Alice Solar City
ENERGY CHAMPIONS

Residential Energy Efficiency Measures

Australian Government
Solar Cities

Alice Solar City

Final report

Residential Energy Efficiency Measures

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Acronyms

The following acronyms are used throughout the Alice Solar City reports:

Acronym	Meaning	Acronym	Meaning
ABS	Australian Bureau of Statistics	KRR	key results reporting
ADC	average daily consumption	kW	kilowatt
AS	Alice Springs	kWh	kilowatt hour
ASC	Alice Solar City	kWh/yr	kilowatt hour per year
ASTC	Alice Springs Town Council	LBEA	Large business energy audit
BMS	building management system	LBEEP	large business energy efficiency program
BP	BP Solar	LEDs	light emitting diodes
CAT	Centre for Appropriate Technology	LGA	Local Government
CEA	commercial energy audit	MER	monitoring, evaluation and reporting
CEC	Clean Energy Council	MWh	megawatt hour
CES	commercial energy survey	NB	new build
CFL	compact fluorescent lamp	NT	Northern Territory
CG	Control Group	OSB	one shot booster switch
CO_2	carbon dioxide	OTP	over temperature protection
CRT	cost reflective trial	PTR	pressure and temperature Relief
DB	database	PV	photovoltaic
DCCEE	Department of Climate Change and Energy Efficiency	PWC	Power and Water Corporation
Deg C	degrees celsius	REC	Renewable Energy Certificate
EC	electricity consumption	RET	Renewable Energy Target
EEM	energy efficiency measure	SBEEP	small business energy efficiency program
EEV	energy efficiency voucher	SD	Sunny Design
FUS	follow up survey	SHW	solar hot water
GHG	green house gases	SHWS	solar hot water system
GIS	geographic information system	SLA	statistical local area
GSM	global system mobile communication	SLC	Smart Living Centre
HEA	home energy audit	SMA	SMA Pty LTD
HES	home energy survey	SME	small to medium enterprise
HVAC	heating, ventilation and air conditioning	SRES	Small Renewable Energy Scheme
HW	hot water	STC	Small Scale Technology Certificate
HWS	hot water system	V	volt
ID's	Identities	VFD	variable frequency drive
IGUs	insulated glass units	W	watt
IHD	in house display	WELS	water efficiency labelling and standards
KAB	knowledge attitude and behaviour		

Introduction

This document reports on the energy efficiency measures (EEMs) component of the residential element in the Alice Solar City (ASC) program. It includes, and is structured around, the key reporting requirements for the Australian Government, which was the major funder through the national Solar Cities program. It provides relevant contextual and technical information, as well as documenting assumptions and rationales associated with information and data management. It also incorporates other aspects of relevance and interest.

The primary audiences are the program sponsors, and although the report is quite detailed, it is not highly technical and is suitable for interested readers. For additional information on ASC's residential program, refer to the range of reports available from ASC's website www.alicesolarcity.com.au.

1. Context

1.1 Background and Aims

Given the relatively extreme climatic conditions of Alice Springs, growing resident expectations of thermal comfort, and the consequent high energy use, a key goal of the ASC project was to promote the informed and intelligent use of electricity within the Alice Springs community. Physical EEMs and energy conserving behaviours contributed to this goal. The EEMs considered in this section do not include solar hot water, photovoltaic panel installations, or the cost reflective tariff trial, which are each the subject of separate reports. The aims of the Residential Energy Efficiency component were to:

- increase household and community awareness of the range of energy efficiency measures appropriate for Alice Springs, and to demonstrate that they are effective options for residents of Alice Springs.
- increase the uptake of household energy efficiency measures, particularly based on advice relevant to individual household circumstances.
- develop and establish a range of recommended EEMs suitable for Alice Springs, and to provide an opportunity to introduce appropriate new EEMs based on a rational investigation.
- contribute to reducing normal and peak demand on the electricity network, and to reducing greenhouse gas emissions.

To support these aims, ASC offered households registered with ASC:

- a free home energy audit (HEA) and associated free energy advice, with the opportunity for one or more follow-up support (FUS) engagements.
- financial incentives for undertaking a wide range of physical EEMs.

Discussion with the resident(s) was a key aspect of the HEA which took approximately 90 mins. Using prior electricity consumption data (if available), site audit information, observation and dialogue, the auditor reviewed household electricity consumption and self-reported electricity-use behaviour, and provided the householder with customised advice on electricity-use and a personalised report on their HEA. The report included recommendations for the implementation of EEMs (which may have been incentivised, non-incentivised, or behavioural). Site audit and household demographic data were collected at the time of the HEA. Energy efficiency vouchers (EEVs) for incentivised EEMs recommended in the report were posted to householders after their HEAs. It was then the householder's responsibility to implement the EEMs using a registered supplier.

1.2 ASC Targets and Actuals for HEAs and Household EEV Use

The initial project targets for residential HEAs and households that used EEV(s) were revised in mid 2009 based on project progress at that time. The targets for EEVs do not include solar hot water, photovoltaic panel installations, or the cost reflective tariff trial, all of which are considered and reported upon individually. The 10:10/20:20 incentive is included in this report, but is not included in the EEV targets or analyses, as vouchers were not issued for this incentive, although there was potential for a financial reward. Its results are presented separately in section 3.5 of this report. The overall targets and the actual results are shown in the tables below. HEA summary data is shown here for comparison with EEVs, and is elaborated in the Residential Overview report.

	Initial target	Revised target	Actual
Number of residential HEAs	1500	2250	2515
Number of households using EEVs	850	1750	1253

Table 1: Program targets and actual numbers for HEAs and households using EEVs

The targets and actual outputs by financial year for residential HEAs and households using EEVs are shown below:

Parameter	Financial year and numbers						
Residential HEAs	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	Total
Target	150	450	800	400	300	150	2250
Actual	207	560	888	383	315	162	2515
Number of households using EEVs	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	Total
Target Households	75	350	660	320	250	95	1750
Actual Households	25	222	483	211	193	119	1253
Total EEVs invoiced	35	316	768	365	385	285	2154

Table 2: Targets and actual numbers by financial year for HEAs and households using EEVs

No explicit household uptake targets were specified for individual EEMs in this report. Although residential Solar Hot Water and PV system installations, and the CRT trial all had targets, they are not considered here.
The number of HEAs exceeded the target by 12%, but the number of households using at least one EEV was significantly under the revised target by 28%.

1.3 Financial Incentives for Completing EEMs

Household eligibility to receive a financial incentive for an energy efficiency measure was dependent upon the completion of an HEA. For each incentivised measure agreed and recommended at the HEA, households received an EEV entitling them to a 35%/capped financial incentive for the implementation of the EEM. The incentives offered by Alice Solar City have changed over time, and those available during the course of the program are summarised below:

Energy Efficiency Measure	Start date	Discontinued date	Maximum Incentive
Installation of "One-Shot" Relay for solar hot water systems	10/03/2008		$150
Service of solar hot water system	3/10/2008		$200
Service of evaporative air conditioner	3/10/2008		$100
Install roof ventilation device	10/03/2008		$300
Paint roof white	10/03/2008		$750
Replace old roof with new white roof sheeting	10/03/2008		$2,500
Install ceiling insulation - batts	10/03/2008		$750
Install ceiling insulation - loose fibre	10/03/2008		$1,500
Replace ceiling Insulation - batts	10/03/2008		$1,000
Replace ceiling insulation - loose fibre	10/03/2000		$1,500
Retrofit insulation into walls	10/03/2008		$1,500
Install bulk floor insulation	18/04/2011		$750
Replace high energy usage lighting with energy efficient lighting	10/03/2008		$200
Replace 12V halogen downlight system with low energy option	10/03/2008		$350
Install motion sensors on external lighting	10/03/2008		$150
Tint windows	10/03/2008		$700
Install double-glazed windows	10/03/2008		$3,500
Install external shading on walls/windows	25/02/2009		$1,000
Install thermal "skin" over external walls	30/09/2009		$1,000
Replacement of perished fridge/freezer seals.	10/03/2008		$100
Replace your old refrigerator with a new, energy efficient model	15/07/2011		$508 *
Replace your old freezer with a new, energy efficient model	22/07/2011		$508 *
Surrender your old refrigerator or freezer	25/07/2011		$208 *
Purchase swimming pool cover	12/06/2009	2/08/2011	$350
Purchase swimming pool cover roller	2/08/2011		$200
Supply and install variable speed pool pump	1/12/2010		$400
10:10/20:20 – Considered as a separate category	10/03/2008		

Table 3: Energy Efficiency Measures and their incentive values

*ASC also organised and paid for de-gas and disposal of replaced and surrendered refrigerators/freezers, at a cost of $108 per unit which is included in the EEM incentive for the total cost of the EEM to the ASC.

