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Who Buys PV Systems? A survey of NSW residential PV rebate recipients¹

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ABSTRACT

The PV Rebate Program (now the Solar Homes and Communities Program) operated from 2000 to mid 2009. Over this time, more than 40,000 PV systems were installed, about half of which were installed in the first half of 2009, and about a quarter of which were in NSW.

This paper presents analysis of the characteristics of NSW PV rebate recipients, using surveys carried out by the NSW Government between 2000 and 2007, and a 2008 survey undertaken for the Commonwealth Government after it took over Program management. The surveys included questions about customer demographics, energy use and awareness, as well as PV information sources and reason for purchasing PV. The analysis in this paper is limited to grid-connected, residential rebate recipients in NSW, but the findings can be considered representative of the situation in Australia as a whole.

Over the life of the Program both the grants and the customer base have changed. The most recent changes to the Program include the doubling of the grant in 2007 and the imposition of a means test in 2008. Variations to customer demographics and investment decisions are evident following these changes.

The data provides a useful glimpse into Australian energy knowledge, attitudes and behaviour and hence provides useful guidance for future programs.

This paper summarises a much larger report for the Commonwealth Department of Environment, Water, Heritage and the Arts, funded through the Low Emissions Technology and Abatement Program.

Keywords: *Australia, Demographic, Photovoltaics, Policy, PVRP, SHCP*

INTRODUCTION

The Solar Homes and Communities Plan (SHCP) (formerly the PV Rebate Program or PVRP) has been providing capital rebates for both grid and off-grid PV systems since 2000. The analysis reported here covers the period to end 2008. According to the Program database, by that time, 19,540 systems, comprising 26,990 kWp of PV capacity, had been installed under the Program, of which 97% were residential systems, 76% were grid-connected systems and about 25% were in NSW. A total of 2,898 grid-

connected systems were installed under the program in NSW up to the end of 2008, comprising 4,303 kWp of PV capacity, the majority of which were residential systems.

While the rebate program has been in operation for over nine years, it has always been on the basis of short-term Commonwealth government budget allocations and subject to frequent changes (Table I). Restrictions on the size of systems have also been in place, and during some periods, different rebates have applied to owner-occupiers and other consumers. Since this research was completed, the rebate Program has been cancelled. Owners of new PV installations are now issued with multiple Renewable Energy Certificates (RECs), which are valid under the Australian Government's Renewable Energy Target (RET) scheme.

Table I: History of the PV Rebate Program for owner-occupiers purchasing new PV systems

	Rebate amount
January 2000	\$5.50/Wp up to 1.5kWp
October 2000	\$5/Wp up to 1.5kWp
May 2003	\$4/Wp up to 1kWp
July 2003	\$4.00/Wp up to 1kWp
July 2007	\$8/Wp up to 1kWp
May 2008	\$8/Wp up to 1kWp, \$100,000 means test

From 2000 to 2007, while administering the Program on behalf of the Commonwealth Government, the NSW Government carried out a customer survey at the time of processing PVRP grant applications. These surveys were analysed by the NSW Sustainable Energy Development Authority in the early years of the grant program (SEDA, 2002, 2003). The NSW Government continued to survey rebate recipients until 2007, when the Commonwealth took over administration of the program. In early 2009 the Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA) sponsored a new survey of grid-connected residential rebate recipients in NSW up to the end of 2008, providing a continuous dataset from 2000-2008. The surveys have sought to provide a profile of PV system purchasers, including:

- Demographic data, such as customer age, sex, marital status, household type, income, occupation;
- Motivations for purchasing the system and awareness and purchasing behaviour; such as sources of information, number of quotes received, and whether a maintenance contract was negotiated;
- The influence of rebate levels and potential other policies on investment decisions; and
- Levels of awareness and interest in other means of reducing energy or greenhouse gas emissions in the home, such as GreenPower and solar water heaters.
- The latest DEWHA survey also investigates the factors that recipients believe would most effectively facilitate the purchase of a PV system, as well as the degree to which PV has reduced their electricity bill, and energy efficiency measures implemented before and after the PV system was installed.

The context for residential PV customers in Australia has changed over the period 2000 to 2008. These changes can be classified into four main types;

- i. Changes in the PV rebate and resultant final cost to the system owner, as well as the availability of the rebate,
- ii. An increase in people's awareness of climate change and of PV,

- iii. Changes in the PV industry, particularly marketing models, as the industry has scaled-up, and
- iv. The recent economic downturn, which has impacted on the purchasing behaviour of some PV system customers.

Within this changing context, this paper reviews the characteristics of people who have purchased grid-connected residential PV systems over the period of the program using the results of the SEDA analyses, as well as the new analysis of the survey data collected by both the NSW government and DEWHA. Since the datasets were collected at different times and with slightly different methods, they overlap during the second half of 2007, and so may include responses from system owners that responded to two (almost identical) surveys. Nevertheless, the results are considered representative of the characteristics of system owners who took advantage of the PVRP/SHCP grants.

