AUSTRALIAN ENERGY COUNCIL

SOLAR REPORT

JUNE 2016

Australian Energy Council

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SECTION I: OVERVIEW OF SOLAR PV IN AUSTRALIA

As many government solar bonus schemes continue to close, the rate of monthly solar photovoltaic (PV) installed capacity continues to slow. Between January and December 2015, the average system size increased from 4.63 kW to 5.48 kW per installation. Since January 2016, average system size has decreased to 5.2 kW. Figure 1 shows the cumulative capacity over the last two years and the average monthly system size installed across Australia. Australia currently has 1.55 million solar PV installations as at 1 June 2016.

Figure 1: Installed solar PV and average system size

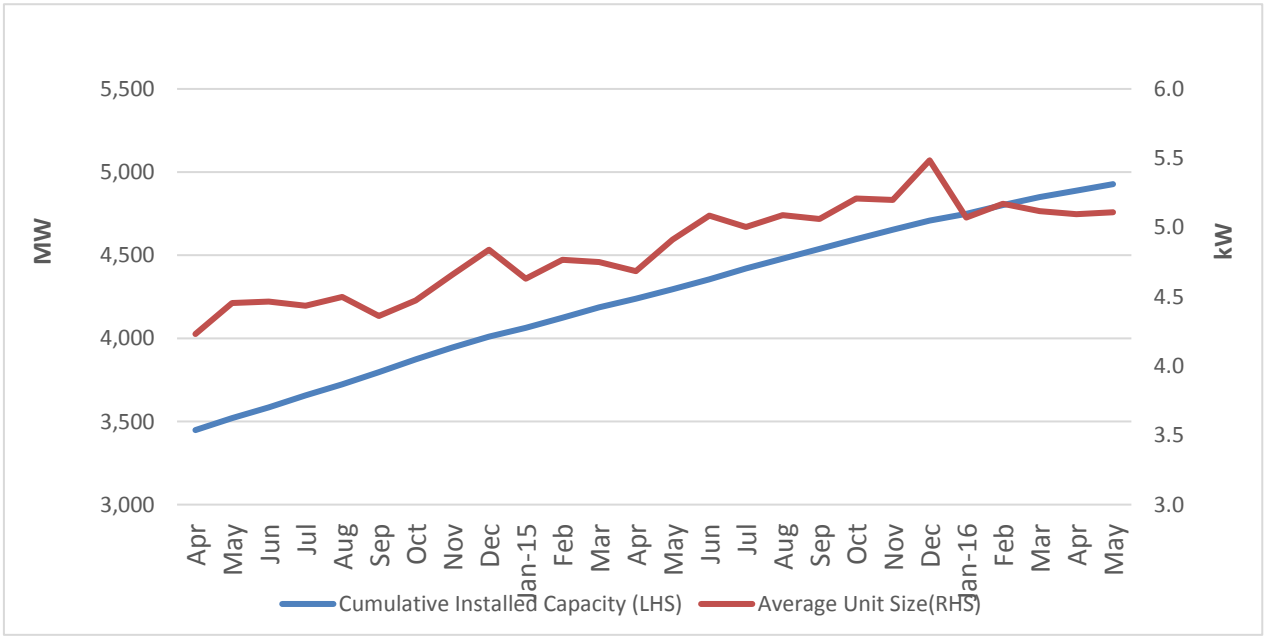

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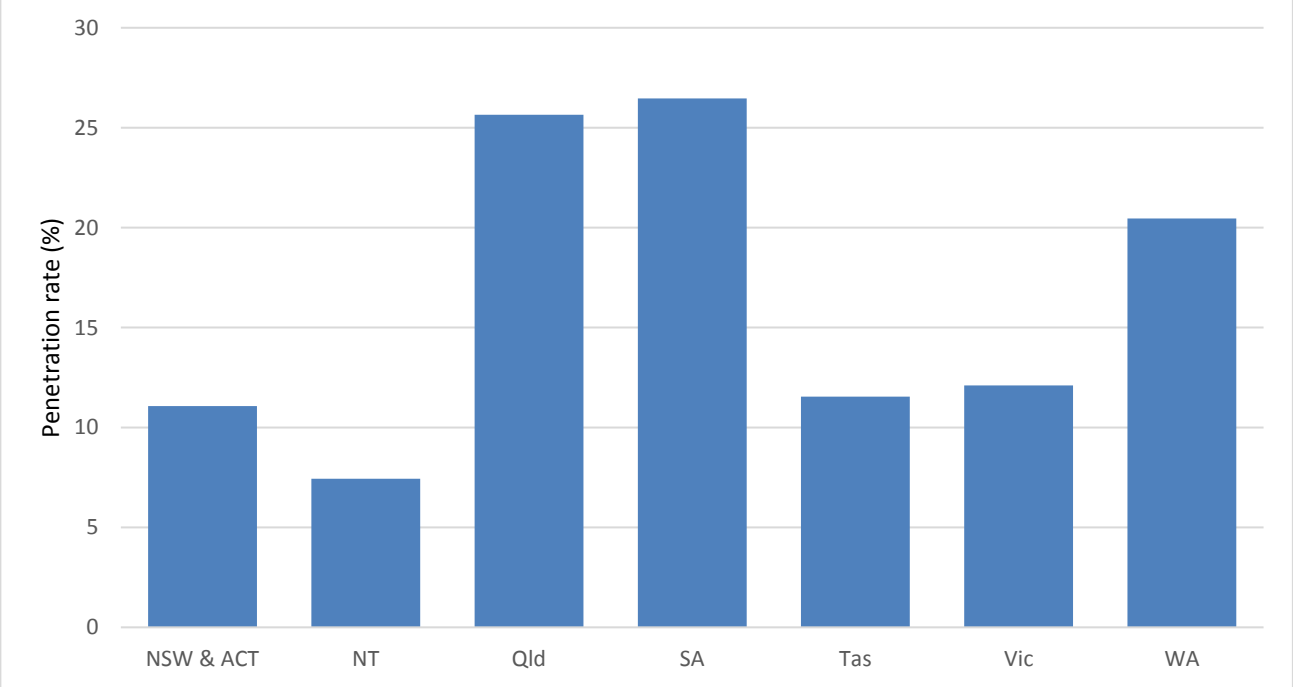
Figure 2 shows the solar PV penetration rates for each jurisdiction. Western Australia is the third jurisdiction to reach 20 per cent penetration rate. South Australia and Queensland have penetration rates of 25.7 and 26.5 per cent respectively.

