Lifecycle cost of Solar Hot Water (financed by loan) vs. Electric Hot Water (bought with cash) in Alice Springs

	Solar hot water	*Electric hot water*
Capital cost	$3,400	$750
Less any rebates (PowerWater)	$1,050	$0
Annual running cost	$15	$325
Scheduled maintenance (every 5 yrs)	$250	
Unscheduled maintenance (3 over 15 yrs)	$150	$130
Life expectancy	15yrs	15yrs
Cash paid upfront	$0	$750
Loan amount (incl $50 fee)	$2,400	$0
Interest rate	11.95%	
Length of loan	4yrs	
Monthly loan repayments	$63	
Savings over 15 years	$1,839	

Observations

A standard 30L, 2 panel solar hot water (SHW) system has higher total costs for the first 7-8 years after purchase, but then saves around $2,000 in the last 7-8 years (almost the cost of a replacement SHW system).

The Centre for Sustainable Arid Towns therefore believes that with financing and rebates (see below) SWH systems are very cost effective for Alice Springs residents over the medium to long term.

We have also developed an Excel program that will assist you to calculate the lifecycle cost of an electric versus a solar hot water system for your specific requirements. Go to www.alec.org.au and follow the links to CSAT.

Solar Hot Water systems add value to your home

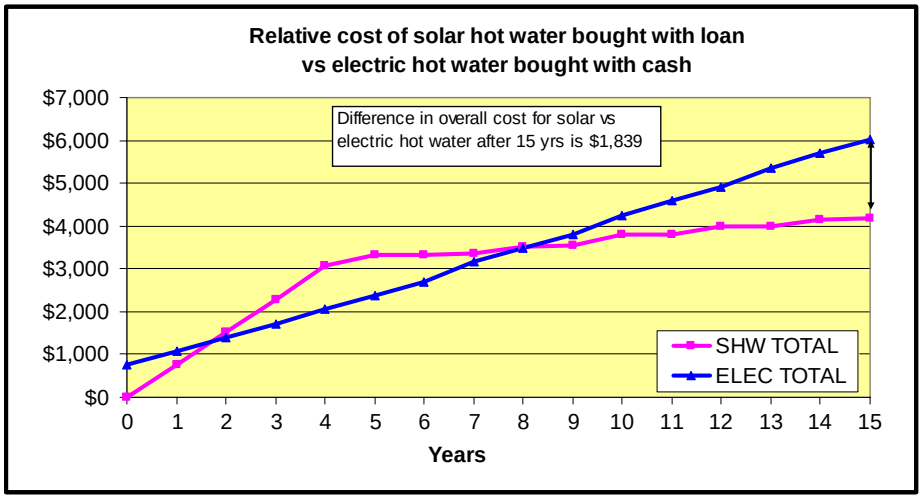
In NSW, the BASIX house rating scheme gives credit points for SHW systems and in the ACT, extra BASIX star ratings increase the value of a house. Therefore, the extra credits gained by a SHW in NSW are likely to add resale value to the house. If homeowners sell their house prior to 7-8 years, they can be relatively confident that the SHW system will always be more cost-effective than an electric system, given that the various scenarios show SHW systems are rarely more than $1,000 above electric systems in the first 7-8 years.

	Cost for solar hot water system					*Cost for electric hot water system*				
Year	SHW TOTAL	Upfront capital	Running cost	Maintenance	Loan repaymt	ELEC TOTAL	Upfront capital	Running cost	Maintenance	Loan repaymt
0	$0	$0			$0	$750	$750			$0
1	$765		$15		$750	$1,075		$325		
2	$1,530		$15		$750	$1,400		$325		
3	$2,296		$15		$750	$1,725		$325		
4	$3,061		$15		$750	$2,050		$325		
5	$3,326		$15	$250	$0	$2,375		$325		
6	$3,341		$15		$0	$2,700		$325		
7	$3,356		$15		$0	$3,155		$325	$130	
8	$3,521		$15	$150	$0	$3,480		$325		
9	$3,536		$15		$0	$3,805		$325		
10	$3,801		$15	$250	$0	$4,260		$325	$130	
11	$3,816		$15		$0	$4,585		$325		
12	$3,981		$15	$150	$0	$4,910		$325		
13	$3,996		$15		$0	$5,365		$325	$130	
14	$4,161		$15	$150	$0	$5,690		$325		
15	$4,176		$15		$0	$6,015		$325		
TOTAL	**$4,176**	**$0**	**$225**	**$950**	**$3,001**	**$6,015**	**$750**	**$4,875**	**$390**	**$0**