Data from the DEWHA survey has been correlated with system cost and size data, enabling the examination of trends in the size and cost of systems being installed and how these patterns have emerged in particular groups of PV purchasers. The paper focuses particularly on the period 2007-2008, spanning the most recent program changes, including a change in the rebate amount from \$4 to 8/Wp in mid-2007 and the application of a means test in May 2008, which restricted the rebate to households with combined taxable incomes no greater than \$100,000. Figure 1 shows a large increase in the number of systems being installed after the doubling of the rebate in mid-2007, but little apparent change in overall rates of systems installed after the introduction of the means test in May 2008.

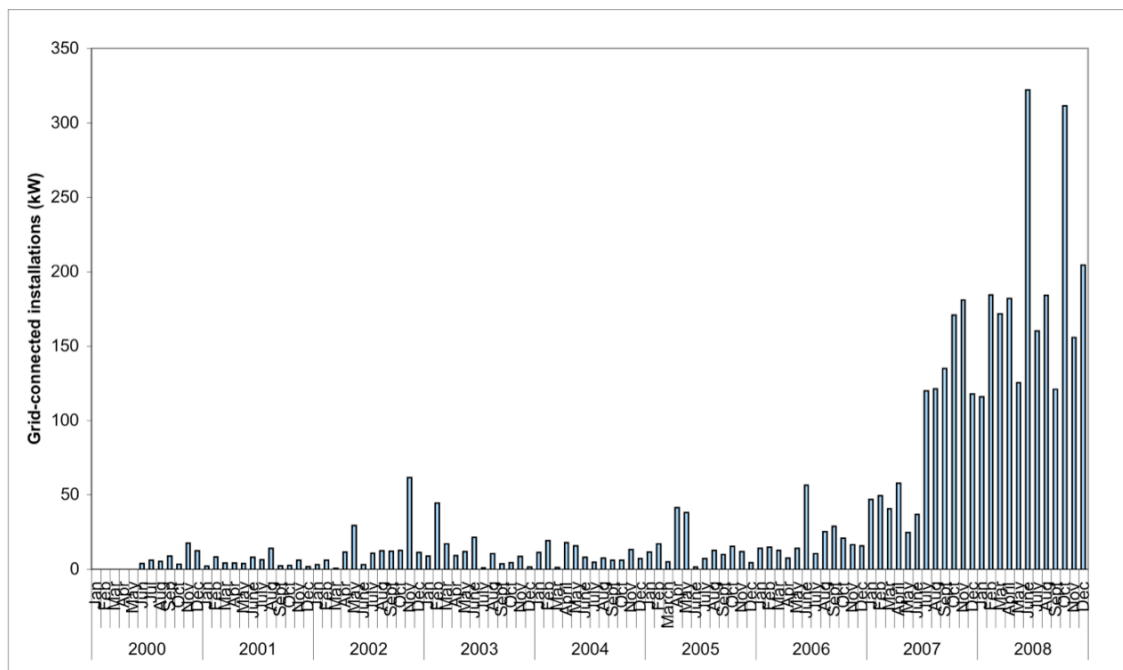


Figure 1: Grid-Connected Systems installed in NSW under the Rebate Program 2000-2008

DEMOGRAPHIC PROFILE OF PEOPLE WHO BUY PV SYSTEMS

In this section, the demographic profile of PV Rebate Program survey respondents and changes in the profile from 2000-2008 are summarised. Some potential explanations for the observed demographic trends and their implications are discussed.

Age Group

Over the period of the program (2000-2008), respondents aged over 40, and especially over 61, were more likely to purchase grid-connected residential PV systems than those in any other age bracket (Figure 2). People over 40 comprised 87.6% of survey respondents compared to 45.65% of the general Australian population (ABS, 2007).

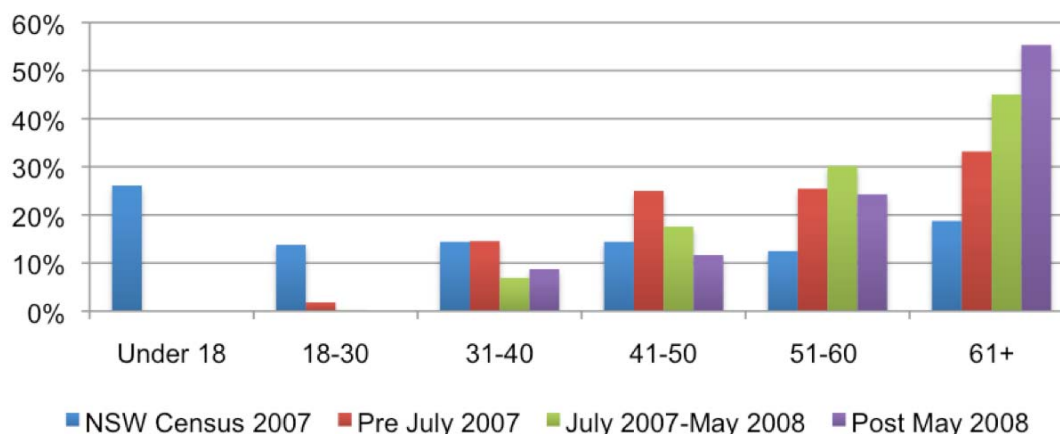


Figure 2: Age of Rebate Recipients compared with NSW Census Data, NSW Census data from (ABS, 2007)