Figure 2 – Penetration rates across Australia



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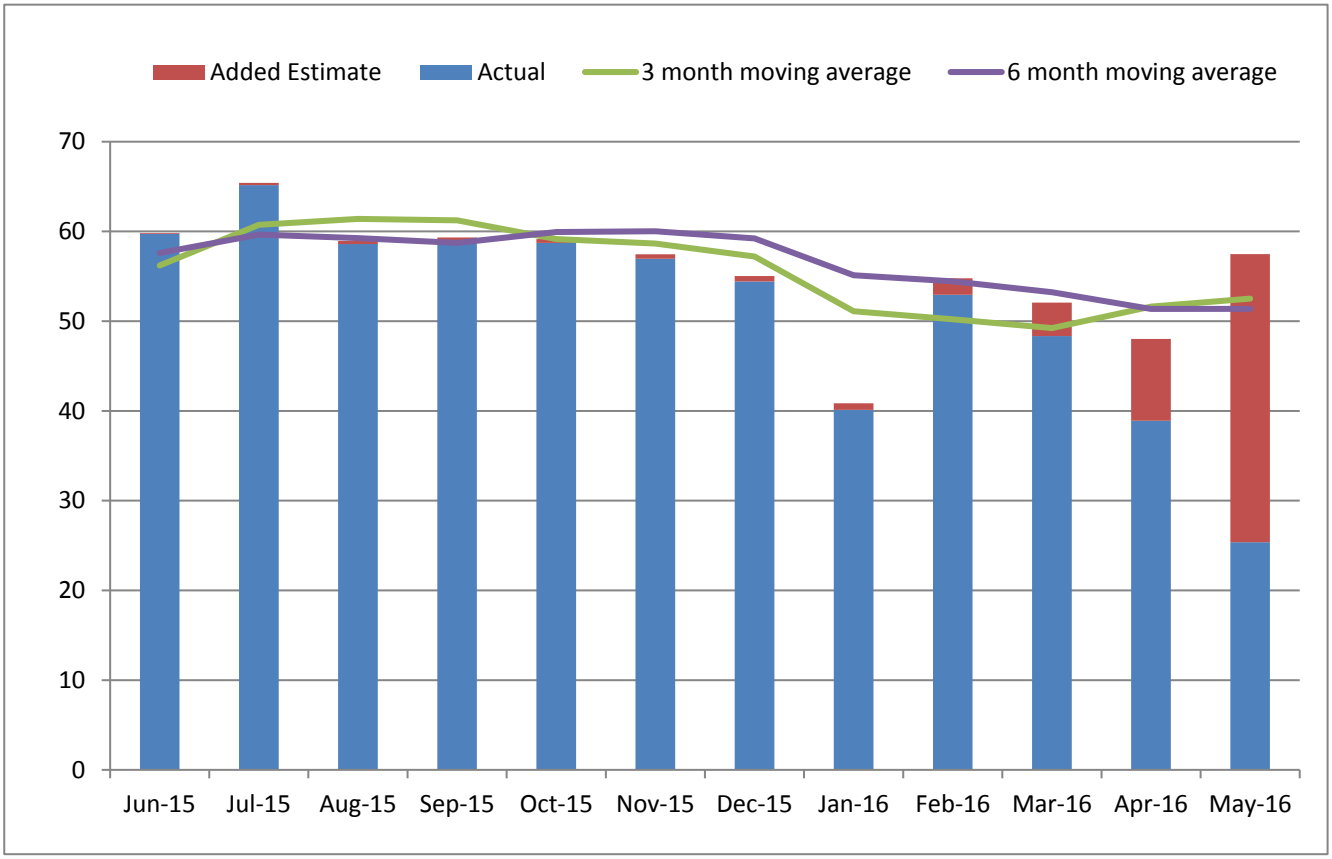
SECTION II: RECENT INSTALLATION RATES OF SOLAR PV

Analysis from the Clean Energy Regulator's (CER) most recent data allows us to estimate the amount of solar PV installed in Australia and the rolling average for new installations. As of November 2015, the CER has consistently released data dated as at the 1st of each month. Previously the data was released intermittently throughout the month. The new consistent release date allows us to provide a more accurate estimate of the capacity of recent installations. Due to the lag in reporting of new installations, the CER data takes up to 12 months to be finalised. Figure 3 shows the actual and estimated capacity additions across Australia from June 2015 to May 2016.

Figure 3 – Estimated monthly solar PV installed capacity (MW)



January seems like an outlier in Figure 3. However, as seen in Figure 4, January is consistently one of the lowest months each year for installing solar PV.