Householders were expected to take responsibility for the implementation of EEMs for which they received an EEV. ASC provided customers with EEVs and a list of registered suppliers (contractors) who customers could contact to obtain quotes and arrange EEM installation. On completion of work, customers paid the installer directly for work undertaken - the total cost less the value of the ASC voucher – and gave the supplier the voucher. All EEVs, except replacing light globes, purchase of refrigerator, and installation of a pool cover/roller, had to be implemented by qualified trades people

and ASC did not issue vouchers for do-it-yourself actions. The installers provided ASC with the customer invoice and the voucher, and ASC reimbursed installers the voucher value (also refer to the Residential Overview). Although more administratively complex than simply providing customers with a refund once work had been completed, the EEV method aimed to reduce the initial financial barriers which could act as a disincentive to the implementation of EEMs.

EEVs had a currency of 4 months from issue (6 months for the first two years of the program), and if they had not been used in this time they were generally cancelled, unless a time extension had been requested. From mid-2009 householders who, according to ASC records, had not used an EEV approximately 2 months after its issue were sent a reminder email/letter alerting them to the situation, to the possible future EEV cancellation, and encouraging them to take action. However customers could normally reactivate a voucher once its initial period had expired and/or it had been cancelled. Customers who had a habit of requesting and then not using vouchers were asked to produce a quote for the measure to prove their intention of going ahead.

1.4 10:10/20:20 Incentive for ASC Customers

This incentive was available to all ASC residential customers. After joining the ASC project, customers could compare their Power and Water Corporation (PWC) quarterly electricity consumption invoices with those for the same quarter the previous year (if available). If customers made a reduction of between 10 and 19.9% in their kWh electricity consumption compared to the same quarter the previous year, they could claim a 10% rebate on the cost of the electricity consumed on their present invoice (daily supply charges excluded). If customers reduced consumption by 20% or more compared to the same quarter the previous year, they were eligible for a 20% rebate. To claim a possible rebate, customers had to supply a copy of their invoices to the ASC and ask for an assessment. If eligible, ASC paid the value of the rebates to PWC and the rebates were then provided to customers as credits on subsequent electricity bills.

The original and revised targets for the number of participants making claims under the 10:10/20:20 incentive are shown below:

10:10/20:20 incentive	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	Total
Original Targets		150	200	350	350	250	1300
Revised Targets		75	75	100	100	100	450
Actual Number of claims		61	122	144	85	133	545

Table 4: Program targets and actual numbers for the 10:10/20:20 rebate

The 10:10/20:20 incentive was designed as an incentive for customers to focus on achieving actual reductions in electricity consumption, providing an additional reward for their energy efficiency investments and/or behaviour changes. However in practice, in the first two years of the program, actual claims were significantly fewer than anticipated by the original targets. Consequently the targets were reduced in early 2010.

Eligibility to make a claim for the 10:10/20:20 incentive began once ASC customers received an invoice for one complete (generally 90 day) billing period after registration with ASC and, as with other ASC incentives, an HEA had to have been completed. ASC did not check customer billing records and instigate the claim process. Instead, interested customers had to take the initiative and provide ASC with a copy of the electricity bill on which they wished to make a claim, and ASC checked claim eligibility before lodging successful claims with PWC . This encouraged customers to monitor and understand their electricity bills, to contact ASC, and so become engaged in the process for this incentive. Information and a calculator was provided on the ASC website to help customers work out if they were eligible for the rebate - they could print out a work sheet or use the online calculator. They were also provided with information on how to read their power bill to assist them in this process. Data used in these analyses is until April 2013, when the final claim was processed. The results for the 10:10/20:20 incentive are presented in a separate section of this report and not in conjunction with EEMs for which vouchers were issued.

2. Design, Technical and Data Aspects for EEMs

2.1 Selection of EEMs

The EEMs initially made eligible for incentive were selected during the final design of the program in late 2007 and early 2008. The measures were to be largely funded through the RRPGP funding stream which was the largest funding source of the ASC program, and were therefore subject to the rules of this program which allowed for up to 35% funding of energy efficiency measures. The selections were based on knowledge gained from the successful Desert Knowledge Australia COOLmob project that had been providing low cost energy audits and energy efficiency advice to Alice Springs householders for several years. Additional EEMs were made eligible for incentive after research and discussion within the ASC team and with consortium members and the Commonwealth.

A guiding rationale was for measures to only be included where an energy efficiency gain could reasonably be expected to eventuate from the intervention, and where the primary benefit of the measure was an energy efficiency gain. A detailed desktop analysis of cost effectiveness was not undertaken.

Some compromise and recognition of issues faced by customers was required, evidenced for example for customers where the existing roof sheeting required replacing. The decision was to support the replacement of the roof sheeting with a high reflectance replacement as a more efficient choice than having new sheeting painted after installation, but the compromise was to only provide support for the material costs of replacing the sheeting (no support for labour costs).

Where practical, EEMs and the voucher issuing process were designed to target maximum energy efficiency gains and limit less effective installations, and the process of requiring a HEA prior to the issue of vouchers aided this. As an example, shading to windows was approved on a case by case basis after survey, or after a post-survey drive-by inspection by ASC staff, in an attempt to ensure installations were focused on windows with realistic solar exposure (avoiding installations which had solely a privacy or aesthetic benefit). Inevitably some EEMs had significant non-energy-efficiency benefits such as tinting windows and purchasing pool covers, but the educational benefit of linking these items to energy efficiency through incentives was a desired outcome.

Supporting the cost of servicing evaporative coolers was offered on the basis of encouraging the retention and use of these as a more energy efficient alternative to replacement with split system air conditioning (with the additional benefit of limiting the growth in peak demand being driven largely by split systems). Replacement of existing appliances and fittings was allowable, and typically no restrictions were placed on the disposal of the replaced equipment (e.g. replaced electric hot water systems). The introduction later in the program of incentives for replacing fridges and freezers did trial a more comprehensive approach, requiring firstly confirmation of an existing unit of sufficient age to provide confidence in a net energy benefit from an upgrade. ASC then required surrender of the existing appliance for which ASC arranged removal, degassing and disposal. This combination of measures was intended to increase the likelihood of an energy efficiency improvement from providing an incentive, allowing inclusion in the program in line with the principles stated earlier.

2.2 Estimated Annual Electricity Consumption Savings from EEMs

As part of the foundational work for Alice Springs household energy flows and potential EEM electricity savings, ASC staff undertook a series of theoretical calculations to provide reasoned estimates of average annual electricity savings associated with the implementation of each EEM. These estimates have been reviewed by persons external to ASC with expertise in this area. They were found to be logical, reasonable calculations, consistent with theory and experience, and acceptable as fair estimates for expected electricity savings. As such, they are considered accurate representations of potential savings (kWh/year) for typical housing stock and usage patterns in Alice Springs. This information is relevant to this report, especially to section 3 on the use of EEVs by customers, and is presented in the table below.