The yearly data from 2003-2008 reveals a trend towards people aged 61 and over making up a greater proportion of system owners. With the increase in the rebate from \$4/Wp to \$8/Wp in July 2007, this trend was more pronounced, while those in the 31-40 and 41-50 age groups became less likely to purchase a PV system.

After the introduction of the means test in May 2008, there was a decrease in the proportion of people in the 51-60 age group taking up the rebate, against the previous trend, while the proportion in the 41-50 age group also decreased. This is probably because, prior to the means test, people between the ages of 41-60 who purchased PV systems were the most likely to have annual household incomes over \$100,000. Those in the 51-60 bracket made up 41% and those in the 41-50 bracket made up 28% of those with incomes over \$100,000 (Table II). The means test would exclude these people from taking up the rebate. Those in the 61+ income group are more likely to be retirees and to have incomes below the means test limit, so would be less likely to be affected.

Table II: Age of people with incomes > \$100,000 that bought PV systems prior to the means test

Age Group	Number of Respondents Before means test	% of Respondents with > \$100,000 income	NSW Census
31-40	22	12%	14%
41-50	51	28%	14%
51-60	75	41%	12.5%
60+	36	20%	19%

Household Type

People who are married or in de facto relationships are more likely to buy PV systems than people who are not, presumably because they are more likely to own their own home and have two disposable incomes, and so be able to install PV.

Income

Prior to the rebate increase in 2007, households with higher taxable incomes (greater than \$70,000 per annum) were more likely to buy PV systems than other households, being over represented in the survey compared to the number of households earning high incomes in NSW as a whole (Figure 3).

After the rebate was increased from \$4/Wp to \$8/Wp (July 2007–May 2008), there was an increase in the proportion of respondents in all income brackets less than \$100,000 and a corresponding decrease in the proportion with incomes greater than \$100,000, which became more representative of the NSW population. This is likely to be because PV systems became accessible to households with incomes less than \$100,000 that had previously been unable or unwilling to pay for a PV system.

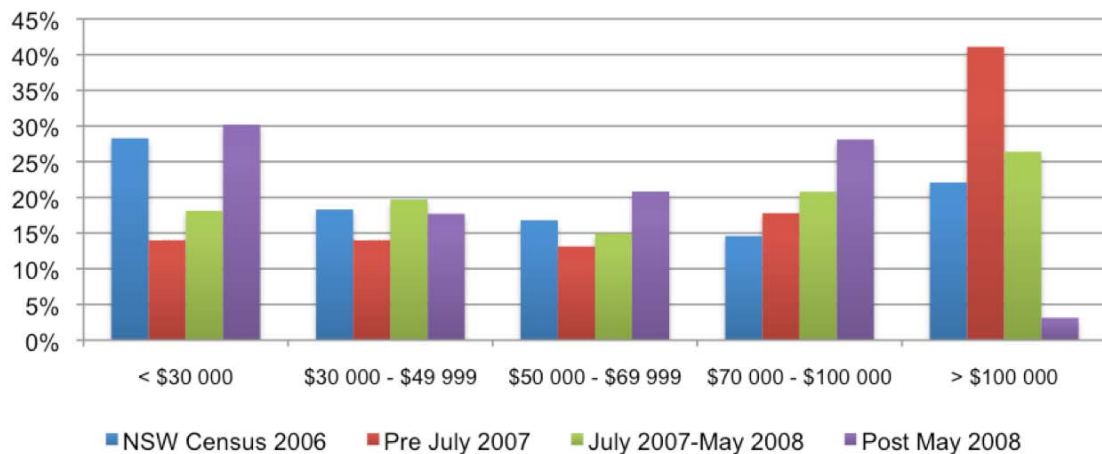


Figure 3: Income of Rebate Recipients 2000-2008 compared with NSW Census Data, NSW 2006 Census data from ABS (2006)

After the means test was introduced, households with incomes greater than \$100,000 were excluded from receiving the rebate. A small number of respondents still claimed to be in this income category, perhaps because of delays in processing applications, being surveyed in a different year than they received the rebate or because they reported their pre-tax income. Although around 25% of those who received the rebate prior to the introduction of the means test had incomes >\$100,00, there has been no slowdown in the rate of installation of PV systems after the introduction of the means test, because there was a corresponding increase in the proportion of respondents in all the other income categories, especially the less than \$30,000 income bracket, possibly due to increased media attention given to the rebate.