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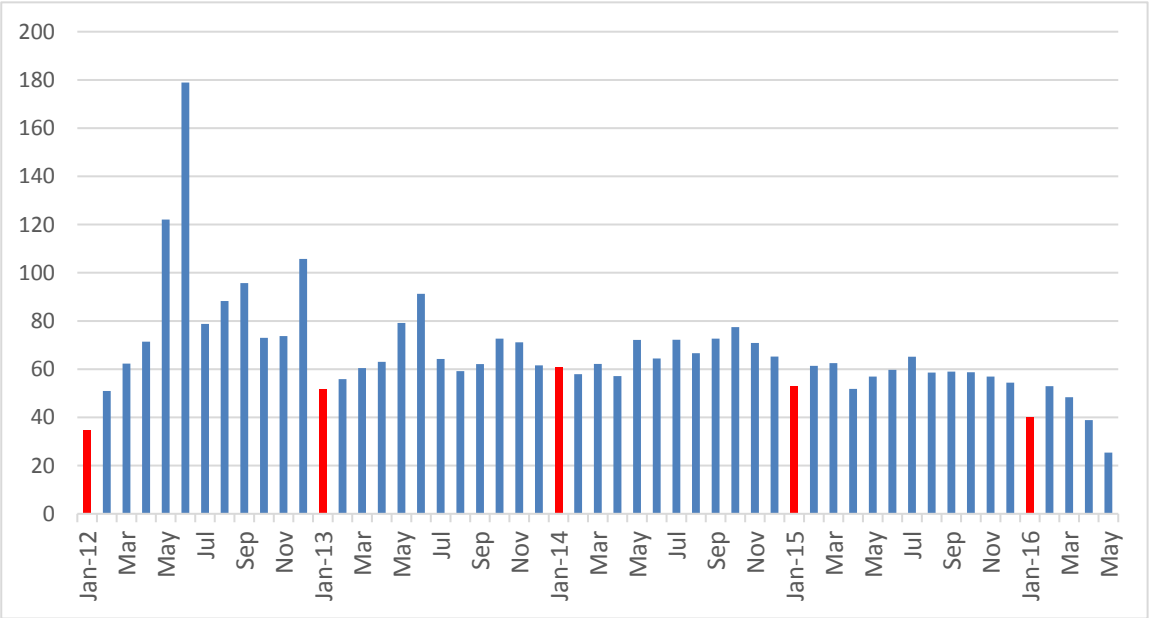
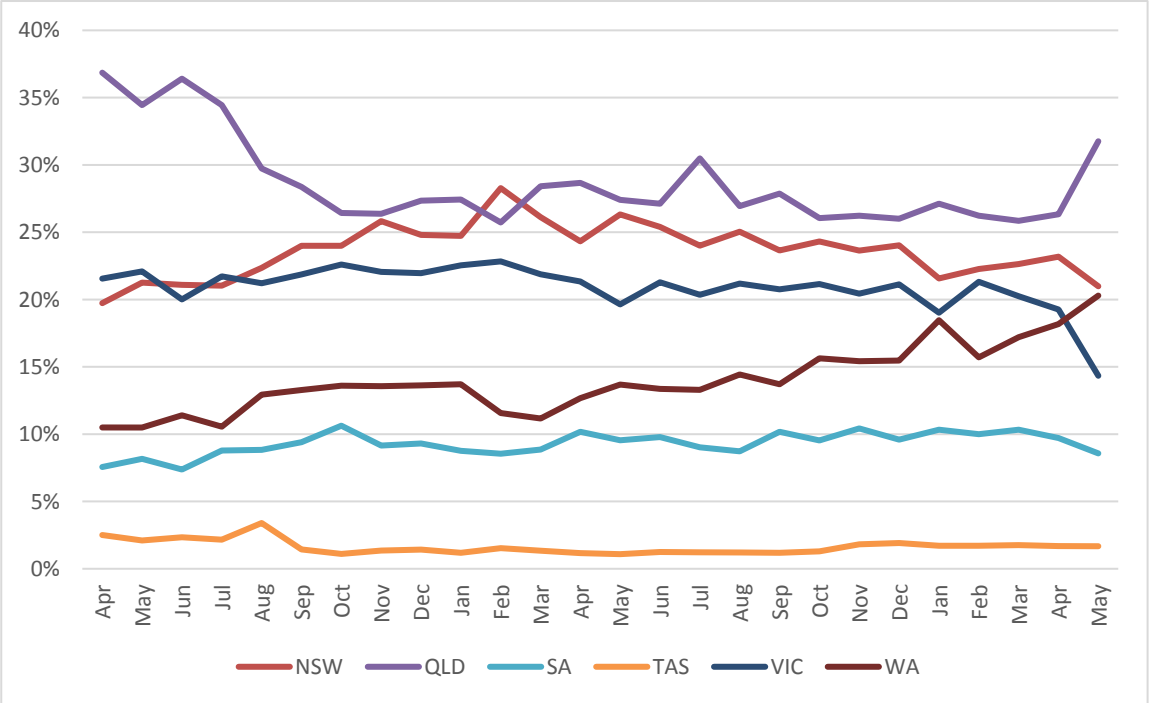
Figure 4 –Monthly solar PV installed capacity (MW)



Drilling further into the data allows us to consider how uptake is shifting in each state and territory. Figure 5 shows the proportion of each month's solar PV capacity that has been installed in each state within the last two years. The Northern Territory and the ACT have been excluded, due to their small population size.

Figure 5: Proportion of monthly installed solar PV capacity by state



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Queensland remains the most popular location for solar PV installations, while the popularity of solar PV continues to increase in Western Australia each month with installed capacity reaching 20 per cent. This increasing interest in solar PV is in part driven by the economics of solar panels in WA as highlighted in Sections 4 and 5, which show that the payback period and the Levelised Cost of Electricity (LCOE) is extremely favourable in Perth.

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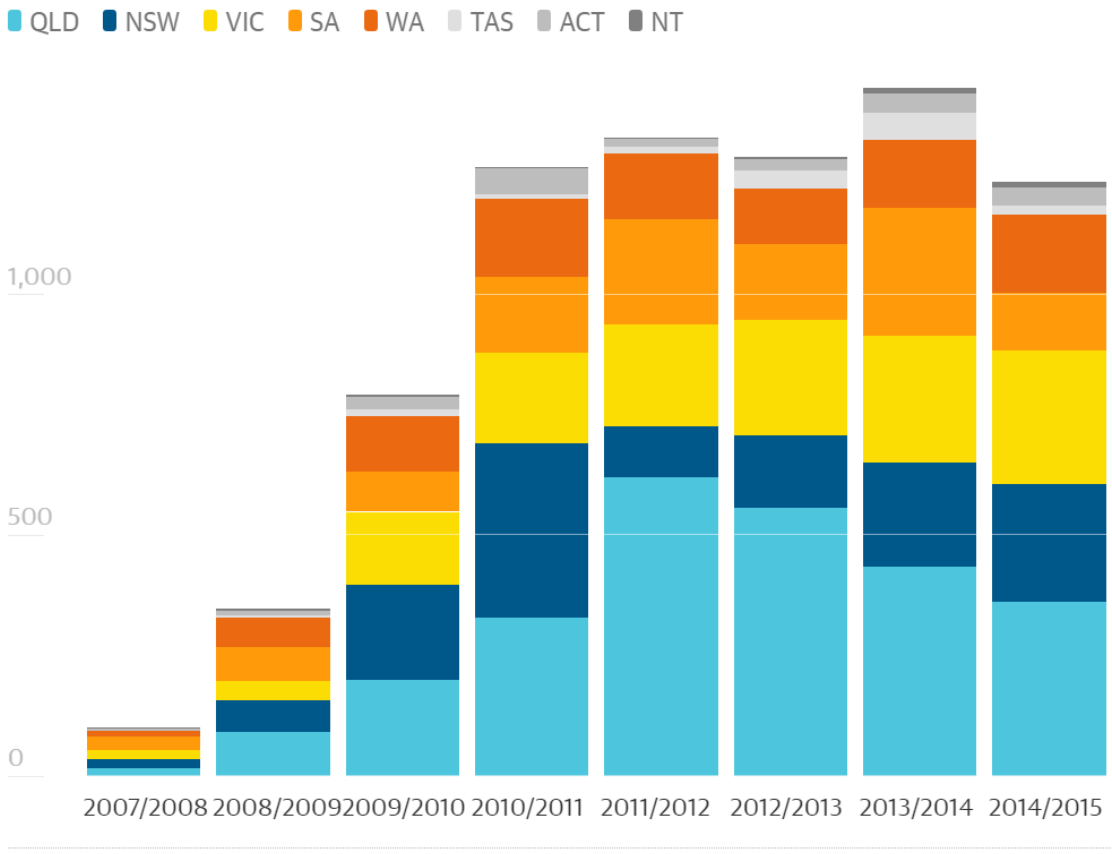
SECTION III: HOUSEHOLD SPEND ON SOLAR

This month, Solar Citizens released a report called The State of Solar: Australia's Solar Rooftop Boom. While the report, as expected, is highly favourable towards solar technology, amidst the pro solar commentary there are some useful figures and statistics. Figure 6 shows the out-of-pocket investment by households on residential installations exclusive of rebates and subsidies.

