Results of the Largest Residential Demand Management Program in Australia

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Abstract This paper provides details and the results of an evaluation study carried out on the largest residential demand management program in Australia, the Sydney Water Corporation (SWC) 'Every Drop Counts' residential retrofit program. The program involves a certified plumber visiting individual houses, replacing where possible inefficient fixtures, checking and repairing leaks and providing general advice. The evaluation conducted measured the water savings of participants of the program and compared them to a control group. Savings of 20.9 ± 2.5 kilolitres per household per annum (kL/hh/a) were found from statistical analysis of water meter readings of the sample of single residential households analysed. These individual savings effectively provide SWC with a potential total saving of 3,344 ± 400 megalitres per annum (ML/a) for the single residential houses retrofitted alone (i.e. 80% of the 200,000 households retrofitted to date). The evaluation identified that no 'decay' in average savings were found over the maximum four year period assessed. Other factors evaluated during the study included: analysis of individual water efficiency measures; comparison of savings with other evaluations; and savings related to occupancy ratio, geographical grouping, income category and defined socio economic categories. This paper will be of interest to: water service providers and water efficiency specialists wishing to undertake evaluation work to understand some of the complex issues that need to be considered; to justify to those determining whether it is of value to invest in evaluation that a great deal of information can be gained; and to those collecting data that sample size and accuracy of data are extremely important when attempting to interpret results.

Keywords Demand management/water efficiency programs; evaluation; Australia.

Background

The program was initially piloted on over 3,500 households from April to July 1999[1]. Following evaluation of the pilot which identified savings of 19.6 kL/hh/a (± 5.0 kL/hh/a), it was decided that the program would be offered more widely in the Sydney area and used to assist in achieving the 2011 target of reducing per capita demand by 35% from 1991 levels (i.e. from 503 litres per capita per day (LCD) to 327 LCD). Since the program was launched in January 2000, over 200,000 households have participated in the program, which offers householders a visit by a certified plumber. The plumber visit includes where possible: replacement of inefficient showerheads, installation of tap flow regulators, installation of toilet cistern flush arrestors, checking of leaks and general advice on water saving in the

1 The Shellharbour Residential Retrofit Progam (Day, 2001 and Sarac et al, 2002).

home. The total cost of the visit is $130 (AUD) but the customer is only charged $22 (AUD) and is given the service 'free of charge' if they can prove low income or concession card status.

In 2003 SWC commissioned an evaluation study (Turner *et al*, 2004) of the program to:

- identify the annual demand reduction achieved by the retrofit program to assist in providing an overall estimation of the program's contribution to SWC's demand reduction target;
- determine whether savings are maintained over time;
- investigate the proportional impacts of various efficiency measures on savings to assist in understanding the cost effectiveness of implementing various measures; and
- investigate the impact of demographic, geographic or other factors to inform future decisions on target populations for similar programs.

Methodology

Of the 200,000 program participants a large sample of over 24,000 randomly selected single residential household participants and an equal number of non participants (representing the control group) were used for the analysis. The purpose of using the control group was to correct for variations in demand that occur due to factors other than the retrofit itself such as the impact of weather variables and water restrictions. The controls were chosen such that each program participant household had a matched pair control group household that is geographically as close as possible to the program participant household (e.g. same street) and yet is not a participating household.

The program participants analysed received retrofits during the period January 2000 to September 2002 with the first retrofits being conducted in quarter January to March 2000. Figure 1 shows the quarterly demand of the participants and matched controls for the entire period analysed. It also shows the participants in the sample increasing per quarter as additional households receive retrofits and the reduction in demand (savings) obtained by participants after retrofits take place.