Occupation

Between 2003-2008, 'professionals' (40.2% of respondents, making up 12.5% of the NSW population (ABS, 2006)) and 'retired/ pensioners' (28.1% of respondents, making up 18% of the NSW population (ABS, 2006)) were much more likely to buy PV systems than people in other occupation groups. The purchase of PV systems by those in the 'retired/pensioner' category has increased over time, while in 2008 the 'professionals' category decreased significantly, presumably because of the means test introduced in May 2008.

After the rebate was increased from \$4/Wp to \$8/Wp in July 2007, in the context of a large increase in uptake of the rebate, the proportion of 'professionals' and 'retirees/pensioners' decreased. However, there was not an absolute decrease in uptake by these groups, but rather an increase in uptake by the other groups.

After the means test, a lower proportion of professionals, managers and advanced clerical and service workers installed systems, while more labourers, technicians and retirees installed systems. This is probably because people in the former occupation groups are more likely to have incomes greater than \$100,000 and therefore be excluded from receiving the rebate.

AWARENESS AND MOTIVATION OF REBATE RECIPIENTS

When asked how they heard about solar power, about a quarter of the people receiving the rebate over the period of the Program said they had previous knowledge. For the remainder, magazines and newspapers have been the most common source of information, followed by the general media. In the last couple of years, fewer people have had previous knowledge and more people have heard about PV through various media sources; presumably because the sudden and significant increase in the rebate in 2007, just prior to a federal election, and the means test introduced in 2008, attracted considerable media attention. The rebate increase was also accompanied by a significant rise in advertising on the part of PV distributors and installers. The trend away from previous knowledge also confirms that the rebate program has been accessed by more 'mainstream' customers recently.

Information about the rebate program most commonly came from the PV supplier or business consultant, followed by magazines and newspapers, then word of mouth. In the last couple of years the PV supplier or business consultant seems to be of decreasing importance while TV, radio and the general media seem to be of increasing importance, consistent with increased media exposure, which helps explain why there was no decrease in average monthly installations after the means test.

The most common reasons given for investing in a PV system were environmental benefits and climate change, following by cost savings, with the latter increasing in importance over time, perhaps because the increase in the rebate from \$4/Wp to \$8/Wp improved the economics of PV system ownership and/or increased media coverage of the rebate, bringing PV to the attention of less environmentally conscious people.

INVESTMENT DECISION AND INSTALLATION

Over the period 2000 to 2008, 65% of respondents said they would not have invested without the rebate (reaching a high of 77% in 2008), while about 15% said they would have, and about 20% said they were unsure.

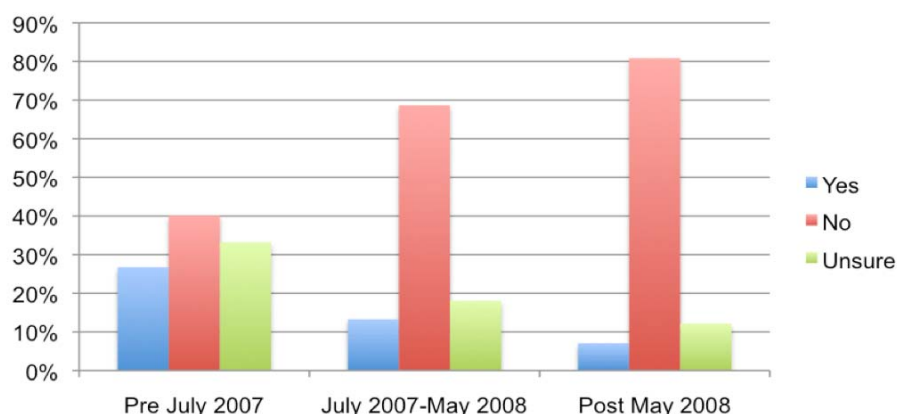


Figure 4: Responses of Rebate Recipients 2000-2008 when asked 'Would you have invested if there was no rebate?'

After the rebate increased in July 2007, the number of respondents who said they would not have invested without the rebate, or with a smaller rebate, increased. This reflects increased participation by people more reliant on the larger rebate, and the trend continued after the means test was introduced.

In 2008, the clear majority of rebate recipients said they would not have purchased a PV system with a smaller rebate of \$1/Wp or \$3/Wp, but significantly more respondents would still have purchased a system if the rebate was \$5/Wp.