Figure 6: Australian 'out-of-pocket' investment in small-scale PV systems (<10kw)



Source: Solar Citizens

According to the Solar Citizens' analysis, $8 billion has been spent on residential solar PV since 2007-08 with peak spending occurring in 2013-14 when customers spent a total of $1.4 billion. This calculation is exclusive of small-scale technology certificates (STC). STCs created under the Small-scale Renewable Energy Scheme provide an initial subsidy to buy solar panels. These subsidies are based on the estimated generation over the life of a solar panel, and have a multiplier attached to them depending on the date of installation.

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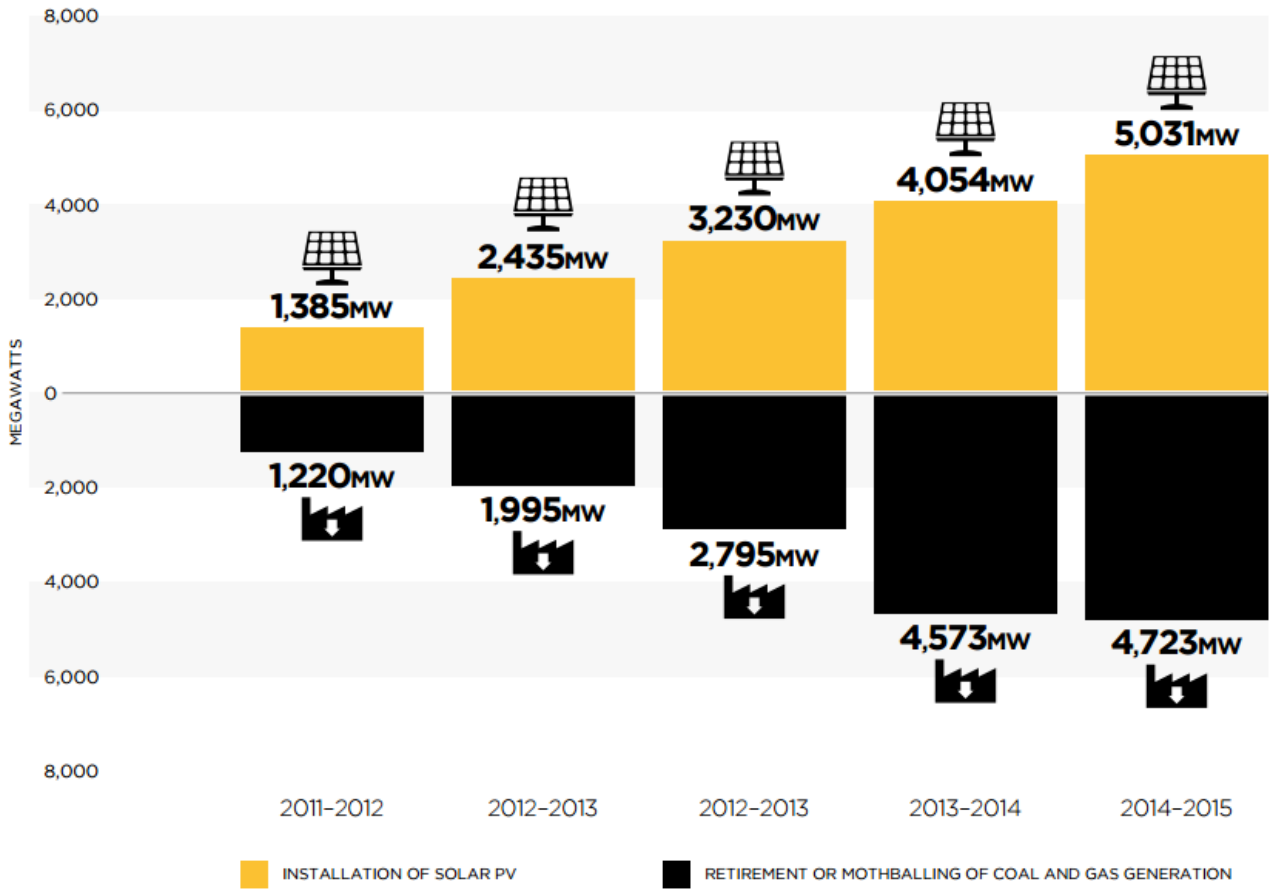
Another chart presented in the report is the cumulative capacity of residential solar, the cumulative capacity of decommissioned and mothballed coal and gas power plants. These numbers seem to mirror one another and without context being added to the chart it is easy to be misled and mistake correlation for causation. For more information on closures and the cause of these please see a recent Energy Insider piece, "The ins and outs of generation".

Figure 7: Installation of solar PV compared to coal and gas generation capacity going offline



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SECTION IV: LEVELISED COST OF ENERGY

The LCOE is the cost of energy per kWh produced. When this is equal to or below the cost that consumers pay directly to suppliers for electricity, this is called grid parity. We have calculated the LCOE for solar in Australia's major cities and below to indicative retail prices and current FiT rates. The detailed methodology can be found in Appendix 1.

The retail comparison rates are representative of the variable rates and do not include supply charges. For all capital cities, excluding Perth and Hobart, charges are based on the implied usage charges from St Vincent de Paul's tracking of market offers, which is released on a bi-annual basis. Perth prices are regulated and obtained from Synergy. Hobart prices were obtained from Aurora Energy's Tariff 31, while Darwin prices are obtained from the Jacana Energy's regulated residential usage charges.

Solar Choice has published data on the price of solar panel installations in Darwin allowing us to calculate the LCOE for the first time. Darwin's LCOE is the highest of any state, starting at 33 cents for a 1.5 kW, 7 cents higher than the second most expensive city and decreasing to 18 cents for a 10 kW system, which is only 1 cent higher than the second most expensive city. The reason for the large difference is the cost of installation in Darwin is much higher than the rest of Australia for 1.5 and 10 kW systems, Darwin's cost of installation is $3,470 and $7,095 higher than the Australian average, respectively for the 1.5 kW and 10 kW systems.