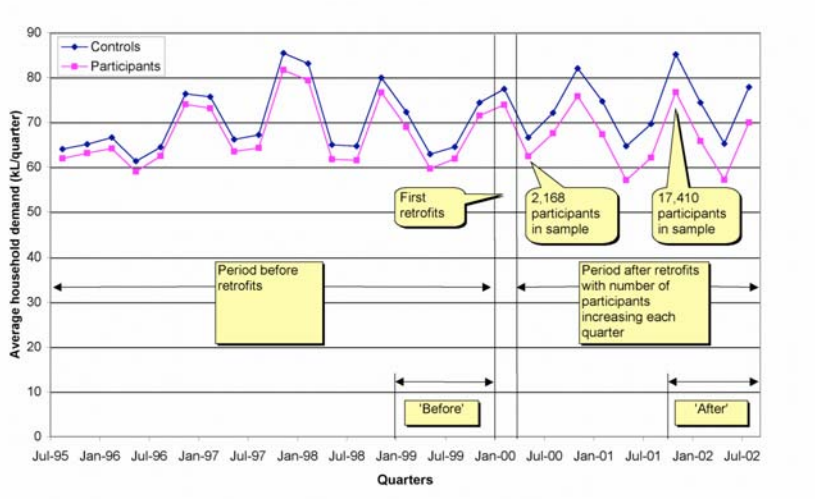

Figure 1 Comparison of average quarterly demand per household for participants relative to controls in the periods before and after retrofits

It should be noted that during the analysis process a number of participants and their matched controls had to be rejected for various reasons (e.g. incomplete meter reading data during the entire period analysed), which reduced the sample size to just over 17,000. During more detailed analysis used to determine the savings associated with specific efficiency measures, demographics, socio economic factors etc. the sample was divided into relevant sub categories, which further reduced the sample being analysed. Hence although a large overall representative sample was used, in some cases only small samples where available for analysis of specific sub categories.

Findings

Annual demand reduction

In the snapshot 'before' and 'after' periods shown in Figure 1 (i.e. January to December 1999 immediately before the first retrofits, and October 2001 to September 2002, the last available data after retrofits), the controls increased demand by 29.3 ± 2.0 kL/hh/a and participants increased demand by 8.3 ± 1.6 kL/hh/a. Hence both the controls and participants increased demand in absolute terms, which is likely to be associated with the fact that 2002 was a hot dry year compared to 1999. However, the participants actually reduced demand relative to their controls. Therefore the 'relative savings' attributable to the program (which are of most interest) are 20.9 ± 2.5 kL/hh/a and indicate the program is resulting in savings of approximately 8% of average household demand and 12% of estimated indoor demand. These savings are consistent with previous evaluations[2], which have indicated savings of 20.1 ± 3.7 kL/hh/a. The relative savings of 20.9 ± 2.5 kL/hh/a take into account the fact that some houses have minimal fittings modified while others have all fittings modified.

The results indicate that the EDC residential retrofit program has resulted in overall savings of somewhere between 2,944 ML/a and 3,744 ML/a (3,344 ± 400 ML/a) for the 160,000 single residential households (80% of the 200,000 participating households) that have participated in the program to date, thus contributing significantly to the SWC demand reduction targets. Similar savings per household will have been obtained by the 40,000 multi residential households (20% of the 200,000 participating households) participating in the program, although, the savings are expected to be marginally less due to the lower occupancy rate generally found in multi residential properties.

Time series analysis of the sample of participants and matched controls was undertaken to determine whether savings have been maintained over time (i.e. whether any decay in the savings associated with the program can be determined). A rolling annual average of seven individual cohorts who received retrofits in successive quarters between the January 2000 and September 2002 period was analysed. Individually the cohorts showed mixed results where some cohorts show a decline in savings over time, some appear to maintain savings and others appear to actually increase savings over time. These average changes are shown by regression analysis, to be statistically insignificant. When the cohorts are combined a picture of the overall program and its savings can be seen. Results of regression analysis on this overall picture show that savings associated with the entire program have not demonstrated a statistically significantly increased or decreased over time.

2 Day, D., Campbell, S., (2002), "Evaluation of the Demand Reduction for the Every Drop Counts Residential Retrofit Program: Nine Areas", Report prepared by the Institute for Sustainable Futures for Sydney Water Corporation.

Efficiency measures savings

As in previous evaluations, the participant group was broken down into sub-groups according to uptake of the various components of the program for each household (e.g. toilets, toilets/showers/taps). Although a high level of detail was collected for each participant the groupings needed to be broader to ensure large enough sample sizes for comparison. Participants were grouped according to whether they did or did not participate in a part of the program rather than by the exact quantity of the uptake. Each sub-group was analysed using a paired two-tailed t-test, which analysed the 'relative savings' of household demand between participant and control.

Table 1 shows the results of the analysis and the savings and significance of 'other' evaluated programs. (i.e. Shellharbour Pilot Program and the Smart Showerhead Program).

