 per kWh in a large scale and targeted approach to households without solar-PV this intervention could result in cost effective electricity reduction. Voltage optimisation costs $14.22 to administer to households (level 1 cost). Comparing the level one cost of

SMS tips and voltage optimisation, shows that SMS tips is approximately 52 times more effective per dollar spent in reducing electricity consumption in the first year.

As the analysis was based only over the trial period (a single calendar year) it is expected that the effectiveness of the voltage optimisation would increase over time, due to the multi-year payback period of voltage optimisation units. Other groups, which use behaviour change based approaches, are unlikely to increase benefits after the program ends. The cost benefit analysis of voltage optimisation units in the test 2 group (Table 63) showed approximate payback period of 20 years.

Cost benefit analysis

Table 69 Cost per dollar saved for test groups, including LIEEP funding and in-kind contributions.

	Savings per household	Level 1	level 2	Level 3	Level 4	Total ($ spent / $ saved)
SMS tips	$61.94	$1.06	$7.75	$13.35	$25.90	$48.06
Personalised feedback	$0.00	$813.24	$480.28	$826.71	$1,603.97	$3,724.20
Voltage optimisation	$34.73	$53.85	$13.83	$23.80	$46.18	$137.66

Table 69 indicates that the greatest cost saving and the approach with the most favourable cost benefit ratio was SMS tips (low intervention group), the trial approach with the most favourable cost benefit ratio is SMS tips. Although the cost effectiveness analysis was quite compelling for SMS tips, this does not translate to the cost savings. At level one (the cost of administering the approach), SMS tips cost $1.06 per dollar saved while the total cost was $48.06 per dollar saved in households without solar-PV. The cost for the voltage optimisation approach was higher, totalling $53.85 per dollar saved. The personalised feedback group, that increased electricity consumption in the trial year, were recorded as zero savings, but for each household involved in the trial cost $3,724.20.

As per the reasoning outlined in the cost effectiveness analysis, benefits of the voltage optimisation would increase over time, whereas the other groups would decrease or stay stable.

The same limitations of the current statistical analysis apply for the cost benefit analysis as the cost effectiveness analysis.

Differences in efficacy of approaches

Unlike in the analysis of all households (see discussion cost analysis), SMS tips are shown to be a cost effective approach in households without solar-PV. Conversely, the impact of both personalised feedback and voltage optimisation was less in households without solar-PV. The difference in outcome could be explained by the operation of the voltage optimisation unit or by the personalised feedback. While it is not possible to separate the effects of voltage optimisation and personalised feedback in the test 2 group, it is assumed that if the appliance mix is similar, which it should be due to the randomised allocation, that electricity and cost saved by voltage optimisation (test 2 group)

should be the same regardless of presence of solar-PV. This suggests a possible interaction between solar-PV and voltage optimisation which Switched on Homes did not determine. Based on the cost effectiveness and cost benefit analysis of households without solar-PV compared to the group as a whole (Table 64), it appears that personalised feedback is not an effective behaviour change tool regardless of solar-PV ownership.

While the results of this analysis indicate that SMS tips might be a more effective approach in some households, conclusions should be drawn with caution. At this stage, the analysis of the low intervention group excludes three phase households and the inclusion of this data could change the outcome.

Appendix 5

Program feedback comments

The following feedback was received from participants in the low intervention, test 1 and test 2 groups in 2016 survey (appendix 2 post-trial survey). The optional response question was "do you have any other comments or feedback for me to pass onto the Switched on Homes team?"