EEM	Estimated annual savings kWh	Assumptions used in calculation of estimated annual savings	Roundings
Paint roof white	200	1. Summer cooling 1950 kWh/yr – 35% gain through roof/ceiling: 1950x0.35 ≈ 700 kWh/yr 2. Paint roof white reduces heat gain by 30-35%: 700x0.32 ≈ 224 kWh/yr	Round to 200 kWh/yr, as about half houses have ceiling insulation, and also to allow for extra winter heating required.
Replace old roof with new white roof sheeting	200	Same as painting roof white	
Install roof ventilation device	20	Minimal effect during Alice Springs summer – estimate as 20 kWh/yr savings	
Install ceiling insulation - batts	350	1. Summer cooling and winter heating effect - 35% of total annual load enters/leaves house through roof i.e. 3400x0.35 ≈ 1200 kWh/yr 2. Ceiling insulation produces a 30% energy saving: 1200x0.3 ≈ 357 kWh/yr	Round to 350 kWh/yr.
Install ceiling insulation – loose fibre	350	Same as for batts	
Replace ceiling insulation - batts	230	1. Assume existing insulation is old and approximately one third effective 2. Replacement has two thirds the savings effect of new insulation: 350x0.67 = 235 kWh/yr	Round to 230 to allow for more effective old insulation.
Replace ceiling insulation – loose fibre	230	Same as for batts	
Install bulk floor insulation	150	1. Only if suspended floor – rare in AS 2. Summer and winter effect -15% of total annual load for suspended floor: 3400x0.15 ≈ 500 kWh/yr 2. Floor insulation produces a 30% energy saving: 555x0.3 ≈ 150 kWh/yr	
Retrofit insulation into wall cavities	200	1. Summer and winter effect -20% of total annual load: 3400x0.2 ≈ 680 kWh/yr 2. Wall cavity insulation produces a 30% energy saving: 555x0.3 ≈ 200 kWh/yr	
Install double glazed windows	200	1. Winter energy loss 20%: 1450x0.2 = 390 kWh/yr 2. Summer energy gain 35%: 1950x0.35 = 700 kWh/yr 3. Double glazing reduces energy flows by 30% in winter and 10% in summer: 390x0.3 + 700x0.1 = 187 kWh/yr	Round to 200.
Tint windows	140	1. Summer energy gain 35%: 1950x0.35 = 700 kWh/yr 2. Tinting reduces gain for sun-exposed windows by approx 40%: 700x0.4 = 280 kWh/yr	Reduce to 140 as assume half widows sun exposed.

Install external shading on windows/wall	300	1. Summer cooling on sun-exposed windows/walls 2. Window/wall average 30% of summer heat gain: 1950x0.3 = 585 kWh/yr 3. Estimate 50% exposure to allow for high summer impact over limited area, for selected high impact households: 585x0.5 = 293 kWh/yr	Round to 300 as variable area.
Install thermal skin over external wall	350	1. Summer cooling for sun-exposed masonry walls – if sun exposed walls, increase heat gain through walls to 30%. 1950X0.3 = 600 kWh/yr. 2. Assume 60% of this gain from sun exposed walls = 600x0.6 = 360 kWh/yr	Round to 350.
Replace 12v halogen downlights with low energy option	400	1. Replace average of 6 x 60W halogens running 4hrs/day: 6x60x4x347: Use = 500 kWh/yr 2. Replacement lighting uses one sixth energy of halogens: 500/6 ≈ 83 kWh/yr 3. Annual savings = 500 – 83 = 417 kWh/yr	Round down to 400 kWh/yr to allow for lower use, fewer lights.
Replace high energy use lighting with energy efficient lighting	400	1. Average lighting use estimated at 6% of 8700 = 522 kWh/yr 2. Low energy globes save 75%: 522x0.75 = 391 kWh/yr	Round to 400 kWh/yr.
Install motion sensors on external lighting	25	1. Assume 150W ext lighting for 1 hour/day average without sensor: 150x365 = 55kWh/yr 2. Use of sensors reduces time period by about 45%: 55x0.45 = 25kWh/yr	
Service solar hot water system	900	1. Generally if SHWS needs a service, then it's likely to be running on booster and/or there is water leakage. However, it may also be routine maintenance for efficient operation. 2. Therefore savings are highly variable depending on prior condition, and can vary from 0 to around 2600 kWh/yr if system is running continuously on booster 3. Auditor experience indicates many units in need of service are faulty – estimated average savings judged conservatively to be 900 kWh/yr (one third of maximum)	
Install one-shot relay on existing solar hot water system	400	1. Assume SHW working as average system – standard electric boost will use from 400 kWh/yr (for attentive householders 50%) to 700 kWh/yr (for inattentive – 25%), and up to 1400 kWh/yr (for excessive use – 25%), : take average of 700 kWh/yr 2. Use of one shot instead of standard electric boost; 65 days, 2 hours per day using 2.4kW: 130x2.4 = 312 kWh/yr. Round to 300 kWh/yr 3. Savings 700-300 = 400 kWh/yr	One shot use estimate rounded down to 300.
Service evaporative air conditioning unit	150	1. Assume average energy use is 1500 kWh/yr 2. Service improves effectiveness and allows for reduction of use by 10%: savings 1500x0.1 = 150 kWh/yr	

Replace perished refrigerator/freezer seals	100	1. Older refrigerator uses on average 700 kWh/yr 2. Replacing perished door seal improves efficiency by 15%: 700x0.15 = 105 kWh/yr	Round to 100.
Replace old style refrigerator/freezer with new energy efficient model	300	Old unit uses 700 kWh/yr. New unit uses 400 kWh/yr. Savings = 300 kWh/yr	
Surrender old style refrigerator/freezer	500	Old unit uses 700 kWh/yr in full year's use. Assume not used for 12 weeks of year. Savings = 700 X 40/52 = 540 kWh/yr	Round to 500
Purchase swimming pool cover or pool cover roller	600	1. Assume standard pump (1.1 kW) use without pool cover as follows: Summer 8 hrs/day for 180 days: 1.1x8x180 = 1584 kWh/yr Winter 4 hrs/day for 180 days: 1.1x4x180 = 792 kWh/yr Total annual consumption without pool cover = 2400 kWh/yr 2. With cover reduces summer pump hours by a half and winter pump hours by a quarter Summer savings = 800 kWh/yr and winter savings = 200 kWh/yr 3. Estimated annual savings with consistent proper use 800+200 = 1000 kWh/yr 4. Assume 60% effective use across pools. Average savings = 1000x0.6 = 600	For pool pump use, round to 1600 (summer) and 800 (winter).
Replace pool pump with variable speed model	1200	1. Standard pump (1.1 kW) without pool cover consumes 2400 kWh/yr (as above) 2. Variable speed pump reduces average consumption by 50%: 2400x0.5 = 1200 kWh/yr	

Table 5: ASC estimated annual electricity savings and related assumptions for each incentivised EEM

2.3 Rationales, Assumptions and Issues in Relation to EEV Data

Please refer to the 'Management and Data Aspects of the Residential Program' in the Registration Overview report for relevant descriptive information about registrations, terminations, tenure types and the control group in relation to EEMs. Further pertinent information follows.

1 Issues that may affect data:

- The total number of registration records did not reflect the actual number of properties/households signed up, as in landlord–tenant situations the registered property was counted twice, and the actual household was the tenant(s) living in the rental property.
- If both landlord and tenant secured ASC vouchers, then there are two registrations with vouchers linked to the one property.
- Similarly if a registration was terminated, the property sold, and a new owner signed–up with ASC, then vouchers could be issued against more than one registration (consecutively) for the same property, but different households.
- At any point in time, registration numbers less landlord numbers and terminations was a fairly accurate representation of the number of active households.
- Correlating implemented EEMs with changes in electricity consumption in landlord-tenant situations was complex, the numbers were very low and therefore this data was not included in analyses - for example the

installation of a SHW system was linked to the landlord and not the tenant, whose electricity consumption was stored in the database.