Category No.	Uptake Category Description	Average Household Relative Savings kL/hh/a	95% Confidence Interval	Number of Paired Records	Average Household Savings & Significance in 'Other' Evaluated Programs**
1	Toilets + Showers + Taps + Leaks	32.3	± 7.7	1971	(+*) 23.3 ± 6.5
2	Toilets + Showers + Taps - Leaks	26.1	± 5.7	3527	
3	Toilets + Showers + Leaks	36.4	± 31.8	77	(+*) 18.4 ±7.8
4	Toilets + Showers - Leaks	49.6	± 22.4	194	
5	*Leaks Only*	*-4.5*	*± 43.2*	*24*	
6	*Toilets + Taps + Leaks*	*-24.7*	*± 38.7*	*47*	
7	Toilets + Taps - Leaks	16.0	± 29.2	131	11.0 ± 18.1
8	Showers ± Leaks	16.2	± 16.1	385	(+*) 14.5 ± 10.3 & (+) 16.5 ± 6.6
8.1	Showers - Leaks	14.8	± 17.6	329	
8.2	Showers + Leaks	24.5	± 39.5	56	
9	*Toilets + Leaks*	*-27.2*	*± 67.4*	*30*	
10	Toilets - Leaks	20.4	± 24.4	209	11.0 ± 22.3
11	Taps ± Leaks	18.4	± 26.2	166	20.2 ± 40.0
12	Showers + Taps + Leaks	15.6	± 9.4	1212	(+*) 19.6 ±7.8
13	Showers + Taps - Leaks	20.0	± 4.8	4670	
14	*No Change*	*-0.6*	*± 19.8*	*219*	

Table 1 Details of uptake categories and results of analysis

Table notes

Grey shading indicates significant at 95% confidence level, black text (without grey shading) indicates the mean relative savings are +ve but are not significant and red italic text indicates the mean relative savings are –ve and not significant.

** Denotes savings from Shellharbour Pilot Program evaluation except for category 8 which also includes the Smart Showerhead Program evaluation (+). +* indicates Shellharbour Pilot Program

(Sarac et al, 2000) evaluated these two categories as one category with ± leaks. + indicates the Smart Showerhead Program[3] (Sarac et al, 2002).

Table 1 indicates some categories showed significant relative savings while in other categories the relative savings had such a large confidence interval that the sample size was not sufficient to show significance at the 95% confidence level. A graphical representation of the uptake categories with significant relative savings is shown in Figure 2.

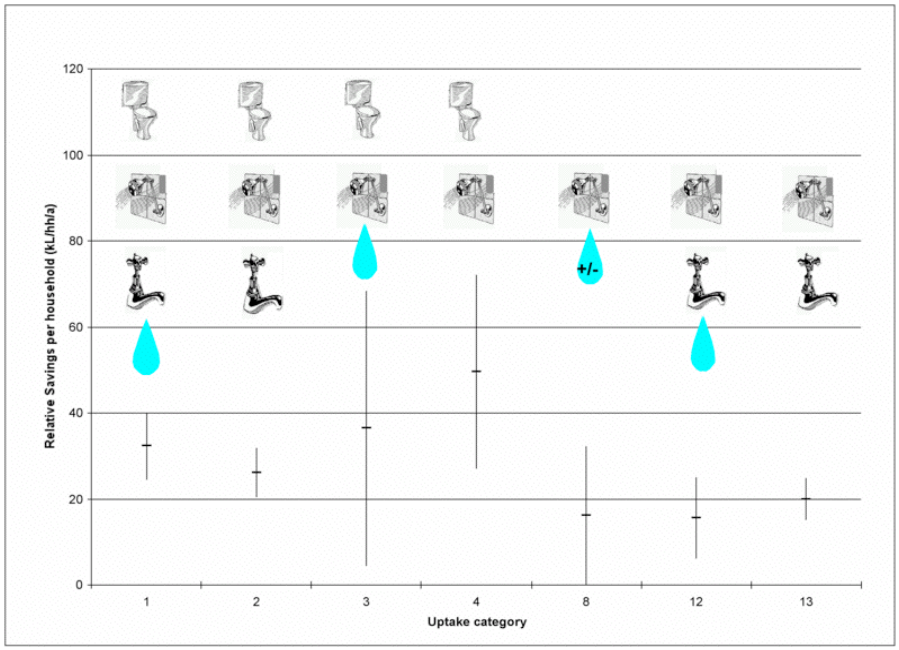

Figure 2 Graphical representation of those uptake categories with significant relative savings to together with their confidence interval

Significant relative savings were found for several categories analysed (i.e. showers & toilets & taps). These have been compared against other program evaluations where possible[4] and are shown graphically in Figure 3.