Table 1: Central estimate: 6.97 per cent discount rate (ten year average mortgage rate)

	System Size						Retail prices	FIT
All figures in c/KWh	1.5	2	3	4	5	10		
Adelaide	$0.18	$0.16	$0.14	$0.13	$0.13	$0.13	$0.32	$0.05
Brisbane	$0.17	$0.16	$0.14	$0.13	$0.12	$0.14	$0.25	$0.06
Canberra	$0.19	$0.17	$0.15	$0.14	$0.13	$0.13	$0.17	$0.08
Darwin	$0.33	$0.29	$0.23	$0.21	$0.18	$0.18	$0.26	$0.19
Hobart	$0.26	$0.23	$0.21	$0.19	$0.18	$0.17	$0.25	$0.06
Melbourne	$0.22	$0.20	$0.18	$0.16	$0.15	$0.15	$0.23	$0.06
Sydney	$0.19	$0.17	$0.15	$0.14	$0.13	$0.14	$0.29	$0.06
Perth	$0.13	$0.13	$0.12	$0.11	$0.11	N/A	$0.26	$0.07

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Table 2: Low cost of capital sensitivity: 5.35 per cent discount rate (low current standard variable rate)

	System Size						Retail prices	FIT
All figures in c/KWh	1.5	2	3	4	5	10		
Adelaide	$0.17	$0.15	$0.13	$0.13	$0.12	$0.12	$0.32	$0.05
Brisbane	$0.15	$0.15	$0.13	$0.12	$0.11	$0.13	$0.25	$0.06
Canberra	$0.18	$0.15	$0.14	$0.13	$0.12	$0.12	$0.17	$0.08
Darwin	$0.30	$0.26	$0.21	$0.20	$0.16	$0.16	$0.26	$0.19
Hobart	$0.23	$0.21	$0.19	$0.18	$0.17	$0.16	$0.25	$0.06
Melbourne	$0.21	$0.18	$0.17	$0.15	$0.14	$0.14	$0.23	$0.06
Sydney	$0.17	$0.16	$0.14	$0.13	$0.12	$0.13	$0.29	$0.06
Perth	$0.12	$0.12	$0.11	$0.10	$0.10	N/A	$0.26	$0.07

Table 3: High cost of capital sensitivity: 14.01 per cent discount rate (indicative personal loan rate)

	System Size						Retail prices	FIT
All figures in c/KWh	1.5	2	3	4	5	10		
Adelaide	$0.26	$0.22	$0.19	$0.18	$0.17	$0.18	$0.32	$0.05
Brisbane	$0.23	$0.22	$0.18	$0.17	$0.16	$0.18	$0.25	$0.06
Canberra	$0.27	$0.23	$0.20	$0.18	$0.17	$0.18	$0.17	$0.08
Darwin	$0.48	$0.41	$0.33	$0.30	$0.25	$0.25	$0.26	$0.19
Hobart	$0.36	$0.32	$0.29	$0.27	$0.25	$0.23	$0.25	$0.06
Melbourne	$0.32	$0.27	$0.25	$0.22	$0.21	$0.21	$0.23	$0.06
Sydney	$0.26	$0.24	$0.21	$0.19	$0.18	$0.19	$0.29	$0.06
Perth	$0.18	$0.18	$0.16	$0.15	$0.14	N/A	$0.26	$0.07

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Small and Large business - Levelised Cost of Electricity

Tables 4 and 5 show the estimated cost of electricity production for commercial-sized solar systems. As businesses look to reduce overhead costs, installation of large-scale solar panels continue to increase.

Business tariffs differ to residential retail tariffs. Depending on the size of the customer and the amount of energy used, businesses have the ability to negotiate lower prices. If a business was to consume all electricity onsite, the electricity prices in Tables 4 and 5 would represent the cost per kWh of consumption from the energy generated from the different system sizes listed. For businesses, installation occur if the benefits of installation outweigh the cost. The average electricity bill for industrial businesses in 2014-15 was 10.72c/kWh[i].

The CER sets out guidelines for the redemption of small-scale certificates. There are two criteria which can exclude a system from receiving STCs: systems cannot exceed 100 kW in capacity or generate more than 250 MWh per year[ii].

Table 4: Central estimate: 7.76 per cent discount rate, ten year average small business interest rate

	System Size			
All figures in c/KWh	10	30	50	100
Adelaide	$0.14	$0.13	$0.14	$0.13
Brisbane	$0.13	$0.13	$0.13	$0.12
Canberra	$0.13	$0.12	$0.12	$0.12
Melbourne	$0.16	$0.15	$0.15	$0.15
Sydney	$0.14	$0.13	$0.14	$0.13
Perth	$0.13	$0.13	$0.13	$0.12

Table 5: Central estimate: 5.83 per cent discount rate, ten year average large business interest rate

	System Size			
All figures in c/KWh	10	30	50	100
Adelaide	$0.13	$0.12	$0.12	$0.12
Brisbane	$0.12	$0.12	$0.12	$0.11
Canberra	$0.12	$0.11	$0.11	$0.11
Melbourne	$0.15	$0.14	$0.14	$0.14
Sydney	$0.13	$0.12	$0.12	$0.12
Perth	$0.12	$0.12	$0.12	$0.11

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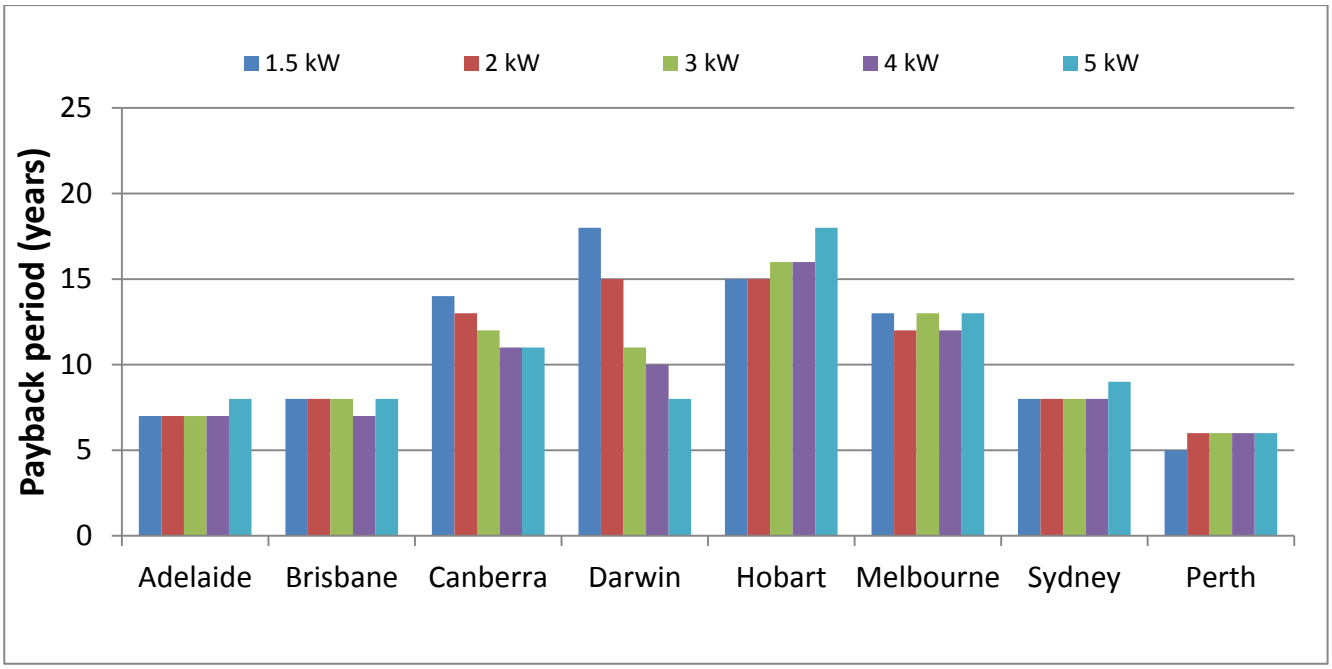
SECTION V: PAYBACK PERIOD, DETAILED MODEL