- At any time during the program, the real number of customers that had 'terminated' due to changed circumstances was likely to be more than the number recorded in the database, due to the notification/awareness time-lag. This also applied at the conclusion of the program.

2 The EEVs in the analysis have the following criteria: the customer was signed up prior to 31 August 2012; all EEVs have either been invoiced or cancelled; the implemented EEMs were all completed before December 31 2012; and financial records finalised by mid-February 2013.

3 The costs used in analyses are the invoiced total cost (as provided to ASC by suppliers), and the amount of incentive paid by ASC (i.e. the voucher value). Overall costs (across all customers) are summed from individual invoice records. The actual cost to the customer is calculated as the total invoice amount less ASC incentive amount.

4 EEMs/EEVs for fridge and freezer replacement or surrender were introduced in the final 2 years of the program. For each replacement or surrender an additional voucher was issued for the disposal and de-gas of the appliance at the local waste management facility. There were thus two vouchers issued for the one completed measure. In analysing numerical EEV data only the vouchers for replacement and surrender are included, and those for disposal are not considered; however, the cost for disposal and de-gas is included in the financial records.

5 EEM estimated annual kWh savings used in calculations are those presented in Table 5. The estimates are based on available regional and national information, and local industry experience. They have been verified by an expert external to ASC. As such, they are considered accurate representations of potential savings (kWh/year) for typical housing stock and usage patterns in Alice Springs.

6 The two CO_2 conversion factors used are taken from the National Greenhouse Accounts Factors published by the Australian Government. The factors are suitable for use over the 5 years of the program and are those published for the Northern Territory. The Scope 1, or direct emission, factor for the burning of fossil fuel to produce electricity is 0.68kg of CO_2 (or equivalent) released per kWh electricity consumed. Adding Scope 3 emissions (for transport of fuel to the generation facility and losses in the transmission of electricity from the place of its generation to end users), for which the NT figure is 0.11, gives 0.79kg of CO_2 released per kWh electricity consumed. Including Scope 3 emissions was not standard practice for the majority of ASC reporting, but is appropriate in the context of reductions in energy delivered to the end consumer (through energy efficiency and solar PV installations).

2.4 Reporting Structure

	EEV Sub-category:
3. EEVs	3.1 Number of households using EEVs against vouchers issued
	3.2 Conversion rates for different types of EEV according to incentive offered
	3.3 Key reasons why households do not utilise vouchers
	3.4 Number of households claiming each of 10:10 and 20:20 credits
	3.5 Number of households undertaking non-incentivised measures
	3.6 Total GHG savings for EEVs utilised

Table 6: EEVs reporting structure

3. Energy Efficiency Vouchers

3.1 Number of Households Using EEVs in Relation to Vouchers Issued

The table below is reproduced from the Residential Overview report and indicates that 2515 properties/households had a HEA that was eligible for incentives (registered up until August 2012). For a property registered against both the landlord and tenant, the HEA has been counted only once.

Tenure	Numbers of Properties	
	Unique property or registration	With HEA conducted
Owner-occupier	2446	2332
Tenant	194	169
Landlord - no tenant registered	34	14
Total	**2674**	**2515**

Table 7: Number of properties that received a HEA

As a HEA is a prerequisite for being issued with one or more EEVs, 2515 will be used as the indicative number of households eligible to receive EEVs and undertake EEMs. Though the number of EEVs issued to any given household varied depending upon household circumstances, preferences, and auditor recommendations, the majority of households received between 1 and 3 EEVs (with 10 being the maximum). Approximately 25% were issued with one EEV and 29% with two EEVs. The number of households that received the various numbers of EEVs is shown in the table below.

No. of EEVs Issued	All Registrations with an HEA		Registrations that were issued one or more EEVs	
	Count	%		
0	318	12.6	Count	%
1	560	22.3	560	25.5
2	635	25.2	635	28.9
3	479	19.0	479	21.8
4	257	10.2	257	11.7
5	139	5.5	139	6.3
6	79	3.1	79	3.6
7+	48	1.9	48	2.2
Total	**2515**	**100.0**	**2197**	**100.0**

Table 8: Count of households with the number of EEVs issued

Of 2515 registrations with an HEA, 318 were not issued with any EEVs. These included customers who did not wish or need to undertake incentivised EEMs, tenants and landlords who themselves did not receive a voucher, and HEAs in which no incentivised EEMs were recommended, but behavioural and non-incentivised EEMs may have been. There were 2197 households that received at least one voucher. Of the 2197 registrations that received EEVs, 944 (43%) did not use any voucher, and 1253 (53%) used at least one.

Overall there were 2515 households eligible to receive EEVs. A total of 5823 EEVs were issued to 2197 of these households, of which 1253 households used at least one EEV, with an overall total of 2154 EEVs used.

Of the households issued with EEVs, 57% of households used one or more EEVs. For the total number of EEVs issued, 37% were used. This data is summarised below.

Household group	Number and %	
	Number of households	Number of EEVs
Eligible households	2515	
Households issued EEVs	2197	5823
Households that used one or more EEVs	1253	2154
Percentage uptake	57%	37%

Table 9: Summary of EEV use by households

The distribution of the number of EEVs used by the 2197 households that received EEVs is shown below. This indicates that 43% of households did not use any of the EEVs issued to them, and that 47% used only one or two EEVs, leaving 10% of households that used 3 or more. A small number of households (33, or 1.4%) used 5 or more EEVs. The percentage use is also shown excluding households that did not use EEVs, i.e. in relation to the number of households (1253) that used one or more EEVs.

Number of EEVs used per registration	Number of registrations	Overall usage (%)	Percentage of registrations that used one or more EEVs
0	944	43.0	
1	719	32.7	57.4
2	311	14.2	24.8
3	129	5.9	10.3
4	61	2.8	4.9
5	21	1.0	1.7
6	8	0.3	0.6
7+	4	0.1	0.3
Total	**2197**	**100**	**100 (1253)**

Table 10: Number of EEVs used relative to numbers of registrations

A breakdown of the number of households issued with EEVs, the number using EEVs issued and the conversion rates is presented below. It shows that the registrations receiving higher numbers of EEVs achieved higher conversion rates in general.

Group: number of EEVs issued	Number of EEVs used	Registrations/Households		Number of households that used one or more EEVs	Total number of EEVs issued per group	Total number of EEVs used per group	EEV Conversion %age per group
		Count	% of group members				
0	0	318	100.0	0	0	0	
1	0	359	64.1				
	1	201	35.9			201	

		560		201	560	201	35.9
2	0	303	47.7				
	1	226	35.6			226	
	2	106	16.7			212	
		635		332	1270	438	34.5
3	0	186	38.8				
	1	162	33.8			162	
	2	91	19.0			182	
	3	40	8.4			120	
		479		293	1437	464	32.3
4	0	62	24.1				
	1	82	31.9			82	
	2	47	18.3			94	
	3	46	17.9			138	
	4	20	7.8			80	
		257		195	1028	394	38.3
5	0	18	12.9				
	1	29	20.9			29	
	2	40	28.8			80	
	3	26	18.7			75	
	4	18	12.9			72	
	5	8	5.8			40	
		139		121	695	299	43.0
6	0	11	13.9				
	1	16	20.3			16	
	2	16	20.3			32	
	3	11	13.9			33	
	4	14	17.9			56	
	5	5	6.3			25	
	6	6	7.6			36	
		79		68	474	198	41.8
7+	0	5	10.4				
	1	3	6.3			3	
	2	11	22.9			22	
	3	6	12.5			18	
	4	9	18.8			36	
	5	8	16.7			40	
	6	2	4.2			12	
	7+	4	8.3			29	
		48		43	359	160	44.6
		2515 (2197)		1253	5823	2154	

Table 11: Households using EEVs – number issued and number used

3.2 Conversion Rates for Different EEVs According to Incentive Offered

Conversion rates for the EEVs offered by ASC are shown below, together with the maximum available incentive, the total cost per EEM, the ASC incentive value per EEM, and its proportion of total cost.