3 The Smart Showerhead Program promoted the sale of water efficient (AAA rated) showerheads by providing $10 discount vouchers to people with their water and energy bills as well as providing vouchers in stores. The program was run in the greater Sydney region from July 1998 to October 1999.

4 SPP (Shellharbour Pilot Program), SSP (Smart Showerhead Program) and EDC have been compared where possible, where SPP and SSP were analysed with ± leaks, EDC indicates ± leaks, EDC* indicates with leaks and EDC** indicates without leaks modified.

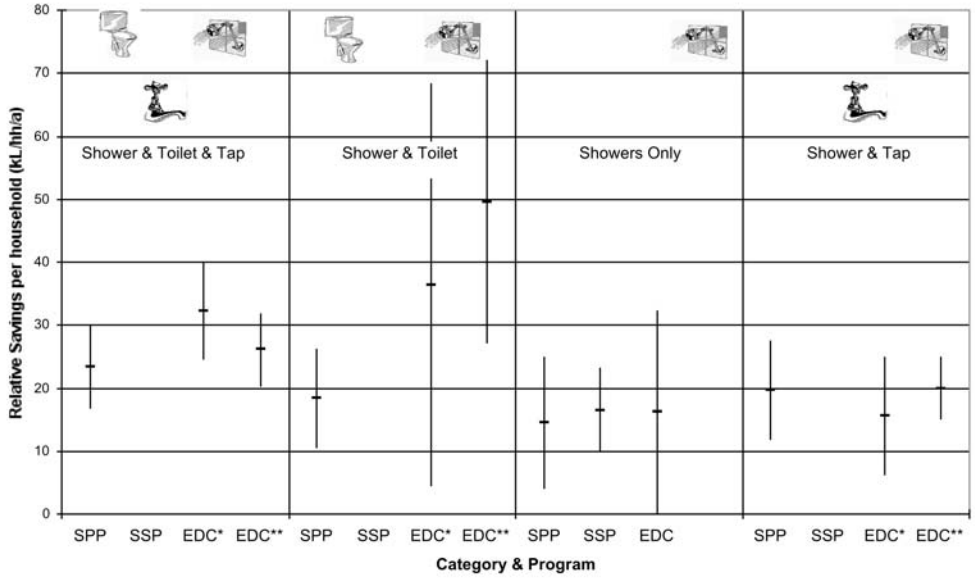

Figure 3 Comparison of relative savings with other evaluations

The results indicate that the EDC program is providing similar savings to previous evaluations carried out in the Sydney region and in some cases provide higher savings. All three evaluations indicate that substantial savings can be gained when both showerheads and toilets are included in the measures modified within the household.

Other factors considered for targeting of similar programs

Demographics

Per person analysis indicates that people within a single occupancy household save significantly more than households with higher occupancies (i.e. single occupants save on average 18.3 ± 7.8 kL/person/a). In both the per person and per household analysis, households with an occupancy of three show significant savings when compared to other household occupancies (i.e. 11.9 ± 2.45 kL/person/a and 35.6 ± 7.4 kL/hh/a respectively). Hence although each person saves less in a household with an occupancy of three compared to a household with an occupancy of one, the overall savings per household are higher and thus for targeting purposes the analysis indicates that households with an occupancy of three provides the greatest potential for water savings. This is closely followed by households with an occupancy of four.

Local Government Areas

Analysis of the savings of participants by Local Government Areas (LGA) shows that participants were spread over 40 LGAs, and that 22 LGAs showed significant relative savings when participants were compared to their controls as shown in Figure 4.