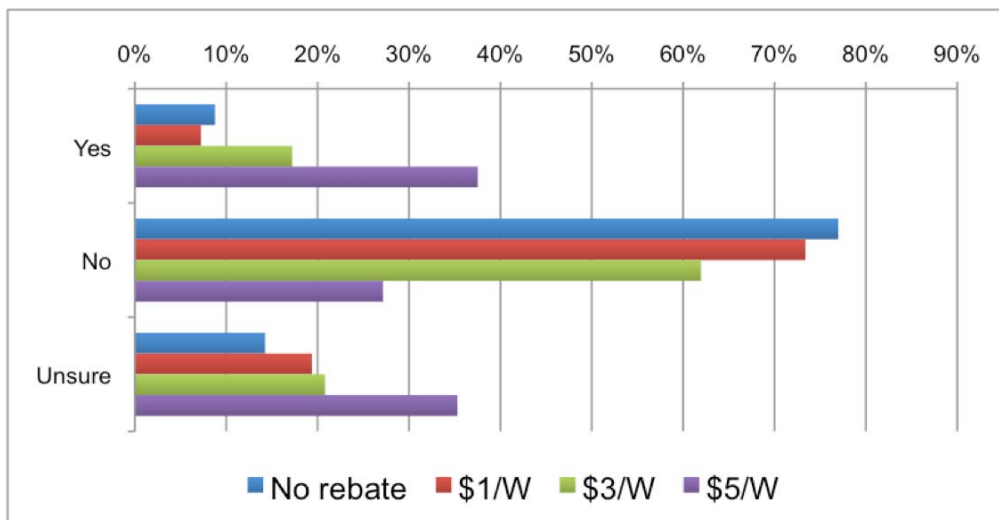


Figure 5: Responses of 2008 Rebate Recipients when asked if they would have invested if there was a smaller rebate.

Facilitating PV uptake (2007/08 installations)

There was little difference in the factors respondents said would make purchase of a PV system easier between 2007 and 2008. Economic incentives were given the highest priority by respondents, followed by reliable technical advice, a simple process for grid connection, a list of trained local installers then a simple process for dealing with council (Figure 6).

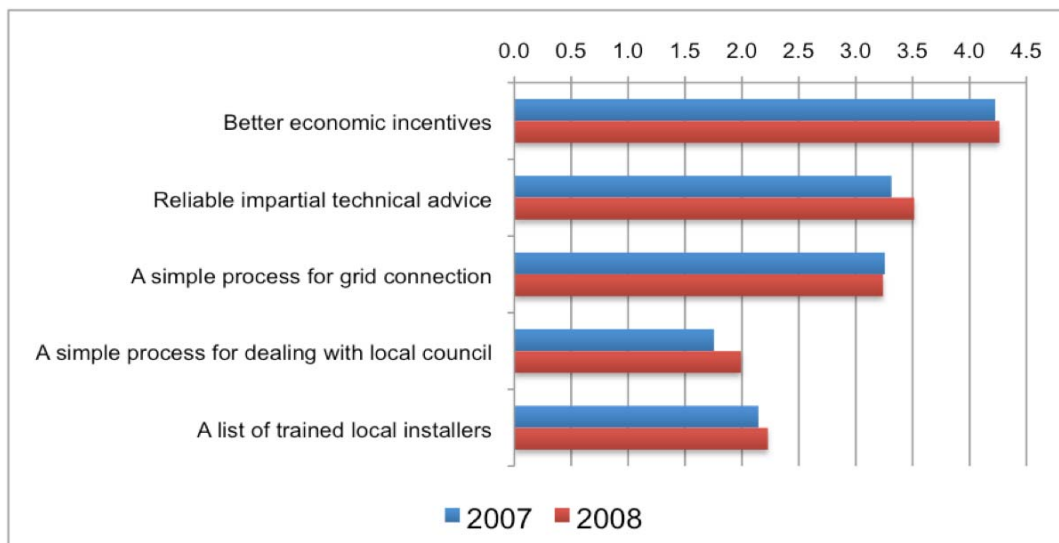


Figure 6: Responses of Rebate Recipients 2007-2008 when asked 'What would make purchase of a PV system easier'

The preferred mechanism of financial support was a Feed-in Tariff (FiT), followed by Solar Credits then a low interest loan (Figure 7). A significant number of respondents support a combination of support mechanisms, with a FiT plus Solar Credits being the most popular, followed by these combined with a low interest loan (Table III). After the means test, there was an increased preference for a low interest loan, presumably because the means test has brought in people for whom up-front cost has been more of a limiting factor and so they are less willing or able to pay for PV.

