AUSTRALIAN ENERGY COUNCIL

SOLAR REPORT

JANUARY 2018

Australian Energy Council

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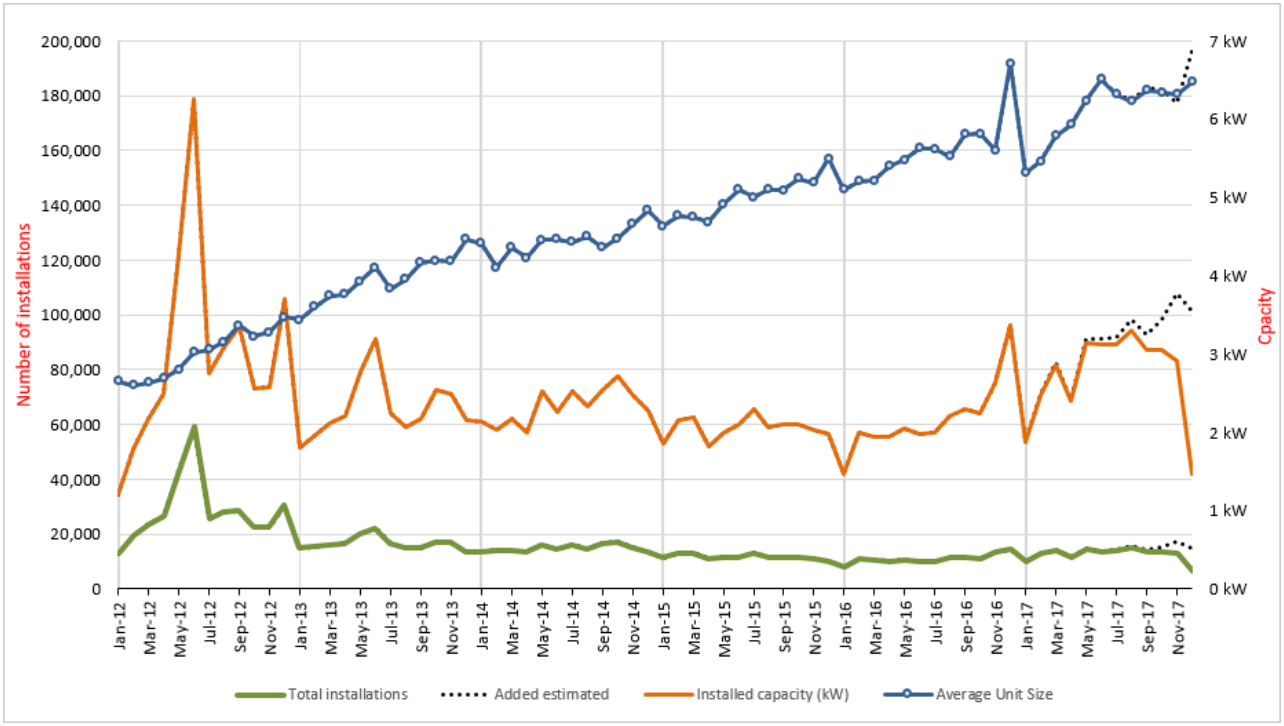
SECTION I: STATE OF SOLAR PV IN AUSTRALIA

Updated data from the Clean Energy Regulator (CER) on 30 January 2018, shows that 2017 was a record-breaking year for solar in Australia[i]. Due to a 12-month reporting lag for solar systems, the raw 31 December 2017 data under estimates the total number of installations and installed capacity[1].

By the end of 2017, cumulative installed capacity for solar photovoltaic (PV) systems in Australia stood at 6,401 MW with close to 1.8 million installations. This is up from 5,463 MW and 1.64 million installations at the same time in the previous year - illustrating the continued strong growth in solar installation. The amount of rooftop PV capacity installed during 2017 is estimated to have reached over 1 GW, making 2017 a record year for Australian rooftop solar PV.

The raw 31 December 2017 data under estimates the total number of installations and installed capacity. This under estimation occurs because solar PV owners have up to 12 months to report their data to the CER, so we do not see the final reported capacity and number of installations for the most recent months.