Financing for Solar Hot Water Systems

Power Water NT provides a rebate for SHW systems. A standard 2 panel, 30L Solahart 302J system attracts a rebate of $1,044 (as of 24/1/06). See www.powerwater.com.au for more details.

Solahart offers a one year loan scheme called “Smart Pay” for the purchase of their SHW systems, which is available only through authorised dealers. See www.solahart.com.au for more details.



The Bendigo Bank provide ‘Green loans’ for solar hot water systems with a 1% discount off the annual interest rate. You can call 1300 366 666 or see www.bendigobank.com.au to find out more.

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Solar Hot Water performance in Alice Springs

Results from one system

February – August 2005

Purpose of monitoring

Solar hot water (SHW) systems are known to work effectively in Alice Springs. However until recently, detailed analyses of performance have not been undertaken to inform design improvements or town planning decisions. To address this information shortfall, one solar hot water system has been opportunistically monitored from February to August 2005 (with monitoring ongoing).

Technical specifications

The monitored Solahart 302J unit and its installation are very typical for Alice Springs. 60% of houses have solar hot water and most are Solahart 302J systems (DIPE survey 2001).

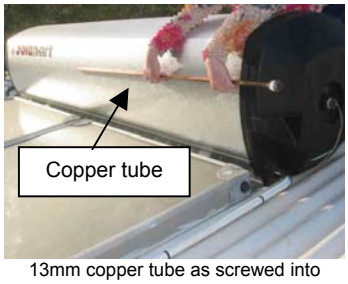
Monitored Solahart 302J unit

Property	Lot 7841 Lillecrapp Rd Alice Springs
House	3 bedroom
SHW unit	Solahart 302J two-panel 300-litre tank
Location	North roof. 20° pitch. No shading.
Booster	2400W electric 'one shot relay' in fusebox (push-button thermostat set to 60°C)
Install date	March 2002
Maintenance	None (to Sep 2005)
Occupants	2 adults, 3 children under 8yo.
Occupancy	Weekdays: 1 adult & 1-2 kids home. Weekends: all home.
Hot water fixtures	Shower (9L/min), bath, handbasin, kitchen sink, laundry tub (hot rarely used), front load washing machine (95% cold washes)
Consumption pattern	Typically 1 x morning shower, 1 x evening shower, 1 x evening bath, dishes washed at night, clothes washed during day.
Tempering valve	Set to 50°C, precedes all hot water fixtures.
Temperature probe	K type thermocouple temp probe inside 1.2m length of 13mm copper tube, screwed into blanking plug at end of SHW tank
Datalogger	DataTaker DT50. 30 min record intervals.

Temperature stratification

Solahart indicates that temperature stratification occurs in the tank, with hotter water nearest the outlet pipes at the top. The temperature probe is in the middle of the tank and recorded temperatures 4 to 8°C lower than the hot water that flows from the pressure relief valve outlet pipe.

Date	Probe temp (C)	Outlet water temp (C)	Diff.
16 Feb 05	80	85	5
10 Mar 05	69	73	4
12 Apr 05	70	75	5
2 Sep 05	50	58	8
Average			5.5



13mm copper tube as screwed into middle of tank

Water temperature

Water temperatures in the SHW tank varied daily with use, sunshine (cloudiness) and night-time thermal loses. In summer (Feb-March) average temperatures ranged from 63 to 82°C and peaked at 88°C (probably 93°C plus in upper parts of the tank). In winter (May-July), temperatures were far lower, averaging 29 to 58°C, with extremes of 15 and 72°C. Night-time thermal loses from the insulated tank averaged 15 to 20°C in winter (6°C min air temp) and 12 to 15°C in summer (18°C min air temp). Hot water was rarely used between 9pm and 7am so the tank was not 'robbed' of heat at night.