Treatment group	Do you have any other comments of feedback for me to pass on to the Switched on Homes team?
Test 2	Found the hints and suggestions about saving power very helpful and informative.
Test 2	Did enjoy being part of the program, found the SMS service interesting and useful.
Test 2	Enjoyed the program.
Test 1	Liked the tips, good reminder of relevant information.
Low Intervention	Respondent thought the hints they were receiving at the start of the program were really helpful, the hints at the end were not as helpful, they were quite obvious. Respondent thought the text message service was really helpful.
Test 2	Thank you for the tips throughout the year.
Test 2	Say thank you for advice and help they have given over last 12 months.
Test 1	Very happy she got involved in the program, a lot more aware of her energy use.
Test 1	Very good with everything.
Test 2	Respondent would like to know how the program went; he struggles to figure out if their decrease and stabilisation of voltage actually decrease their bill.
Control	Make the questions easier to understand and shorter.
Low Intervention	Helps to save money.
Test 2	Reduced voltage to 220 volts so elements burn as hot. Improved use of appliances because of this.
Test 1	Interesting project, SMS messages relevant and informative.
Test 1	She enjoyed it and gained a lot.
Low Intervention	Done a good job. Text messages really good information.
Test 2	Since unit on the wall huge increase in length of use of appliances with decrease in power subsequently.
Test 1	Thoroughly enjoyed it but twice got an SMS to say turn off second switch, but doesn't have one. Had turned the fridge up though.
Test 1	Thank you very much she enjoyed it very much.
Test 1	Enjoyed being a part of it. It was useful to look at the usage.
Low Intervention	Already pretty savvy but good reminder, should educate younger people about energy efficiency
Test 1	Enjoyed the text messages, very informative.
Test 1	Those living in retirement villages have no access to email. Need information other ways.
Low Intervention	Disappointed that more information wasn't available regarding personal usage, didn't see specific enough information. Would have led to greater efficiency.
Test 1	Very educational and I enjoyed doing it.
Test 2	They found it interesting to get the SMS every week.
Test 1	Really eye opening experience.

Test 2	All texts messages she had she couldn’t access them again so if there was a website for it.
Low Intervention	Good experience.
Test 2	Useful exercise.
Test 2	No during time didn’t have any troubles.
Test 1	SMS really interesting and helpful, got call when usage was too high which was appreciated.
Test 1	All of the things they suggested were very good and some of them they hadn't thought of before and now much more aware of what to do.
Test 1	Really was painless, easy to understand. The little SMS hints were really beneficial.
Test 1	Very happy but if they had the system for another year would continue.
Test 2	Thanks for helpful hints.
Test 1	It was good to be able to take part.
Test 1	Very enjoyable.
Test 2	Very good.
Test 1	Found most of suggestions are common sense so probably not a lot that actually needed to change.
Low Intervention	It went very well. Very well organised. Good opportunity to reduce energy consumption.
Low Intervention	Amazing trial.
Test 1	Very good experience.
Low Intervention	I learned quite a bit and put a lot into practice.
Test 2	Wonderful idea, wish hadn't been so badly ill.
Test 2	More information.
Test 1	Very good.
Low Intervention	No - happy to get the messages.
Test 2	Very useful SMS's outlined electricity use.
Test 1	Very happy bills decreased.
Test 2	Thank you for service.
Test 2	Very happy with the reports.
Test 1	50% of the advice was useful and the other 50% was more addressed to teenagers than adults.
Test 2	Quite interesting, some benefit.
Test 1	Solar panels are not worth it as the expense outweigh the savings.
Test 2	No - they have done a very good job.
Low Intervention	Most of suggestions in the SMS service were very basic, didn’t really help.
Low Intervention	Glad for all the tips.
Test 1	Enjoyed the process. Found it very interesting. Enjoyed getting the texts, gave an idea how she was going - good confirmation. Good getting prompt replies from program staff which was nice.
Test 2	Is a good program, power bill dropped.
Low Intervention	Efficient job.
Low Intervention	Good tips. Do not like the tip about the security light.
Test 2	Very good exercise.
Test 1	The text messages were not as useful as promised. It does not really help. Just monitoring on appliances would be better.
Test 2	Respondent would be interested to find out more detailed information about his electricity use, e.g. When he used the most, from what appliances etc.