EEV groups	Maximum incentive $	EEVs issued	EEVs used	% converted	ASC incentive $	EEM total cost $	% ASC contribution
Paint roof white	750	707	218	31%	122,934	362,759	34%
Replace old roof with new white roof sheeting	2,500	90	33	37%	62,134	215,555	29%
Install roof ventilation device	300	228	67	29%	12,857	37,688	34%
Install ceiling insulation - batts	750	241	39	16%	26,442	86,396	31%
Install ceiling insulation - loose fibre	1500	5	2	40%	2,541	7,260	35%
Replace ceiling insulation - batts	1000	34	4	12%	2,655	8,192	32%
Install bulk floor insulation	1000	1	1	100%	750	5,214	14%
Retrofit insulation into walls	1500	7	1	14%	1,478	4,224	35%
Replace high energy usage lighting with energy efficient lighting	200	1165	208	18%	11,663	45,097	26%
Replace 12V Halogen downlight system with low energy option	350	427	112	26%	24,954	86,579	29%
Install motion sensors on external lighting	150	58	10	17%	855	2,908	29%
Tint windows	700	126	68	54%	26,219	76,832	34%
Install double-glazed windows (IGU's)	3500	26	12	46%	23,386	76,982	30%
Installation of "One-Shot" Relay for solar hot water systems	150	296	111	38%	12,446	39,203	32%
Service of Solar Hot Water system	200	435	210	48%	38,389	137,972	28%
Replacement of perished fridge/freezer seals	100	95	23	24%	1,677	5,125	33%
Service of evaporative A/C	100	741	411	55%	40,018	152,774	26%
Install external shading on	1000	397	181	46%	137,389	485,955	28%

walls/windows							
Purchase swimming pool cover	350	407	234	57%	62,828	205,688	31%
Install thermal "skin" over external walls	1000	14	3	21%	2,424	9,543	25%
Supply and install variable speed pool pump	400	85	51	60%	19,150	64,855	30%
Replace your old refrigerator with a new, energy efficient model	400	92	53	58%	26,180	110,842	24%
Replace your old freezer with a new, energy efficient model	400	11	8	73%	3,048	9,427	32%
Surrender your old refrigerator or freezer	100	58	50	86%	9,847	9,847	100%
Purchase swimming pool cover roller	150	77	44	57%	8,153	26,742	30%
Totals		**5823**	**2154**	**37%**	**680,417**	**2,273,658**	**30%**

Table 12: EEV conversion rates for each incentive (March 2008 – December 2012)

Comments on EEV conversion rates:

- The overall conversion rate for EEVs is 37%, and the total cost of implemented EEMs is approximately $2.3M, with an ASC contribution of approximately $680,000, or 30% of the total cost.
- The average EEM cost was $1056, and average incentive received was $316.
- The correlation coefficient between the maximum dollar values of ASC incentives per EEM and the conversion rates per EEM was calculated. This was close to zero (-0.04), indicating that there is no correlation between these two parameters. There was thus no discernable influence of the value of the incentive on EEV conversion rate.
- The EEMs with an EEV conversion rate above 45% and at least 50 EEVs used were:
  - surrender your old refrigerator or freezer – 86% – an easy one as customers earned $100 to have an old item taken away
  - supply and install variable speed pool pump – 60%
  - replace your old refrigerator with a new, energy efficient model – 58%
  - purchase swimming pool cover or cover roller – 57%
  - service of evaporative A/C – 55%
  - tint windows – 54%
  - service of Solar Hot Water system – 48%
  - install external shading on walls/windows – 46%
- It is possible that various circumstances positively influenced EEV conversion, including:
  - preliminary customer intention to undertake EEMs (i.e. before ASC registration) that encouraged initial participation in the ASC project. In this instance, customer motivation is already present, thereby increasing the likelihood of specific EEV use after HEA
  - the relative ease associated with organising/undertaking specific EEMs (e.g. servicing an existing SHW system as opposed to installing a “one-shot” relay)
  - the lower overall costs in relation to other comparable EEMs (e.g. painting the roof white versus installing ceiling insulation)
  - perceived EEM effectiveness and/or attitude toward EEM
  - external issues influencing EEM uptake, such as the Government insulation rebate program that was offered nationally during ASC operation.

3.3 Key Reasons Why Households Did Not Utilise Vouchers

3.3.1 ASC data collection

During the first two years of the program, EEVs had a currency of 6 months which was then reduced to 4 months. ASC carried a financial commitment for vouchers issued, and it was important for both financial and planning purposes to ascertain, towards the end of voucher currency, if customers wanted to renew and use a voucher, or if they were happy to cancel the voucher. To accurately establish why households did not use EEVs proved a difficult undertaking, but ASC staff considered it useful to try and understand the reasons why customers did not make use of EEVs before their expiry dates. There were four sequential approaches, and all were problematic. A brief description of each follows.

- A tertiary environmental studies student on extended work experience set up a record system and phoned householders to ask if they wished to extend their voucher(s), and if not what were/was the reasons why they did not use the voucher. This process often required several phone calls to make contact, and participants did not readily discuss reasons. During this period the data base was modified to provide an editable drop-down list of possible reasons.

- After the student returned to studies, ASC staff continued to attempt to make phone contact close to the time of voucher expiry, but this proved very time consuming in relation to the information obtained. When contact was made, staff reported that customers were sometimes naturally reluctant to acknowledge that lack of finances was a contributing factor. To address the issues of staff time and customers' reluctance to share personal reasons on the phone, a short print survey was established and posted to customers prior to voucher expiry, with a reply-paid envelope. Response rates proved to be unsustainably low.

- Customers were informed that vouchers would be automatically cancelled after they expired, unless the customer contacted the ASC to request an extension. However for high dollar value EEMs attempts were made by ASC to contact customers by phone to discuss possible extensions or reasons for cancellation.

The resultant data from customers was obtained with some difficulty and varied in quality, as customers were generally reticent to provide reasons for non-implementation. A large number of EEVs were automatically cancelled by ASC upon expiry without obtaining a response from the customer. There were 5823 vouchers issued of which 2154 were used. The data available for those not used and hence cancelled in the ASC database is shown in the table below.

Reason from database list	%age	Grouped %
Cancelling automatically - no reason ascertained	42.16	71.70
Expired after 6 months, no response from customer	17.60	
No response/action to ASC email and phone	8.01	
Expired and issued > 12 months ago	3.22	
Vouchers cancelled on/after termination of reg	0.70	
Not within budget - no quotes received	5.85	8.68
Not within budget - at least 1 quote received	1.32	
Don't think it's worth it on economic grounds	1.52	
Moving town/house	2.13	2.13
Installed at own expense	4.15	4.15
Other projects/works preventing short term action	1.99	1.99
Don't think it's practical for the property	2.89	2.89
Didn't get round to it	1.70	3.33
Not had time to arrange work	0.41	
Had forgotten about vouchers	0.73	
Lost vouchers	0.41	

Unable to get installers to quote	0.09	
Used other grant/rebate program or alternative EEM	2.08	3.60
Replaced appliance instead of servicing it	1.37	
Replaced with new updated voucher	0.15	
Don't think it's worth it on environmental grounds	0.09	1.52
Objection to EEM on aesthetic grounds	0.06	
Other	1.37	
Total	**100.00**	**100.00**

Table 13: Overall reasons why EEVs were not used

The data above shows that, over the course of the program, approximately 72% of vouchers were cancelled without responses from customers. Further details about the remaining 28% are shown in the table below.