Month	Air temperature		Solar hot water temperature	
	Average min (C)	Average max (C)	Average min (C)	Average max (C)
Feb 05	18.3	35.0	62.9	82.0
Mar 05	17.6	35.2	63.7	80.9
Apr 05	15.5	33.1	59.5	75.3
May 05	7.6	26.0	37.8	57.6
Jun 05	6.2	21.0	28.7	51.3
Jul 05	5.2	19.3	32.9	54.4
Aug 05	5.6	22.4	39.0	61.2
Average	10.8	27.4	46.4	66.1

Air temp from BOM data

Monitoring by

Centre for Sustainable Arid Towns

Contact CSAT via www.alec.org.au

CSAT is a knowledge-based consultancy helping clients to achieve efficient, cost-effective and intelligent resource use in arid land communities.

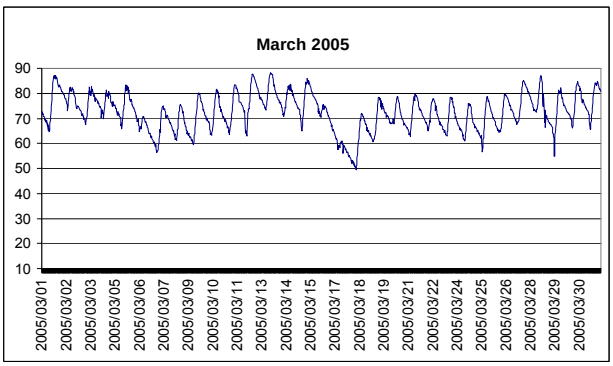
Monitoring equipment supplied by

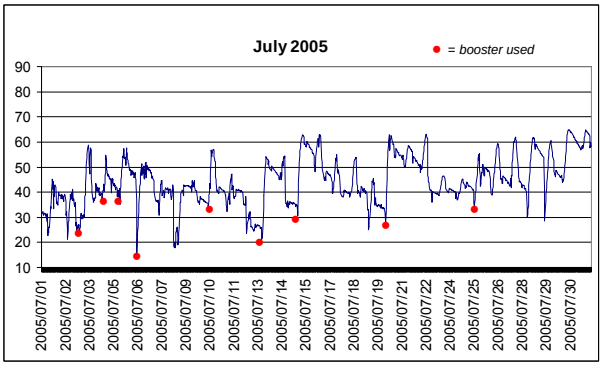
PowerWater

Solahart

Solar Hot Water performance in Alice Springs (cont)

Typical monthly temperature profiles





Sunshine hours

The sun generally raised SHW temperatures from 8.30am to 5.30pm (9 hrs) in summer and 9.30am to 5pm (7.5 hrs) in winter. Alice Springs is amongst the sunniest places in Australia due to long days and relatively cloud-free skies. From February to August 2005, Alice Springs averaged 9.5 hours of sunshine per day. Only 22 of the 210 days from February to August had less than 6 hours of sunshine. In comparison, Melbourne, Brisbane and Perth average 6, 7.5 and 8 hours of sunshine per day annually.

Month	Sunshine
	Average hrs/day
Feb 05	10.0
Mar 05	10.1
Apr 05	10.3
May 05	9.6
Jun 05	8.3
Jul 05	8.4
Aug 05	10.1
Average	9.5

BOM data

Temperatures below 60°C

There is a theoretical risk that SHW systems may allow the growth of Legionella bacteria if water is stored below 60°C[1]. For the monitored SHW system, water temperatures were below 60°C for almost the whole of May to August (an average of 22 hours per day). In summer (Feb-Mar) water was above 60°C for all but 1.1 hours per day (on average). [1] 'Public Health Aspects of Rainwater Tanks In Urban Australia' Occasional Paper 10, CRC for Water Quality and Treatment.