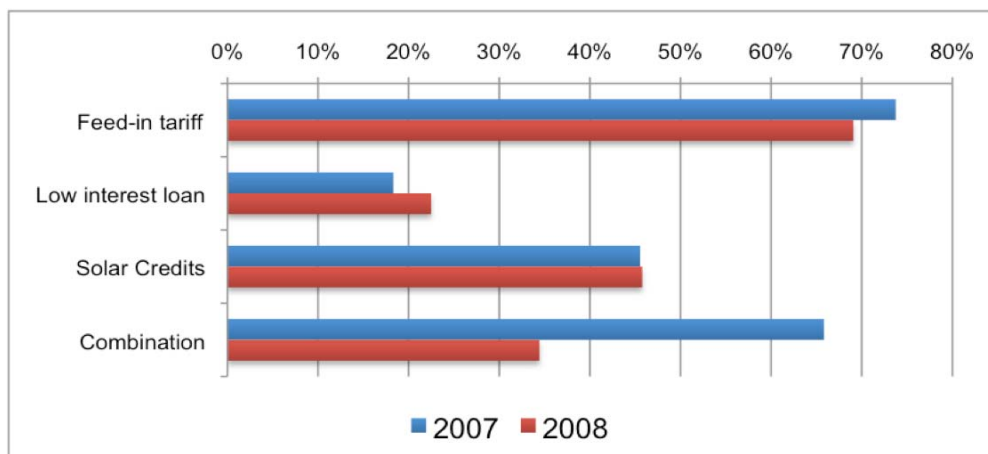


Figure 7: Preferred mechanism of support of Rebate Recipients 2007-2008

Table III: Preferred combinations of policies of Rebate Recipients 2007-2008

Policy combination	2007	2008
1 & 2	12%	3%
1 & 3	47%	55%
2 & 3	0%	2%
1 & 2 & 3	41%	40%

1 = FiT, 2 = Low-interest loan, 3 = Solar Credits

Decision and installation process

Prior to purchasing a PV system, most system owners contacted only one supplier and received only one quote, however the proportion that contacted 2 or more is generally increasing. In the vast majority of cases no maintenance contract was offered or requested.

The most common reason for selecting a particular system was price, with the next most common reason being because it suited the owner's purposes/requirements. Both these reasons have been increasing over time, with price possibly becoming more important because the higher rebate and means test have resulted in a higher proportion of people for whom the expense of PV systems had otherwise been a limiting factor.

In the second half of 2007, a recommendation by the supplier and 'good service/liked supplier' seemed to be of more importance when selecting a particular PV system, while brand and being suited to requirements were of less importance – which may reflect entry into the market of people who are less knowledgeable about PV and so more in need of the supplier's recommendation. After the means test, there was a clear trend to contacting fewer suppliers, which may reflect increased marketing activity by specific suppliers in the local area.

ENERGY USE IN RECIPIENTS' HOUSEHOLDS

GreenPower

Over the period 2000 to 2008, 87% of survey respondents on average had heard of GreenPower, and 25.3% on average bought it. These percentages have both increased over time, consistent with increasing numbers of Australians purchasing GreenPower, until 2007. They have, however, decreased over the past two years, possibly due to entry into the PV market of people that are less willing or able to pay for both PV and GreenPower, and possibly also people who are more mainstream and so less 'green'. Still, these percentages are higher than amongst the general population, presumably because owners of PV systems have greater concern about climate change and increased awareness of renewable energy and GreenPower.

The main reasons for not buying GreenPower cited by people that installed systems in 2007 and 2008 were that they prefer to generate their own renewable energy and that GreenPower is too expensive. The next most common reasons were that they didn't know enough about it and that they don't trust the utility/government. More recently, lack of knowledge and high cost have been more common reasons given by people for not buying GreenPower. Again, this may reflect the entry into the market of people who are less willing to pay or are more 'mainstream'.

Reducing energy use

On average, respondents perceived that their electricity bills had been reduced by PV by about 25%. Many energy efficiency measures had been implemented before a PV system was installed, with energy efficient lights and insulation the most common, and more efficient heating and double glazing the least common. On average, energy efficiency measures were thought to account for just under 20% of the reductions in electricity bills. After the means test, respondents were more likely to believe that PV and energy efficiency accounted for smaller energy reductions and were slightly less likely to have implemented energy efficiency measures prior to installing PV.

TRENDS IN THE SIZE AND COST OF SYSTEMS BEING INSTALLED

During the period 2007-2008, average system sizes, and therefore overall system costs, have decreased steadily (Figure 9), perhaps as a result of the advent of bulk purchase schemes for 1kWp systems and the economic slowdown over this period. This change occurred for PV systems purchased by those in all age groups, income groups and occupation groups.