Reason from database list	%age	Grouped %	Grouped reasons
Not within budget - no quotes received	20.66	30.68	Financial
Not within budget - at least 1 quote received	4.65		
Don't think it's worth it on economic grounds	5.37		
Installed at own expense	14.67	14.67	Own expense
Moving town/house	7.54	7.54	Moved house
Other projects/works preventing short term action	7.02	7.02	Other priorities
Don't think it's practical for the property	10.23	10.23	Not useful
Didn't get round to it	5.99	11.78	Didn’t get around to it
Not had time to arrange work	1.45		
Had forgotten about vouchers	2.58		
Lost vouchers	1.45		
Unable to get installers to quote	0.31		
Used other grant/rebate program or alternative EEM	7.33	12.71	Alternative used
Replaced appliance instead of servicing it	4.86		
Replaced with new updated voucher	0.52		
Don't think it's worth it on environmental grounds	0.31	5.37	Other
Objection to EEM on aesthetic grounds	0.21		
Other	4.86		
Total	**100.00**	**100.00**	

Table 14: Reasons for non-use of EEVs excluding automatic cancellations

- Of those voucher cancellations for which a reason was ascertained, approximately 30% of cancellations were for financial reasons. Another 15% of actions were completed at the owners’ expense without any financial support from ASC, possibly do-it-yourself actions where tradesmen did not have to be paid, and thus, effectively, a financial reason.
- Overall, financial reasons account for approximately 45% of ascertained non-use of EEVs.
- Another group, in the order of 12%, did not get around to it or forgot about the vouchers, perhaps due to time or financial constraints.
- After consideration, and sometimes ASC site inspections, other customers (approximately 13%) replaced an original EEV with one more suitable for their needs e.g. service solar HWS rather than replacing it, tinting windows rather than external shading.

3.3.2 Commissioned telephone survey

In April 2012 ASC commissioned a telephone survey of ASC registrants to explore a number of pertinent questions about the ASC program. ASC had significant input into the design of the survey which was conducted successfully in July 2012, by McGregor-Tan Consulting. Three groups of ASC customers were canvassed in the survey – those that had used no EEVs (74), those that had used one EEV (113), and those that used more than one EEV (150) – a total of 337 responses, a significant number from which to generalise. In the context of a group of questions about EEMs, participants were asked an open-response question: "What were the impediments or barriers preventing you from using any of/other incentives offered specifically to your household?" Respondents could provide more than one barrier and this is reflected in the percentages in each of the EEV-used categories in the table below, in which the overall percentages are also shown.

Reason given at phone interview	Number of EEVs used			Overall %
	0 (n=74)	1 (n=113)	>1 (n=150)	
	% of responses			
Upfront cost	49	43	37	38.9
Time factors – too busy	11	11	4	7.4
Difficult process – quotes, planning etc	16	4	4	6.2
Voucher expired	8	3	0	2.6
Finding supplier	3	3	1	2.0
No real need for the EEM	0	10	5	5.2
Other priorities	1	4	3	2.7
EEM not considered effective	1	3	3	2.4
No barriers	7	0	5	3.5
Other	15	16	12	13.1
Don't know/not sure	5	15	25	16.1

Table 15: Barriers to EEV use from telephone survey

- Moving house would not have been mentioned by the telephone survey group as they were all still in the homes where they had done the HEA and received their vouchers.
- A range of other reasons (not recorded) and don't know/not sure have high response rates. If the 'don't know/not sure group' is removed, the 'upfront cost' barrier to EEV use increases to 46% of responses.

3.3.3 ASC data and telephone survey

There is a reasonable consistency between the data gathered by ASC and that from the telephone survey. Both sources of data indicate that financial reasons were the main barrier to the use of EEVs. Time and process factors, including 'not getting around to it', appear to be the next main barrier.

3.4 Number of Households Undertaking Measures without Incentives

ASC did not have any formal ongoing processes in place to obtain data from households about their implementation of EEMs for which they received no financial support from ASC. These could have been EEMs (with ASC incentives) which they did themselves, or any of a number of measures without incentives that may or may not have been recommended by ASC at the HEA or later. Thus there is no good quality comprehensive data available to address this question.

However there are two minor data sources that can provide some insights: (i) the McGregor-Tan telephone survey described in previously in 3.3.2; (ii) the follow up survey (FUS) offered by ASC to customers, and usually requested by customers sometime after their HEA. Data from these sources is described below.

3.4.1 Commissioned telephone survey

In the McGregor-Tan telephone survey participants in the three groups of ASC customers (no EEVs, one EEV, more than one EEV) were asked the open response question: "Have you undertaken any other recommended physical energy efficiency measures without obtaining an Alice Solar City voucher, or done measures not recommended by ASC?" If they answered 'yes', they were asked to elaborate. Initial yes/no responses are given below:

Have you undertaken any other recommended physical energy efficiency measures without obtaining and Alice Solar City voucher, or done measures not recommended by ASC?	Number of EEVs used			Overall %
	0 (n=74)	1 (n=113)	>1 (n=150)	
	% of responses			
Yes	43	42	45	43.5
No	52	58	50	
Don't know/not sure	5		5	

Table 16: Use of EEMs without incentives –from telephone survey

Of the respondents, 43.5% indicated that they had undertaken one or more such measures. The measures described are shown below.

Physical energy efficiency measures done without obtaining a Alice Solar City voucher, or measures not recommended by ASC	Number of EEVs done			Overall %age
	0 (n=74)	1 (n=113)	>1 (n=150)	
	%age of responses			
Installed energy efficient lighting	9	7	5	6.5
Installed energy efficient appliance(s)	9	8	15	11.3
Serviced solar HW or air conditioning	5	0	0	1.1
Installed solar PV	4	0	3	2.2
Installed ceiling insulation	4	5	4	4.3
Completed from of window treatment	4	7	5	5.5
Painted roof white	0	0	7	3.1
Others	15	11	11	11.9
Modified habits	0	12	3	5.4

Table 17: Types EEMs without incentives undertaken - from telephone survey

Use of more energy-efficient appliances and lighting are the two most common measures. Some form of window treatment and ceiling insulation are the second and third most common. Other non-specified actions constitute a considerable group.

3.4.2 ASC data collection through the FUS

The FUS offered by ASC had a number of options from a short consultation at the ASC office, to a second full HEA. Most were at some intermediate level, with a focus on a specific energy efficiency action/measure, or had distinct energy-saving orientation. FUSs became available in the latter half of 2011, and 160 were completed. As part of the FUS, the auditor had the option of asking (and recording in the database), what EEMs the customer had undertaken apart from those recommended at the HEA or requested after the HEA.

Of the 160 completed FUSs, only 10 had any data recorded about EEMs or actions without incentives, but this does not imply that only this proportion (6%) had undertaken such EEMs or actions, as, in the context of many FUSs, the question was not relevant and not asked. Those EEMs recorded are shown in the table below.

EEMs or actions without incentives	Number
Replace high energy usage lighting with energy efficient lighting	2
Replace 12V halogen downlight system with low energy option	1
Change your light globes - DIY	1
Purchase swimming pool cover	2
External shading on walls/windows	2
Service of evaporative air conditioner	1
Pool/spa improvements	1
Increase fan numbers - DIY	1
Make a difference: reduce pool pump hours/day	2
Make a difference: turn off electric hot water system when going away	1

Table 18: Types non-incentivised EEMs undertaken - from FUS data

3.4.3 ASC FUS data and telephone survey

It is evident that there is only a modicum of high quality data to elicit information about the implementation of EEMs and actions other than those for which customers received a voucher. Of the two sources, the telephone survey data is more valid due to the number of respondents, which means it is also likely to be more representative.