Month	SHW temp	
	No. days <60C	Average hours/day <60C
Feb 05	4	1.1
Mar 05	6	1.1
Apr 05	15	3.1
May 05	31	21.4
Jun 05	30	24.0
Jul 05	31	22.5
Aug 05	31	19.7
Average	21.1	13.3
Total	148	

Booster use

The booster is a 2,400W 'one shot relay' push-button booster manually pushed by occupants when hot water feels luke warm. It stays on until water in the tank reaches 60°C then turns itself off.
The booster was used only 14 times over the 2005 winter. The average water temperature was 26°C when activated and 58°C when the booster finished. The booster stayed on for an average of 4.7 hours each time. Electricity costs averaged $1.59 per boost or $22 for the winter (14.02 c/kWh). An alternative booster is a push-button timer that stays on for 1.5 hours before turning itself off, no matter what the water temperature. This would have used only $7 of electricity for 14 boosts (saving $225 over 15 years) but with high water demand may have been activated more often.

Month	Booster use	
	Total no. boosts	Total hours boosted
Feb 05	0	0
Mar 05	0	0
Apr 05	0	0
May 05	0	0
Jun 05	4	19
Jul 05	9	43
Aug 05	1	4
Average	2.0	9.4
Total	14	66
Cost		$22.21

Electricity use by manual on-off booster switches has not been measured in Alice Springs despite their prevalence. Many households turn their boosters on in May and leave them on until September. It is expected this uses around $200 of electricity per year (based on electric hot water systems using around $330 per year, proportionally more in winter than summer).

Water use

A cold-water tempering valve is fitted to the solar hot water outlet to prevent scalding hot water exiting taps in summer. It is set at 50°C. In summer (Feb-March), almost half of water exiting hot taps was mixed cold water (57 L of 124 L/day) whilst in winter (May-July) only 20% of water was mixed cold water (36 L of 178 L/day). Winter hot water use was higher than summer due to longer/fuller showers/baths. Hot water use is typical for Alice Springs (ASP averages around 150 L/house/day).

Tempering valve & 1 of 2 water meters for SHW tank

Month	Hot water use		
	Total (L/day)	Hot from SHW (L/day)	Cold from tempering valve (L/day)
Feb 05	122	69	53
Mar 05	126	65	61
Apr 05	128	67	61
May 05	181	142	39
Jun 05	159	125	34
Jul 05	195	160	35
Aug 05	169	127	42
Average	154	108	47

Further data
Detailed data sets from this monitoring are available from CSAT.
csat@ozemail.com.au ph 08 8952 6066.

Additional monitoring
CSAT monitors many household appliances incl. electric hot water systems, refrigerative and evaporative air conditioners, building thermal performance, water consumption. Contact CSAT for details.

Booster Use for Households with Solar Hot Water (SHW)

ALICE SPRINGS

May – Sep 2005

Summary of Results

24 Alice Springs households with solar hot water (SHW) monitored their electric booster use through the winter of 2005 (May-Sep). Summer monitoring was not undertaken as boosters are rarely if ever required during the hotter months in Alice Springs. Six households turned their boosters on for more than 45 days of winter, and appear to have SHW systems that are inappropriate for the amount of use they receive. With these exceptions the remaining households used their booster on average for 10 separate days in the 5 months (using approximately $17 of power). These results indicate that SHW systems are effective during winter (May to September) for the majority of Alice Springs residents.

Standard Solarhart 302J SHW system

Types of Boosters

Manual On/Off Switches – Common in older systems. When on, this booster effectively turns a SHW system into electric water heater. The use of these boosters throughout winter can use up to $150 power/ year.

Daily Timer – 24 hr timers set to turn a booster on and off each day at certain times. Boosters are unfortunately often on when not necessary and therefore can use up to $30 of power in winter months.

Push-Button Timer – Householder activates the timer button and booster stays on for certain time (often 90 minutes). Costs approximately $8/year in power if used only in winter when the household requires.

One-Shot Relay – Similar to a push button timer, the relay's button is pushed and stays on until water reaches a pre-set thermostat temperature. Costs approximately $8/year in power if used only in winter when the household requires.

CASE STUDY

From Nov 2002 to April 2004 CSAT monitored a donated Solarhart 302J at the Alice Springs Cool Living House. The results showed that the SHW system used far less electricity than an electric unit but a timed booster used considerably more electricity than a one-shot-relay booster.