Figure 1: Monthly installations, installed solar PV capacity and average system size Jan 2012 – 2017



Source: Clean Energy Regulator (adjusted data), Australian Energy Council analysis, January 2018

Illustrated in figure 1, the two most recent months of November and December show an apparent sharp drop in installed capacity and total installations again likely to be due to the 12-month lag in

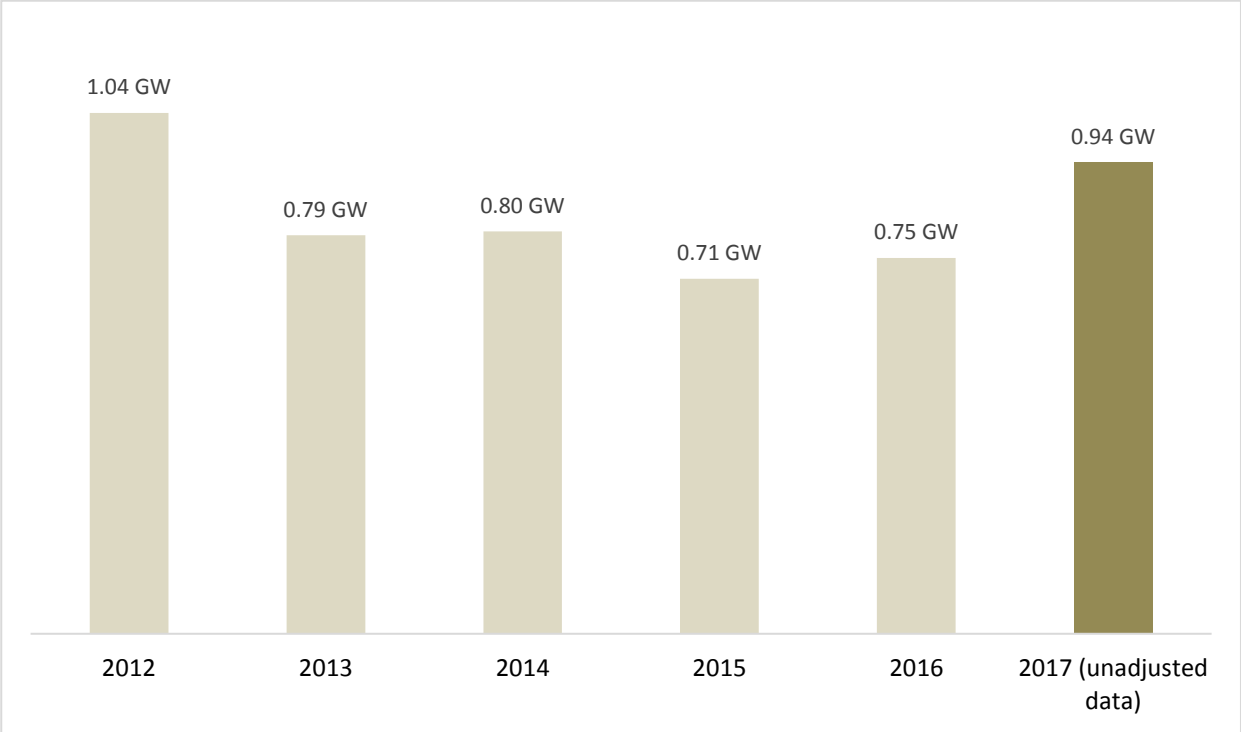
[1] Solar PV system owners have up to 12 months to report their data to the Clean Energy Regulator, so the reported data for the most recent months is likely to understate the number of actual installations, as well as the installed capacity.

data[1], which does not reflect the actual capacity uptake in more recent months as of 31 December 2017.

We estimated November and December 2017 only accounts for around 75 and 43 per cent of actual installations and installed capacity respectively. The adjusted data will of course show a significant increase compared to the raw data.

Our adjusted data reveals that the total number of rooftop PV installations reached a record high, surpassing 17,000 installations in November 2017. The monthly number of installations has been consistent for the past year (excluding January) and the estimated monthly average unit size reached 6.87 kW. Households and small businesses have opted for bigger system sizes, with one factor being the rapid fall in solar PV costs[2].