With a conservative interpretation of the data, it appears reasonable to conclude that about 30% of ASC customers undertook some physical energy efficiency actions that were not financially subsidised by ASC. These actions tended to be relatively easy or straightforward, such as replacing lighting, purchasing energy efficiency appliances, servicing units, or using other avenues (such as the earlier federal government ceiling insulation rebate).

3.5 ASC 10:10/20:20 Claims Option

To encourage reductions in household electricity use, ASC offered customers a 10:10/20:20 incentive. The incentive provided ASC participants with a 10% credit on their next electricity bill if they used 10% to 19.9% less units of electricity in any given billing period compared to the same period of the previous year. If electricity usage was reduced by 20% or more, a 20% credit was applied to the subsequent electricity bill.

Eligibility to make a claim under the incentive began once ASC customers received an invoice for one complete (generally 90 day) billing period after registration with ASC and, as with other ASC incentives, an HEA had been undertaken. ASC did not check customer billing records and instigate the claim process. Instead, interested customers provided ASC with a copy of the electricity bill on which they wished to make a claim, and ASC checked claim eligibility before lodging successful claims with Power and Water Corporation. This encouraged customers to monitor and understand their electricity bills, contact ASC and engaged them in the incentive process. Claims closed on April 30 2013, and data presented in the following tables is until that date.

Percentage reduction in consumption	Number of claims	Reduction in electricity use kWh	Incentive paid to claimants $
10-19.9	154	48,362	6,468
20 or more	391	350,465	35,426
Totals	**545**	**398,827**	**41,894**

Table 19: Summary of 10:10/20:20 claims

Number of claims per household	Number of households	Total number of claims
1	61	61
2	48	96
3	29	87
4	16	64
5	9	45
6	12	72
7	3	21
8	4	32
9	1	9
10	2	20
11	1	11
13	1	13
14	1	14
	188	545

Table 20 Number of 10:10/20:20 claims and number of households

Band of total kWh saved per household kWh	Number of households	Band of total value of claims per household $	Number of households
0-199	9	0-49.9	23
200-399	15	50-99.9	42
400-599	17	100-149.9	27
600-799	17	150-199.9	23
800-999	19	200-249.9	17
1000-1399	15	250-299.9	15
1400-1799	15	300-399.9	13
1800-2199	20	400-499.9	7
2200-2599	13	500-599.9	9
2600-2999	9	600-699.9	4
3000-3999	12	700-799.9	3
4000-5999	9	800 -1299	5
6000-7999	15		
8000-11600	3		
	188		188

Table 21: kWhs saved and values of 10:10/20:20 claims by number of households

Comments on the 10:10/20:20 claims:

- a total of 188 households made 545 successful 10:10/20:20 claims
- of the households making successful claims, 68% (127 households) made multiple claims
- the majority of claims (391 or 72%) showed a 20% or more reduction in electricity usage

- for all the billing periods compared in the claims, the total reduction in household electricity use was 398,827 kWh
- an incentive total of $41,898 was paid to householders through credits on PWC electricity bills
- the payments were at an average rate of 10.5 cents ($0.105) per kWh reduction
- one and two claims per household were the most common number of claims over the course of the program
- there was a significant number of households (42%) that made 3 or more claims, indicating ongoing efforts to reduce electricity consumption

3.5 Total GHG Savings for EEVs Utilised

3.5.1 Theoretical savings

Using the previously described (see Table 5) estimated annual savings per EEM (reduction in kWh/year), it is possible to calculate theoretical total kWh saved and thus reductions in GHG emissions based on EEM uptake. As shown in the table below, ASC EEM installations have the potential to reduce residential electricity consumption by approximately 818,760 kWh/year and in doing so, decrease GHG emissions by 556,757 kg/year.

EEV groups	Number of EEVs used	kWh/yr savings	Estimated effective life - years	Total savings per year		Cost $		Cost per year of life per kWh saved		Cost per year of life per kg GHG saved	
				kWh/yr	GHG kg/yr	Total	ASC	Total	ASC	Total	ASC
Paint roof white	218	200	10	43,600	29,648	362,759	122,934	0.83	0.28	1.22	0.41
Replace old roof with new white roof sheeting	33	200	25	6,600	4,488	215,555	62,134	1.31	0.38	1.92	0.55
Install roof ventilation device	67	20	15	1,340	911.20	37,688	12,857	1.88	0.64	2.76	0.94
Install ceiling insulation - batts	39	350	25	13,650	9,282	86,396	26,442	0.25	0.08	0.37	0.11
Install ceiling insulation - loose fibre	2	350	25	700	476	7,260	2,541	0.41	0.15	0.61	0.21
Replace ceiling insulation - batts	4	230	25	920	625.60	8,192	2,655	0.36	0.12	0.52	0.17
Install bulk floor insulation	1	150	25	150	102	5,214	750	1.39	0.20	2.04	0.29
Retrofit insulation into walls	1	200	25	200	136	4,224	1,478	0.84	0.30	1.24	0.43
Replace high energy usage lighting with energy efficient lighting	208	400	5	83,200	56,576	45,097	11,663	0.11	0.03	0.16	0.04
Replace 12V Halogen downlight	112	400	10	44,800	30,464	86,579	24,954	0.19	0.06	0.28	0.08

system with low energy option											
Install motion sensors on external lighting	10	25	5	250	170	2,908	855	2.33	0.68	3.42	1.01
Tint windows	68	200	15	13,600	9,248	76,832	26,219	0.38	0.13	0.55	0.19
Install double-glazed windows (IGU's)	12	200	25	2,400	1,632	76,982	23,386	1.28	0.39	1.89	0.57
Installation of "One-Shot" Relay for solar hot water systems	111	250	10	27,750	18,870	39,203	12,446	0.14	0.04	0.21	0.07
Service of solar hot water system	210	900	5	189,000	128,520	137,972	38,389	0.15	0.04	0.21	0.06
Replacement of perished fridge/freezer seals.	23	100	5	2,300	1,564	5,125	1,677	0.45	0.15	0.66	0.21
Service of evaporative A/C	411	150	1	61,650	41,922	152,774	40,018	2.48	0.65	3.64	0.95
Install external shading on walls/windows	181	300	15	54,300	36,924	485,955	137,389	0.60	0.17	0.88	0.25
Install thermal "skin" over external walls	3	350	25	1,050	714	9,543	2,424	0.36	0.09	0.53	0.14
Purchase swimming pool cover	234	600	5	140,400	95,472	205,688	62,828	0.29	0.09	0.43	0.13
Purchase swimming pool cover roller	44	600	5	26,400	17,952	26,742	8,153	0.20	0.06	0.30	0.09
Supply and install variable speed pool pump	51	1,200	7	61,200	41,616	64,855	19,150	0.15	0.04	0.22	0.07
Replace your old refrigerator with a new, energy efficient model	53	300	10	15,900	10,812	110,842	26,180	0.70	0.16	1.03	0.24
Replace your old freezer with a new, energy efficient model	8	300	10	2,400	1,632	9,427	3,048	0.39	0.13	0.58	0.19
Surrender your old refrigerator or freezer	50	500	5	25,000	17,000	9,847	9,847	0.08	0.08	0.12	0.12
Totals	***2154***			***818,760***	**556,757**	**2,273,658**	**680,417**				

Table 22 Theoretical impacts of ASC implemented EEMs on electricity use and GHG emissions

According to the assumptions and calculations that are part of the above table, some EEMs are more productive than others in reducing electricity use per unit cost, especially when their costs are amortised over the expected effective lifetime of the EEM. The top 8 are shown below.