Background

Solar hot water (SHW) systems are known to work effectively in the ideal solar climate of Alice Springs. Approximately 60% of houses in Alice Springs use solar hot water, mostly Solarhart 302J models, and virtually all boosters are electric due to high gas costs (both installation and ongoing).

CSAT opportunistically monitored the water temperature of one solar hot water system from Feb to Aug 2005. This data is summarised in a CSAT Fact Sheet (*'Solar Hot Water performance in Alice Springs, Results from one system: February – August 2005)*. In summary, SHW temperatures in summer were found to be between 63-82^{o}C and winter temperatures of 29-58^{o}C. The booster was only used 14 times between May and Aug, costing $22. At SHW temperatures below 60^{o}C, the booster was not used even though at this temperature there is a theoretical risk of Legionella bacteria growth in the hot water tank.

Climate

Temperatures between May and September 2005 ranged from 5.2^{o}C to 30.3^{o}C with average sunshine of 9.3 hrs/day and cloudiness of 2/8ths. The table opposite summarises the climatic conditions experienced throughout the monitoring period.

Month	Air Temperature		Sunshine	Cloudiness	
	Average minimum (^{o}C)	Average maximum (^{o}C)	Average hours/day	Average at 9am (8th)	Average at 3pm (8th)
May 05	7.6	26.0	9.6	3	3
Jun 05	6.2	21.0	8.3	2	2
Jul 05	5.2	19.3	8.4	2	2
Aug 05	5.6	22.4	10.1	1	1
Sep 05	13.6	30.3	10.0	2	2
AVERAGE	**7.6**	**23.8**	**9.3**	**2**	**2**

Climate data for Alice Springs – May to Sep 2005

Methodology

24 households took part in the monitoring. Householders were given a monitoring sheet which they were asked to place near their booster switches. Throughout winter 2005, from May to the end of September, householders were asked to note on this sheet every time they turned the booster on and off and the reasons for use. NOTE - CSAT recognises that participating households are likely to be more diligent about their booster use than the average household, demonstrated by their voluntary involvement in this monitoring project.

General Trends

The majority of participants lived in houses with 2 panel SHW systems, 1-6 years old. Except for one house with a push button thermostat, all of the houses had manual on/off thermostat type boosters, with no shading over solar panels - a typical Alice Springs scenario.

The graph on the opposite page indicates the number of days on which a booster was used in winter 2005 for all households. These average usage figures do not indicate the exact amount of time that boosters were used but gives a comparative figure of the number of separate days the booster was