Using a similar methodology to that used to calculate the LCOE of solar PV in Australia (see Chapter 4), the Australian Energy Council has calculated the payback period for residential solar PV systems. The payback period is defined as the year when the cumulative savings are greater than the cumulative costs of a solar PV system. Savings represent the avoided cost of consumption and any revenue received from FiTs. The cumulative cost incurred represents the initial investment and the time value of money. A detailed methodology is contained at Appendix 2. Payback period calculations include Darwin for the first time. Interestingly, Darwin has the highest cost of installations across Australia, but also has the highest FiT in Australia. This leads to a quicker payback period for larger systems due to assumed increases in exports to the grid.

Figure 8 highlights the payback period for different system sizes across Australia. Note that electricity prices are increased at CPI levels and if these prices rise above or below CPI, this will change the payback period

Figure 8: Payback period for solar PV (5.35 per cent discount rate)

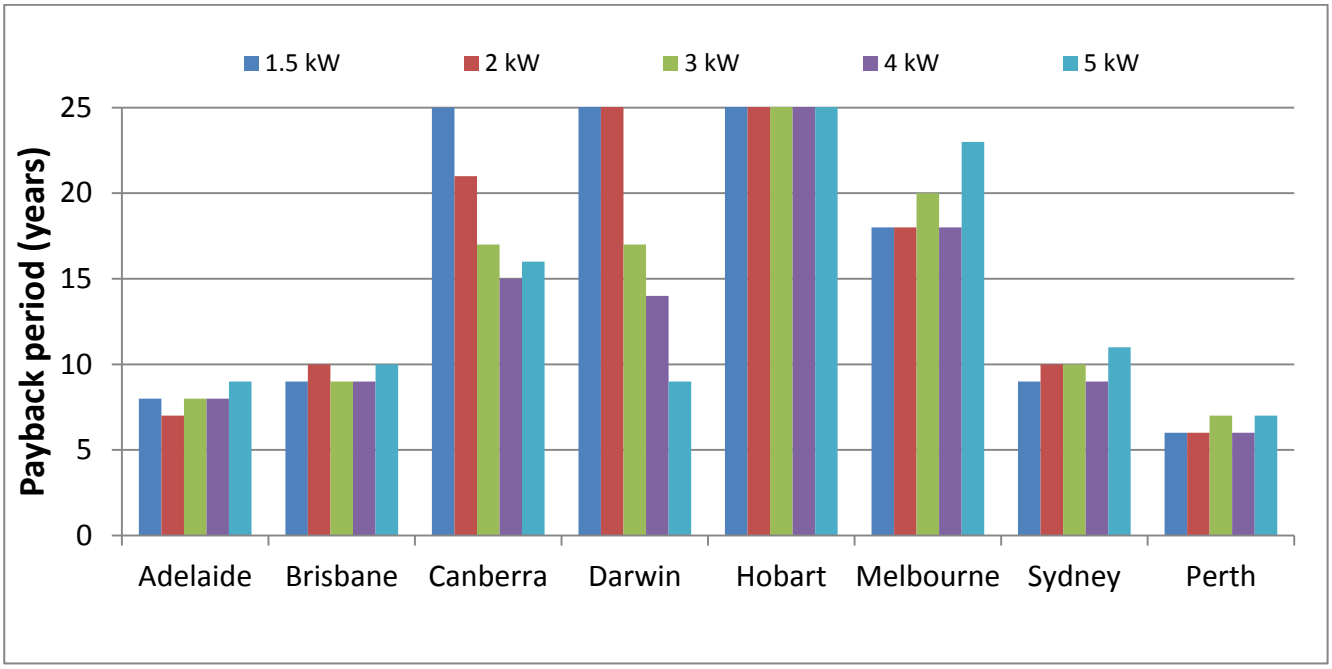


Adelaide, Perth and Brisbane all have consistently low payback periods. These three cities have high output rates with 4.2, 4.4 and 4.2 kWh produced on average each day for each kW of installed capacity (kWh/kW/day). Although Canberra sees similar rates of output (4.3kWh/kW/day), electricity costs are

the lowest in Australia, which changes the payback period. The calculated usage charge is 12 cents lower than the second lowest price in Australia and 15 cents lower than the highest.

Payback periods are extremely sensitive to the discount rate applied. Figure 9 shows the expected payback period for systems with a 7.02 per cent discount rate (10 year average home loan rate). This scenario suggests that Hobart's payback period exceeds 25 years for many large system sizes including 4 kW; 5 kW while Melbourne's 5 kW systems have payback periods exceeding 25 years.

Figure 9: Payback period for solar PV (6.97 per cent discount rate)



Under the scenario where customers are buying a solar system with a personal loan where the minimum of the Big Four banks payback rate is currently 14.01 per cent, no payback period is less than 25 years.