Energy Efficiency Measure	Cost per year of life per kWh saved $		Cost per year of life per kg GHG saved $	
	Total	ASC	Total	ASC
Surrender your old refrigerator or freezer	0.08	0.08	0.12	0.12
Replace high energy usage lighting with energy efficient lighting	0.11	0.03	0.16	0.04
Installation of "One-Shot" Relay for solar hot water systems	0.14	0.04	0.21	0.07
Service of solar hot water system	0.15	0.04	0.21	0.06
Replace 12V halogen downlight system with low energy option	0.19	0.06	0.28	0.08
Purchase swimming pool cover roller	0.20	0.06	0.30	0.09
Purchase swimming pool cover	0.29	0.09	0.43	0.13
Install ceiling insulation - batts	0.25	0.08	0.37	0.11

Table 23: Cost efficient EEMs

3.5.1 Calculations of actual savings for EEMs

For a number of the EEMs, there was a relatively small group of households which had only implemented one incentivised EEM. To identify these households all measures were considered, including SHW, PV, CRT and 10:10/20:20, which have hitherto been excluded from this EEMs report, but which may have contributed to a reduction in household electricity use. The inclusion of these four measures reduced the number of households that had implemented only one measure from 719 (table 10 above) to 329. And for many EEMs the resulting number of sole-EEM households was low (less than 12), which was considered too low to include in calculations as a number would be removed in the process due to lack of adequate EC data.

In addition an adjustment was made using the data from the informal control group (ICG) (see Residential Overview report), in which and ADC per month for all non-ASC residential customers was calculated, followed by a change in the ADC around that month between the year after and year before the month. This ICG adjustment factor was applied to changes in calculated ADCs for EEMs by subtracting it form the year after- year before change in ADC.

The steps used in the calculations for actual changes, shown in tables below, were:

- Identify and filter-in those households for which the EEM under consideration was the sole EEM implemented - include SHW, PV, CRT and 10:10/20:20 and all other EEMs in those implemented.
- Run and ADC extract for the EEM under consideration – for one year before and one year after the supply date of the EEM
- In the ADC extract:
  - Identify (tag) those households for which the EEM was the sole EEM done
  - Remove households that had less than 300 days of EC data in both the year before (BP1) and the year after (AP1) EEM supply – this reduces the number of households in the data set
  - Calculate an average annual ADC across all the households with 300 or more data days in each of BP1 and AP1
  - Calculate the change in average annual ADC i.e. AP1-BP1; a negative number indicates a decrease in ADC, and a positive number and increase in ADC
  - Apply the informal control group adjustment factor by subtracting it from the AP1-BP1 change

- Split the households into two groups: (i) those for which the EEM was the sole recorded EEM, and (ii) those that had implemented the EEM and at least one other EEM
- Convert the average annual ADC change to an average yearly change (by multiplying by 365) and compare this to the theoretical estimated savings for the EEM (documented in table 5 above)

- Summarise the resulting data, as shown in the tables below

Paint roof white	Number of households with data	Average daily consumption kWh				Average annual change kWh		
		BP1	AP1	AP1-BP1	AP1-BP1-CG	Data	With CG	ASC Theoretical Estimate
More than 1 EEM	127	20.00	18.64	-1.36	-1.25	-496	-455	- 200
Sole EEM	22	17.95	16.98	-0.97	-0.96	-354	-351	

Table 24: ADC change around implementation of sole EEM – paint roof white

- Although the number is fairly low (at 22) it appears that painting the roof white has an impact on annual consumption comparable to the theoretical estimate

Replace halogen downlights with efficient lighting	Number of households with data	Average daily consumption kWh				Average annual change kWh		
		BP1	AP1	AP1-BP1	AP1-BP1-CG	Data	With CG	ASC Theoretical Estimate
More than 1 EEM	71	23.81	22.21	-1.60	-1.56	-584	-571	- 400
Sole EEM	7	17.25	16.52	-0.73	-0.44	-267	-159	

Table 25: ADC change around implementation of sole EEM – replace halogen downlights

- The number is very low (at 7) and the data from this group shows a decrease in annual consumption but less than the theoretical estimate – the control group data has a significant influence
- The BP1 ADC for the sole EEM group is a low base (17.25 kWh) from which to achieve a decrease

Service solar hot water system	Number of households with data	Average daily consumption kWh				Average annual change kWh		
		BP1	AP1	AP1-BP1	AP1-BP1-CG	Data	With CG	ASC Theoretical Estimate
More than 1 EEM	114	21.97	21.62	-0.36	-0.18	-131	-67	- 900
Sole EEM	30	18.25	17.68	-0.57	-0.26	-209	-94	

Table 26: ADC change around implementation of sole EEM – service SHW system

- The decrease in annual consumption is very much low than the theoretical estimate which is based on a SHW that requires servicing due to significant malfunction.
- The results may indicate that malfunctioning systems were replaced rather than serviced and that for many households that undertook the service it was an opportune and future cost saving action rather than a response to a pressing need.

Purchase swimming pool cover or roller	Number of households with data	Average daily consumption kWh				Average annual change kWh		
		BP1	AP1	AP1-BP1	AP1-BP1-CG	Data	With CG	ASC Theoretical Estimate
More than 1 EEM	169	29.41	28.23	-1.18	-1.28	-430	-469	- 600
Sole EEM	42	28.39	27.69	-0.70	-0.78	-257	-284	

Table 27: ADC change around implementation of sole EEM – purchase swimming pool cover/roller

- There was a decrease in annual consumption about half of the theoretical estimate which may reflect less than consistent use of the swimming pool cover.
- All households that purchased a swimming pool cover had higher than average ADC (28-29 kWh), probably reflecting the energy use associated with maintaining a pool

Install external shading on windows or walls	Number of households with data	Average daily consumption kWh				Average annual change kWh		
		BP1	AP1	AP1-BP1	AP1-BP1-CG	Data	With CG	ASC Theoretical Estimate
More than 1 EEM	100	23.49	22.16	-1.33	-1.32	-485	-480	- 300
Sole EEM	32	21.84	22.86	1.03	1.06	376	386	

Table 28: ADC change around implementation of sole EEM – install external shading

- The households that implemented external shading as the sole EEM showed a large increase in annual consumption, which seems an anomalous result. Although ASC aimed to support shading installations that would decrease solar input to residences, it is possible that some installations were more cosmetic than energy efficient.

Based on the calculations in this section for the limited number of EEMs that were 'sole EEMs' with adequate data, it appears that actual reductions in electricity consumption per ASC EEM, under average household living conditions, are generally less than the theoretical estimates, despite the latter being conservative.

4. Learnings and Issues

An overarching observation of the ASC voucher system trial is that it was administratively complex and difficult to communicate consistently and clearly to some customers and suppliers.

Open EEVs were represented as a financial commitment in the ASTC accounting system. Given the high rate of issue of vouchers in the first two years, the relatively low conversion rate, and low actual claim amount compared to the maximum value cap, this represented a significant financial over-commitment, until measures were put in place to optimise the forward commitment.

Ongoing review of the EEV process produced the following changes in 2008 and 2009:

- reduce expiry period to 4 months after issue
- limit of 3 vouchers per customer after HEA
- issue a reminder to all voucher holders at the 2 month mark
- add an "is post audit incentive" to capture the issuing of vouchers some time after the HEA

The voucher process was used to drive uptake of HEA, however many customers who participated in a HEA because they were required to do so in order to access incentives were difficult to engage with as a result. It is unclear whether the HEA had a positive impact in the face of begrudged participation. It is apparent that there was a small group of very motivated customers who received several vouchers and had a high conversion rate, in comparison to a base of customers with limited uptake and limited reductions in consumption.