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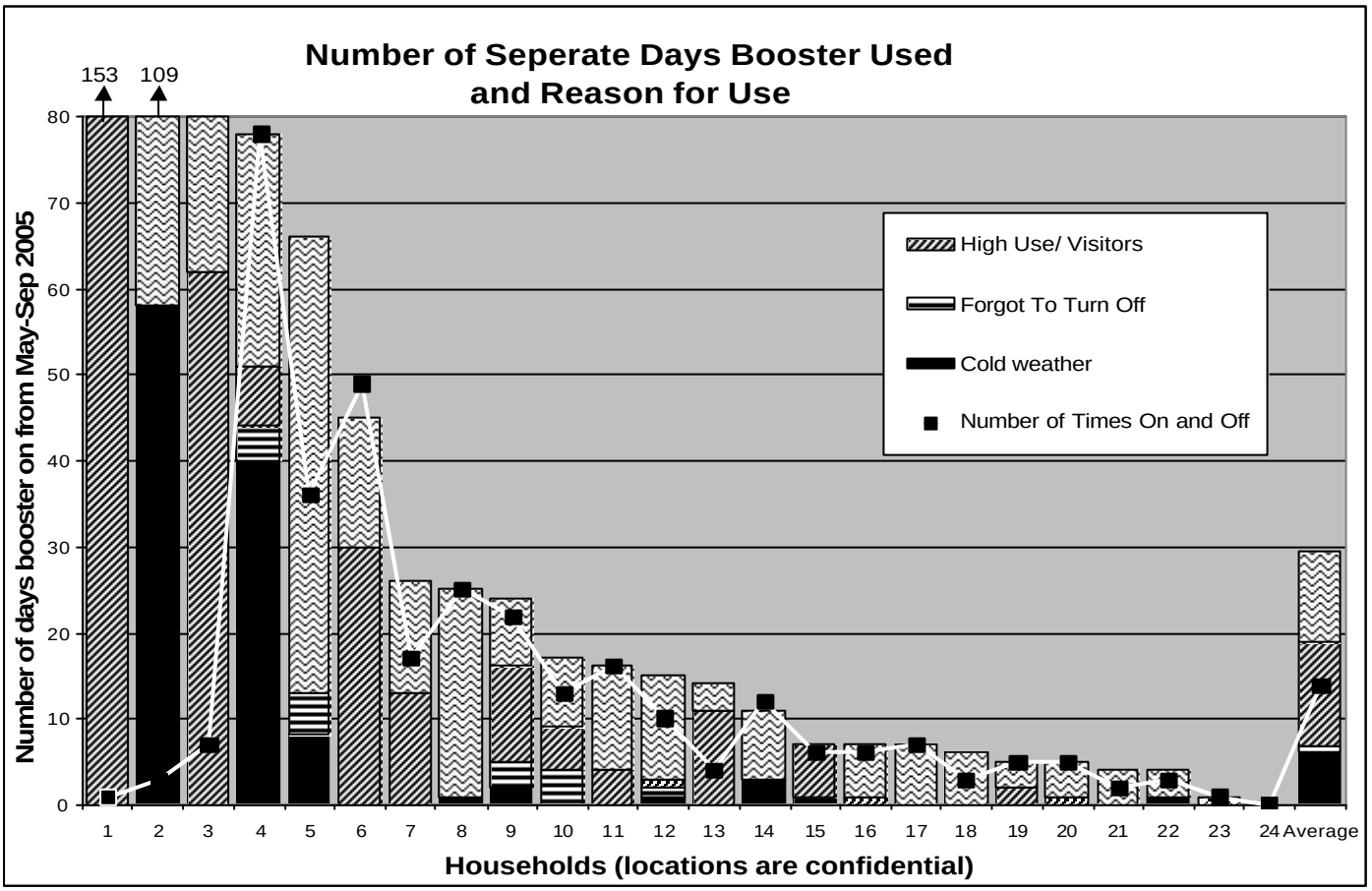
in use. Reasons for booster use varied amongst residents but was most often as a result of cloudy, overcast weather (on average, 11 days per household) when there was insufficient sunshine to ensure adequate water heating.

Visitors and high water use were also reasons for turning on boosters (10 days on average for each household), often in combination with overcast weather. The white line on the graph indicates the number of times the booster was turned on and off. Six residents kept their boosters on for all or most days in winter (more than 45 days). However the majority of residents were actively turning their boosters on and off, mostly on a daily basis, so the number of times the SHW system was turned on and off is generally very close to the total number of days the booster was in use.

Including the six households where the booster was on for the majority of winter, 30 days was the average days that boosters were in use over a 5 month period (153 days). Without these six households, the average use was 10 days, equating to approximately $17 of power per winter period.



Comments from participants

"Over winter, no booster is needed for 3 people, but we leave the booster on if 5 people are in the house. When there is 4 people in the house we have to turn the booster on and off, which is where a one shot boost or a timer would be most useful"

"Our system (180L Beasley with single panel) does not cope well in winter and when the booster is on. I suspect the booster kicks in before the sun has had a chance to heat up the panel."

Type of residence	?	24 houses
Number of solar panels	? ?	18 households with 2 solar panels 6 households with 1 solar panel
Age of hot water system	? ?	Ranged from 1-15 years Majority between 1-6 years
Shading over solar panels	? ?	16 households had no shading 8 households had some shading
Booster type	? ?	1 push button thermostat 23 manual on/off thermostats

Summary of household solar hot water specifications

Conclusions

The results of this monitoring indicate that for the majority of Alice Springs residents, a standard SHW system is adequate for winter hot water consumption except on a small number of days. For residents who needed the booster on throughout winter, their systems may be an old or inefficient system. These residents should consider a larger SHW system or alternatively install a booster on a daily timer to reduce electricity consumption over winter. Further investigations are required into how long boosters stay on every time they are activated and how often boosters which are permanently on, cycle on and off.

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