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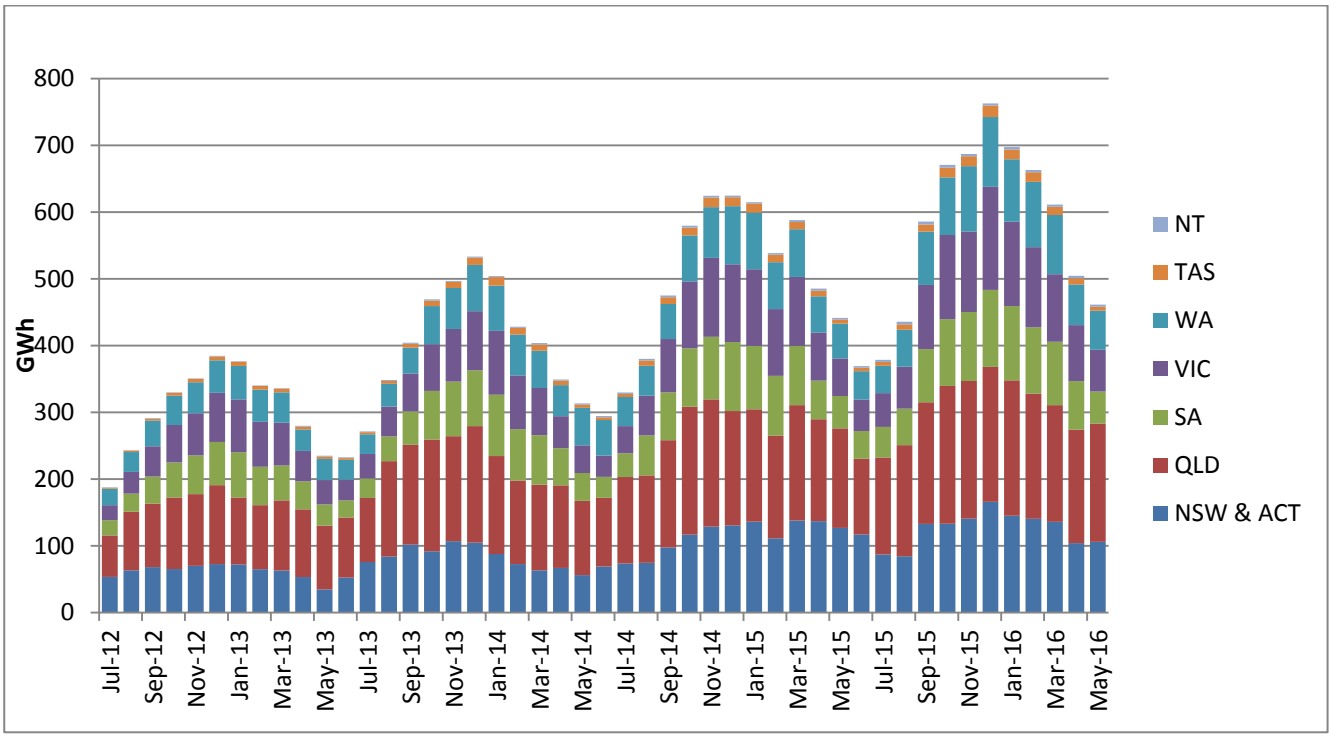
SECTION VI: ESTIMATED RESIDENTIAL PV GENERATION

Figure 10 shows the estimated total output of solar systems in each jurisdiction since July 2012. The PV output is obtained by multiplying the efficiency factor of systems with the estimated MW capacity in each state (as described in Section 2 of this report).

Figure 10: Estimated residential PV generation (GWh)



The efficiency factor is calculated from PVoutput.org where self-selecting solar systems enter data into a database. Due to self-selection, the estimate may have an upward bias as self-selecting clients are more likely to maintain solar systems and therefore have a higher efficiency factor. Sample sizes for the Northern Territory and Tasmania are very small. The CER data may not accurately capture the rooftop PV generating capacity due to systems that have failed, and are no longer generating or upgraded systems which have not been notified to CER. All systems which are reported to the CER are assumed to be residential.

The month of February shows a large decrease simply due to being the shortest month.

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SECTION VII: SOLAR NEWS ROUND UP

Tesla bid to buy Solar City for $3.75 billion

Tesla has offered to purchase SolarCity, the largest producer of solar panels in the US for $US2.8 Billion ($3.75 Billion). The deal would make Tesla the first company to offer 'end-to-end' clean energy products. The move would enable consumers to produce solar power from a Tesla PV unit, store power in their Tesla battery and subsequently charge their Tesla electric vehicle. As Elon Musk, the Chief Executive Officer and top shareholder of Tesla is already the Chairman of SolarCity and its top shareholder, the deal is set to proceed on 'friendly terms'.

Source: 22nd June 2016, retrieved from Sydney Morning Herald

Australia's second solar installer goes into liquidation

One of Australia's largest installers of rooftop solar, Metro Solar has gone into liquidation, according to a 15 June notice from the Australian Securities Investment Commission (ASIC). However, customers have been assured that they will not suffer and warranties will be honoured as the new owners of the company have agreed to take on all debt. This is not the first Australian solar company to suffer financial trouble this year, as February saw Melbourne retailer Infinity Solar go bust. Clean energy retailer Go Energy was also put into voluntary administration in April of this year.

Source: 20th June, 2016, retrieved from Reneweconomy

Lightweight Solar System drives down installation time and labour costs

The traditional commercial rooftop solar's biggest disadvantage is its size. Most commercial roofs are unable to support the weight of a conventional rooftop solar array. Beamreach Solar has designed a new solar panel, called *Sprint*, which resolves this dilemma. The installation process is estimated to be five times faster than a conventional roof system with less tools required and zero grounding.

Source: 21st June 2016, retrieved from Renewable Energy World

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SECTION VIII: APPENDICES

1. Appendix 1: Levelised Cost of Electricity Methodology

Introduction

The methodology outlines our approach in calculating the Levelised Cost of Electricity (LCOE) for solar panels installed across capital cities in Australia. Our analysis includes the following:

- Initial investment
- Annual costs
- Discount rate
- Efficiency
- System degradation rate

Initial investment

The initial investment plays a major role in the LCOE calculations. The initial investment represents the cost of buying and installing solar panels all values are inclusive of Federal small-scale technology certificate (STC) discounts.

The initial investments in this report are obtained from the Solar Choice website. Solar Choice takes prices from over 125 installers across Australia and updates pricing data monthly.

Annual costs

We have estimated the annual cost to clean a solar panel at $12.50[iii], and the average sized solar panel in our calculations to be 200W.

Discount rate

The discount rate represents the risk nature of the consumer. For this exercise, three different discount rates have been used and will be updated each quarter. The central estimate is based on the 10-year average home loan, as presented by the Reserve Bank of Australia (6.97 per cent).

The low discount rate sensitivity is based on the minimum variable home loan mortgage rate offered by the Big Four banks (currently 5.35 per cent).

The high discount rate sensitivity is based on personal loans offered by the Big Four banks as the assumption has been made that a personal loan will include all costs including the initial start-up of the loan (14.01 per cent).