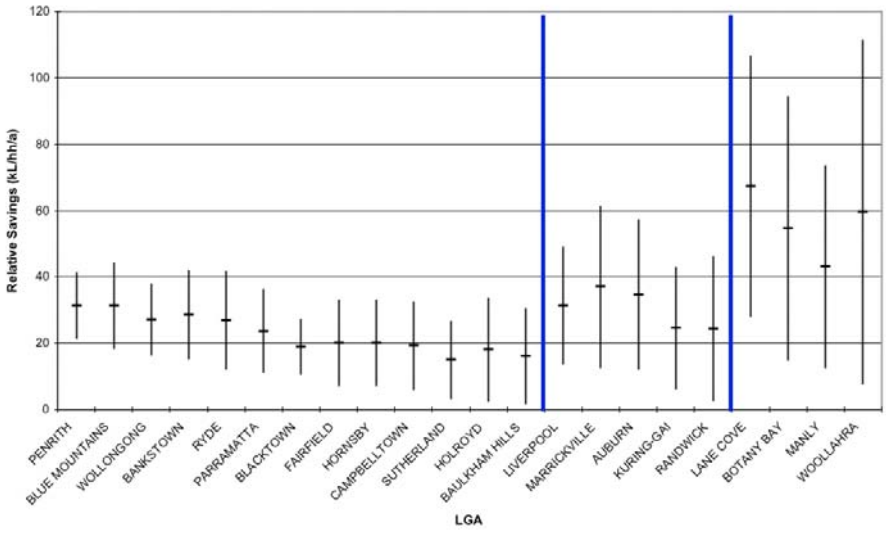

Figure 4 Relative savings and confidence intervals per household by LGA

Of these LGAs Lane Cove and Woollhara showed significant relative savings on both a per household and per person basis against a large number of other LGAs. Thus indicating that targeting of these LGAs could be beneficial and provide high relative savings.

42 Faces

In addition to LGA comparisons participants and matched controls were analysed according to Face category using a sample size of 9,000. Face categories refers to a data analysis method provided by the Australian Bureau of Statistics "The Faces of Australia" which categorises census collection districts (approximately 200 households) into 42 socio-demographic characteristics, such as 'Developing Professionals' and 'Empty Nesters'. This method can provide useful information for designing communication strategies for increasing the uptake rate of programs.

Income

Three income groups were analysed based on the participants category in terms of health care card eligibility, which is income-tested: full paying/non cardholders (0), healthcare card or veteran gold cardholders (1) and pensioners (2) who are recipients of government income support. Of the over 200,000 participants 38% were exempt from paying for the retrofit due to proof of low income status. This proportion is considerably higher than the Australian Bureau of Statistics figures which indicate that in 2000/01 22% of households in the Sydney identified that the principal source of income came from government pensions and allowances.

The results of analysis indicate (although not significant on a per household basis), that it would be beneficial to seek higher uptake (if possible) amongst healthcare card/veteran gold cardholders (1) who have high relative savings of 25.5 ± 5.5 kL/hh/a compared to non cardholders (0) with relative savings of 22.6 ± 3.6 kl/hh/a and the pensioners group (2) with relative savings of 19.2 ± 7.1 kL/hh/a. The healthcare card/veteran gold cardholders group

(1) show considerably higher relative savings than the overall average relative savings 20.9 ± 2.5 kL/hh/a.

The proportional split between healthcare cardholders and veteran gold cardholders cannot be determined from the data analysed. However, it is anticipated that healthcare cardholders, which are means tested, dominate this group. Hence targeting of this low income group will not only provide high relative savings, thus increasing the overall level of savings of the program, but also lead to added social benefits for low income households in the community.

Summary and conclusions

Savings of 20.9 ± 2.5 kL/hh/a were found from statistical analysis of water meter readings of the sample of single residential households analysed. These individual savings effectively provide SWC with a potential total saving of 3,344 ± 400 ML/a for the single residential houses retrofitted alone (i.e. 80% of the 200,000 households retrofitted to date). The evaluation identified that no 'decay' in average savings were found over the maximum four year period assessed. Other factors evaluated during the study included: analysis of individual water efficiency measures; comparison of savings with other evaluations; and savings related to occupancy ratio, geographical grouping, income category and defined socio economic categories.

The analysis undertaken as part of the Study has shown the importance of ensuring that a large initial sample is taken to enable a reasonable sample size for more detailed analysis of sub categories such as the savings associated with a specific measure (e.g. a showerhead). In addition it is imperative that accurate data collection at the time of the retrofit (e.g. no. of people in the household, measures fitted, leaks rectified) is undertaken to allow findings from the analysis to be drawn. The individual components of this evaluation (e.g. savings per measure and per LGA) will enable SWC to check whether particular measures are worth investing in as part of the program and where they should target their program geographically to gain maximum savings.

The use of 'relative savings' or savings of the participants relative to their paired control is crucial to ensure that the real savings from the program are identified. Absolute savings of the participants in any one year will not provide a useful finding as they do not account for other factors such as climate variables or restrictions which can significantly change household demand from year to year. The use of relative savings for the whole program means that SWC can be confident in reporting on total savings from the whole program.

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