Test 1	They enjoyed the program a lot. 99% of the time they already did the tips and they liked to know that they are on a good way
Test 2	Good program.
Test 1	Great project.
Test 1	The SMS did not help that much but it was a good program.
Test 2	She enjoyed it and it made her more aware.
Test 2	Enjoyable and easy process, well managed.
Low Intervention	He found it very beneficial to be involved.
Test 2	Didn't realise it was going on because they have smart power meter, hints helpful.
Control	No. Good idea.
Low Intervention	The tips are interesting.
Test 2	No quite useful. Knowing what they used was useful and should be implemented everywhere.
Test 1	.really enjoyed the program.
Low Intervention	She enjoyed it a lot.
Test 1	No but would like to get feedback on how energy use matches with bills.
Low Intervention	Good program.
Test 2	Noticed power was down with some appliances, didn't lower cost though.
Low Intervention	There are 4 adults living in the house and not two.
Low Intervention	Positive thing to be a part of. Reminded you to be more aware.
Test 2	Interesting experience, liked all the tips however they knew a lot of them.
Test 1	Did not get enough information.
Test 2	It was all done very professional.
Low Intervention	Common sense tips.
Test 1	Some of the information in the SMS are boring.
Test 1	Yes was supposed to receive texts every week but didn't.
Test 2	Thank you very much for all the effort.
Low Intervention	Good program.
Low Intervention	Very good program.
Test 2	I do not learn from it.
Test 1	Some energy smart tips unclear.
Test 2	Convey thanks for being a participant, really improved quality of life by lowering electricity bill.
Test 1	As less invasive as possible.
Low Intervention	For people who are already energy efficient many of the tips were redundant.
Test 2	If it wasn't for future costs, too greater cost for regulator.
Low Intervention	Thanks for vouchers.
Test 2	Didn’t find it very beneficial, a lot of money spent for the trial but didn’t get much benefit, respondent didn’t find the SMS feedback personalised enough - wasn’t very helpful
Low Intervention	Taught lots about being efficient.
Test 1	Most grateful for being able to participate. Made her more thoughtful about her energy usage and able to see which appliances are taking up the most power.
Low Intervention	Very pleased with their tips.
Test 1	Amazing job of making people more aware and where their power is going.
Test 1	No inconvenience

Test 1	Sometimes felt that what was on the text message had nothing to do with respondent's situation.
Low Intervention	Keep sending out reminders. Overall good.
Test 2	It was interesting. Good woolies vouchers. Allowed us to be more conscious.
Test 2	Learnt a lot and do think it was beneficial
Test 2	Quite happy.
Test 1	Commend the team for the scheme. Alerted to some improvements. Restricted because pensioners.
Control	Nothing really. Really Good idea though
Test 2	Job well done. Changed the way he looks at power. Very interesting.
Test 2	The system worked very well. Since put in usage has decreased because it has been stabilising.
Test 2	Nothing to add.
Test 2	Wonderful program.
Test 1	Would have done better if less people in house.
Test 2	Brilliant and have saved money.
Test 1	Very well run.
Low Intervention	Effortless.
Test 1	Good receiving weekly tips.
Test 1	Respondent would have liked to have been informed about how much electricity each of his appliances are using.
Test 1	The data that was sent via SMS was very interesting, thoroughly enjoyed.
Test 2	The texts sent were brilliant. Made her more aware of what was going on.
Low Intervention	Ideas and suggestions were very good.
Test 2	Very good idea and very informative.
Test 1	Very interesting, enjoyed the feedback she received.
Test 2	The follow up was really good, and really appreciate the opportunity.
Low Intervention	Information was very useful.
Control	Disappointing that they didn’t get to participate, due to an isolated incident with the position of their house.
Test 2	Really liked the voltage optimisation system.
Low Intervention	A lot of the suggestions were common knowledge.
Test 1	Respondent is now much more conscious of energy use.
Test 1	Great program, very helpful.
Test 2	Enjoyed getting the tips, learnt a lot.
Test 1	Make sure to use language that is very simple and understandable in the Energysmart tips.
Low Intervention	I don't want to be added to the email list due to all the messages, weekly, and received only one in which I wasn't already applying. They were all common sense.
Low Intervention	A tariff would force people to boil in summer and freeze in winter due to the suggested times. Switching them around would still save energy.
Low Intervention	Didn’t think anything in her electricity bill changed.