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Small business and large business discount rates are based on the 10-year average of the variable weighted average rate on credit outstanding. The large business discount rate is 5.83 per cent and the small business discount rate is 7.76 per cent.

The discount rate also takes into account the Consumer Price Index (CPI); this has been given a constant value of 2.5 per cent.

Efficiency

The kWh/kWp represents the average daily production of solar panels. The number was obtained from the Clean Energy Council's consumer guide to installing household solar panels[iv]. The efficiency figure represents the average daily output for a 1kW system.

System degradation rate

The system degradation rate is used to show the reduced output of a system from year to year. Numbers vary from approximately 0.1 per cent to 1 per cent depending on the system. The Australian Energy Council has used 0.5% as a constant degradation rate for all LCOE calculations.

Formula

$$LCOE\ \$/kWh = \frac{Initial\ Investment + \sum_{N=1}^{N} \frac{Annual\ Costs}{(1+Discount\ Rate)^n}}{\sum_{N=1}^{N} \frac{Initial \frac{kWh}{kWp} * (1-System\ Degradation\ Rate)^n}{(1+Discount\ Rate)^n}}$$

Retail comparison rates

St Vincent de Paul tracks market offers on a bi-annual basis. New South Wales, Queensland, South Australia and Victoria implied usage charge of electricity have been obtained from these reports.

A single rate tariff was analysed to calculate the implied usage charge in Victoria, South Australia, New South Wales and the ACT. Tariff 11 in Queensland. Tasmania's usage charge was obtained for Aurora Energy tariff 31 and Synergy the sole retailer in Western Australia was used.

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2. Appendix 2: Payback period methodology

This methodology outlines our approach in calculating the payback period for solar panels installed across capital cities in Australia. Our analysis includes the following:

- Initial investment
- Discount rate
- Efficiency
- System degradation rate
- Export rate
- Avoided usage cost
- FiT

Initial investment, discount rate, efficiency and system degradation rate are described in appendix 1. Key difference to LCOE calculation is the payback period assumes no annual maintenance cost.

Calculation

Payback period occurs when $\sum$ savings > $\sum$ cost

Where:

Savings = (usage cost x $(1+ CPI)^t$ x consumption / 100) + (Export x FiT)

Cost = investment x $(1 + \text{real discount rate})^t$

t = years

Avoided cost and FiT

The onsite consumption is multiplied by the retailer's usage charges, CPI has been applied to the usage charge to allow for growth in retail prices. The excess energy is exported to the grid and the customer is expected to receive the mandatory FiT or a realistic market offer where mandatory tariffs are not applicable.

Export rate

The percentage of onsite consumption and electricity which is exported to the grid is calculated using the median value from Sunwiz's analysis[v]. See Figure 6 below.

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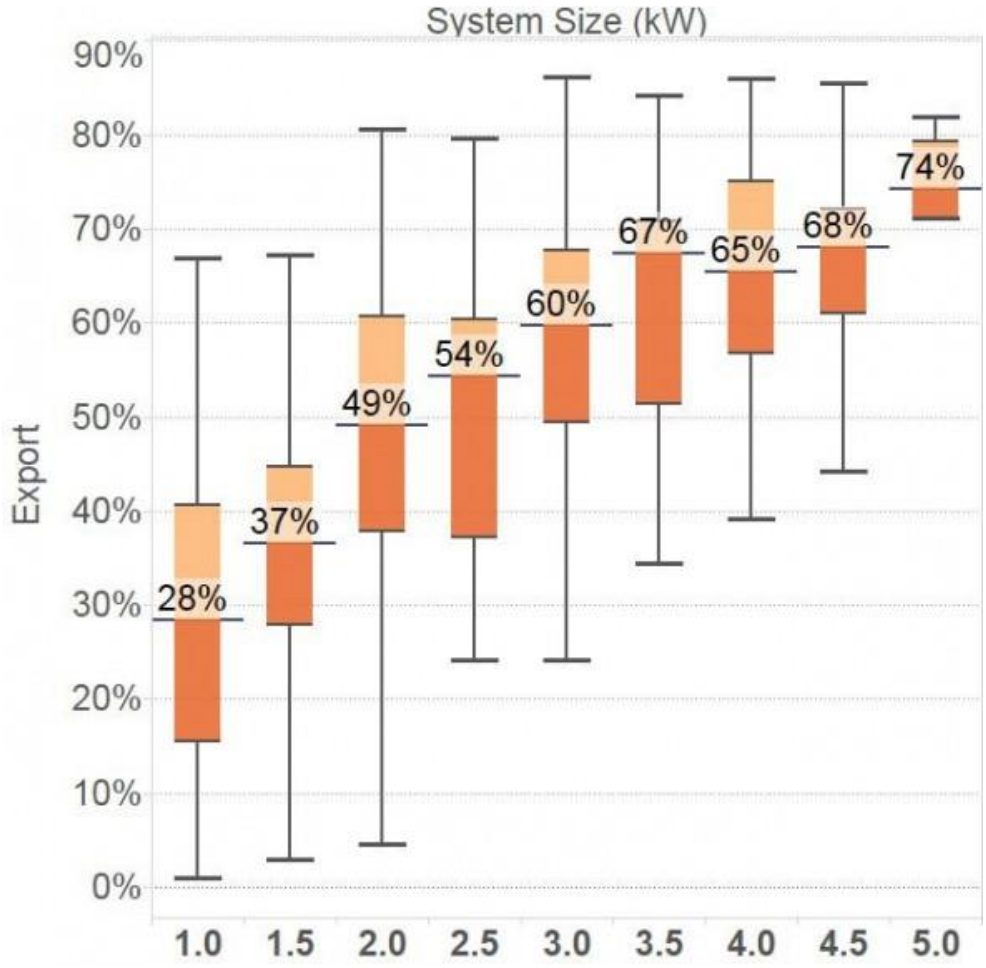
Figure 6: Export rate of residential solar PV at different system sizes



[ii] Clean Energy Regulator, "How to have STCs assigned to you as a Registered Agent", http://ret.cleanenergyregulator.gov.au/For-Industry/Agents/Having-STCs-assigned-to-you/stcs-assigned-to-you

[iii] estimate based on, RenewEconomy, 26 August 2013, http://reneweconomy.com.au/2013/hidden-cost-of-rooftop-solar-who-should-pay-for-maintenance-99200

[iv] Clean Energy Council, http://www.solaraccreditation.com.au/dam/cec-solar-accreditation-shared/guides/Guide-to-installing-solar-PV-for-households.pdf

[v] Sunwiz, Solar Pays Its Way on Networks. Last accessed 17 June 2015.

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