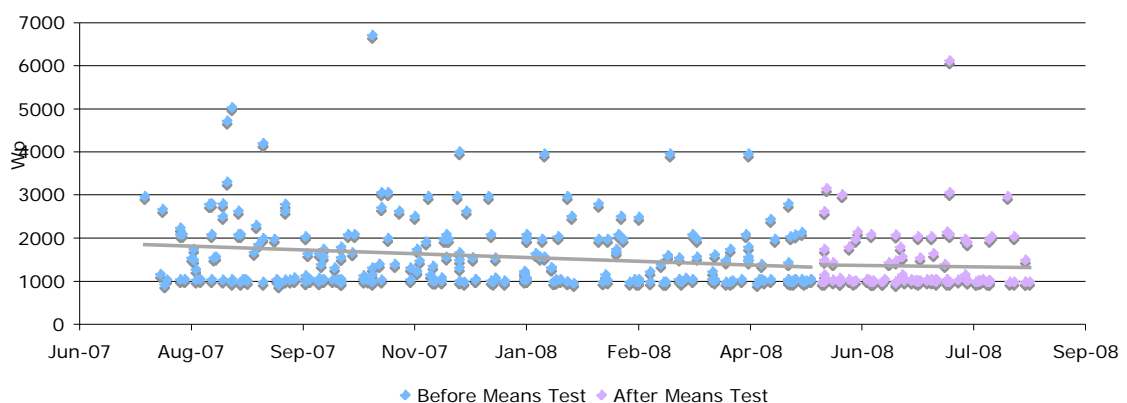


Figure 9: Capacity of Systems Before and After Means Test, showing average trend line

Although overall system costs have decreased appreciably, only a very small decrease in the average \$/Wp cost of systems occurred between July 2007 and August 2008 (during which period the rebate remained at \$8/Wp, while the means test was introduced in May 2008). By comparison, PV prices in other countries are lower and have decreased more rapidly (Figure 10). It is not clear why Australian PV prices have not decreased significantly, even in the context of opportunities for learning by doing and economies of scale. Exchange rates may play a part, as well as the relative predominance of small (~1 kWp) systems compared with a much wider size range internationally. It should be noted that although average \$/Wp system costs have not decreased significantly, the decrease may have been greater were it not for the decrease in average system size after the rebate doubled and the means test was introduced, because smaller systems have a greater \$/Wp installed cost.

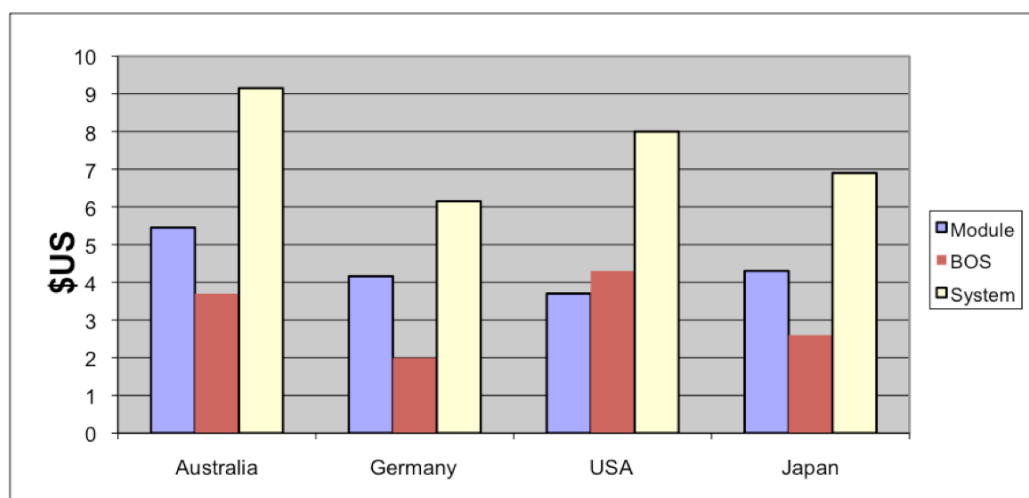


Figure 10: Costs of PV modules, balance of system and overall system costs \$US/Wp 2008 (IEA PVPS, 2009)

According to the line of best fit for a chart of system cost versus size, the cost of a residential PV system in NSW (before rebate) since May 2008 was comprised of a fixed cost of approximately \$3,800 plus \$10.7/Wp of capacity installed (see Figure 11). Since almost all rebate recipients installed systems of 1kWp or larger, and hence received the maximum rebate amount; the impact of the rebate was essentially to reduce the fixed cost by \$8000 (see Figure 11). Similarly, between July 2007 and May 2008, when the rebate was \$4/Wp, the Cost to the Owner (after rebate) was approximately \$4,000 less than the overall System Cost, because the majority of rebate recipients received the maximum \$4,000 rebate.

The \$3,800 fixed cost implies that, on average, a rebate of less than around \$3,800 would result in a higher \$/Wp cost to the owner for smaller systems than for larger systems, whereas a rebate amount greater than \$3,800 would, on average, bring the \$/Wp cost to owners of smaller systems down below that of larger systems.

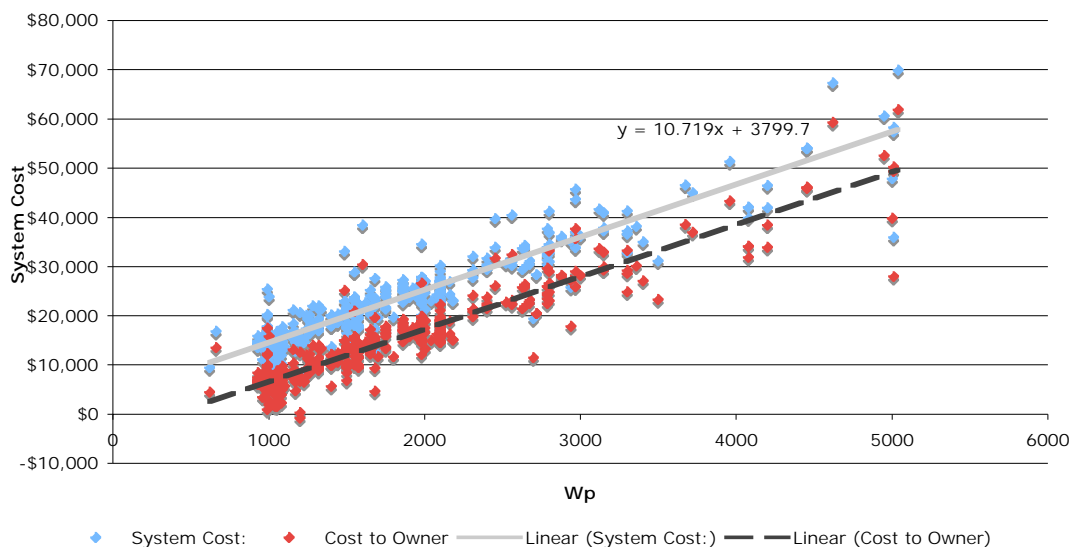


Figure 11: System Cost (before rebate) and Cost to Owner (after rebate) vs Capacity with \$8/Wp rebate¹

The Relationship between System Owner and System Size

Before the means test, on average, the largest PV systems were purchased by respondents in the 51-60 and particularly the >61 age groups, households in the \$50,000-\$69,000 income category and those in the 'professionals' and 'retirees/pensioners' occupation categories. After the means test, the number of large systems purchased by households in all of these demographic groups was reduced, bringing the average system size and cost down to the level of other demographic groups.

The means test may explain the reduction in large systems purchased by those in the 51-60 age group, and professionals who were likely to have incomes >\$100,000, while the economic slowdown may also have contributed. Households in the \$50,000-\$69,000 income category, however, are not impacted by the means test, so the change in their purchasing behaviour is probably explained by economic circumstances. Those in the 61+ age group and retirees were also unlikely to be impacted by the means test, but could have been impacted by the reduction in the value of retirement assets.

CONCLUSION

The Solar Homes & Communities PV rebate program had a major impact on the Australian PV market. Prior to its introduction, there were few grid-connected PV systems in Australia, while off-grid systems were small and usually custom-built. The PV rebates have been popular with the Australian public since their advent, with high take-up rates leading to eligibility changes several times. After 8 years of the Program, 27 MW of PV had been installed, of which 22 MW was grid-connected. In NSW over this time 6.5 MW had been installed under the Program of which 4.3 MW was grid-connected.

The characteristics of the PV industry have changed over this time from a number of small PV design & install companies, typically in regional areas, to a wide range of businesses across the country. Systems have become more standardised, installation

¹ Note that one very large system (\$90,000) was removed from the data as it was considered unrepresentative.

times and costs have decreased and the industry has established an accreditation program to ensure good design and installation practices.

Awareness of PV amongst the Australian public has increased markedly and uptake has spanned all customer age and income groups. When the rebate doubled to \$8/Wp, uptake spread to what looks like a more mainstream market, which relied on mainstream media for its information, rather than having prior knowledge or using specialised sources.

Results of the customer surveys undertaken between 2000 and 2008 show that the highest number of installations have been for married / de facto couples over 40, particularly professionals and retirees, with the former dropping off when the \$100,000 means test was introduced. Environmental concern was the most important driver for PV installation, although economic considerations increased in importance over the 8 years of the Program. High environmental concern is also reflected in higher than average uptake of GreenPower, energy efficiency and solar water heating, although these dropped when the rebate doubled and take up became more mainstream.

Packaged 1 kWp systems, targeting groups of installations in a single locality to reduce installation costs, have become more common, with some advertised at close to zero net cost over the last few months of the Program. As a result, system sizes dropped towards 1 kWp after the rebate doubled.

Support for small-scale PV systems is to move to market-based support via the Renewable Energy Certificate mechanism of the Renewable Energy Target, and potentially to Solar Credits, with RECs multipliers available for a few years, if the legislation is passed as proposed. This will result in lower dollar value of support, which will vary with REC price and location, so it is difficult to gauge how the market will respond. It is hoped that the SHCP has raised sufficient interest in PV and sufficient capacity in the industry to be able to maintain installation rates and use of PV in Australia in the long term.

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Brief Biography of Presenter

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