Figure 2: Total installed capacity (GW) since 2012 in Australia



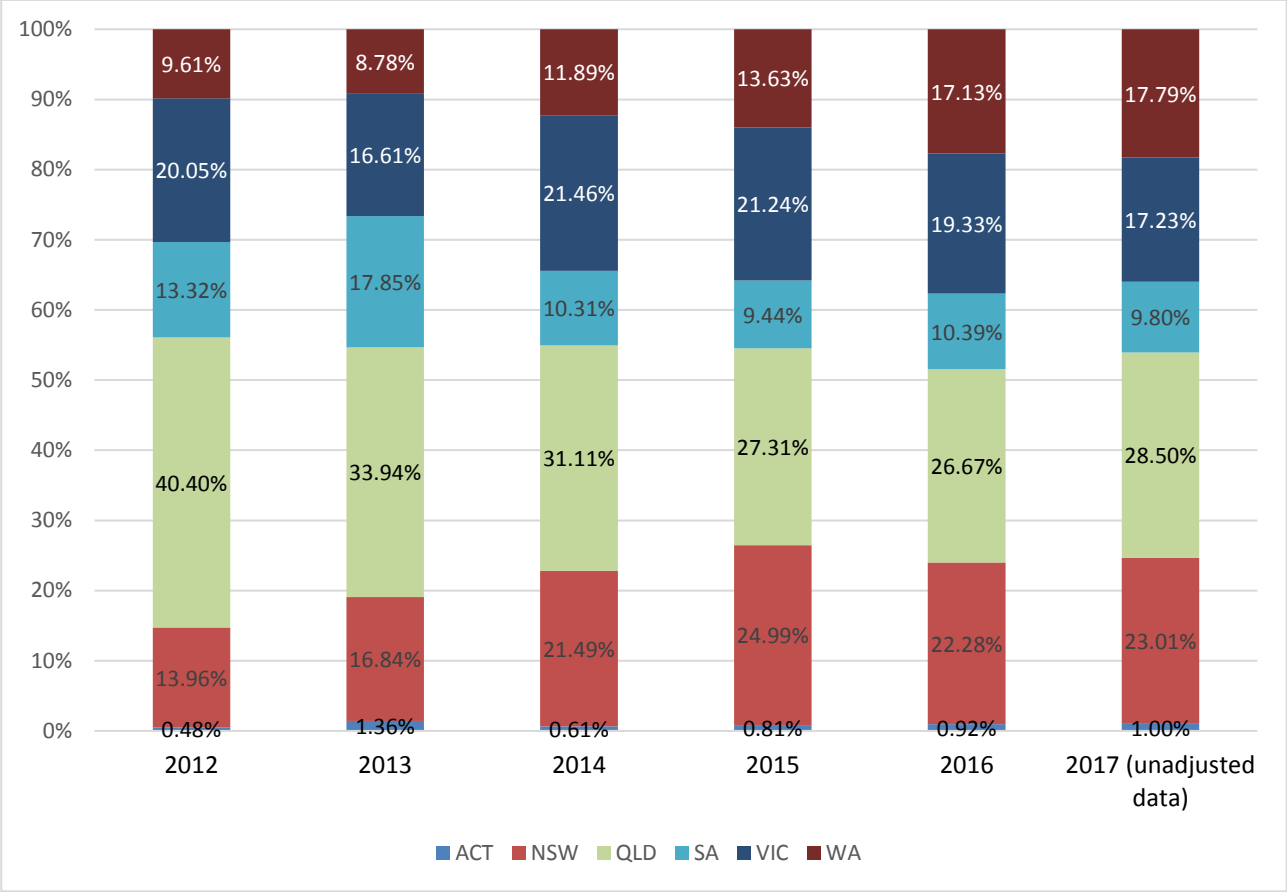
Source: Clean Energy Regulator data, Australian Energy Council analysis, January 2018

Australia added more solar power in 2017 alone (937.8 MW of solar capacity) than the capacity of South Australia's decommissioned Northern and Playford power stations (784 MW), which closed in 2016. Due to reporting lag, the actual number of installed rooftop PV capacity is expected to be higher, and we estimate it reached over 1 GW.

With the deployment of new battery storage technologies, the growth of rooftop PV is expected to be driven more in future by the commercial and industrial sectors rather than residential installers, who have been the main source of growth up to date.

[2] March 2017 Solar Report, Australian Energy Council

Figure 3: Proportion of yearly solar PV installed capacity across jurisdictions



Source: Clean Energy Regulator data, Australian Energy Council analysis, January 2018

Figure 3 shows that Western Australia has had a continuous increasing share of national rooftop PV capacity. While Queensland's yearly installed capacity remains the largest share across the nation, although the state is no longer experiencing the same growth boom that was seen in 2012-13.

SECTION II: BATTERY STORAGE UPDATES

The concept of solar-powered rechargeable batteries has been increasingly mentioned in the media and gained significant attention late last year when Tesla's 100MW battery was installed in South Australia.

According to the latest data, released by the Clean Energy Regulator on 30 January 2018, the number of concurrent small-scale solar and battery installations of all brands reached 3,763 installations in 2017, a large jump from 1,566 installations in 2016.

Illustrated in figure 4, the strong end to 2017 was led by the charge of home batteries in New South Wales, Victoria and Queensland. In the past two years, the total concurrent installations of these states account for 80 per cent of solar PV with concurrent battery installations throughout Australia.

2017 saw New South Wales dominate with 42.6 per cent of installations, followed by Queensland and Victoria with 18.2 and 15.9 per cent respectively. Despite having a high percentage growth, the Northern Territory and Tasmania have the least amount of concurrent solar-battery installations a factor of their smaller populations (table 1).

Figure 4: Australian distributed solar PV with concurrent battery installations

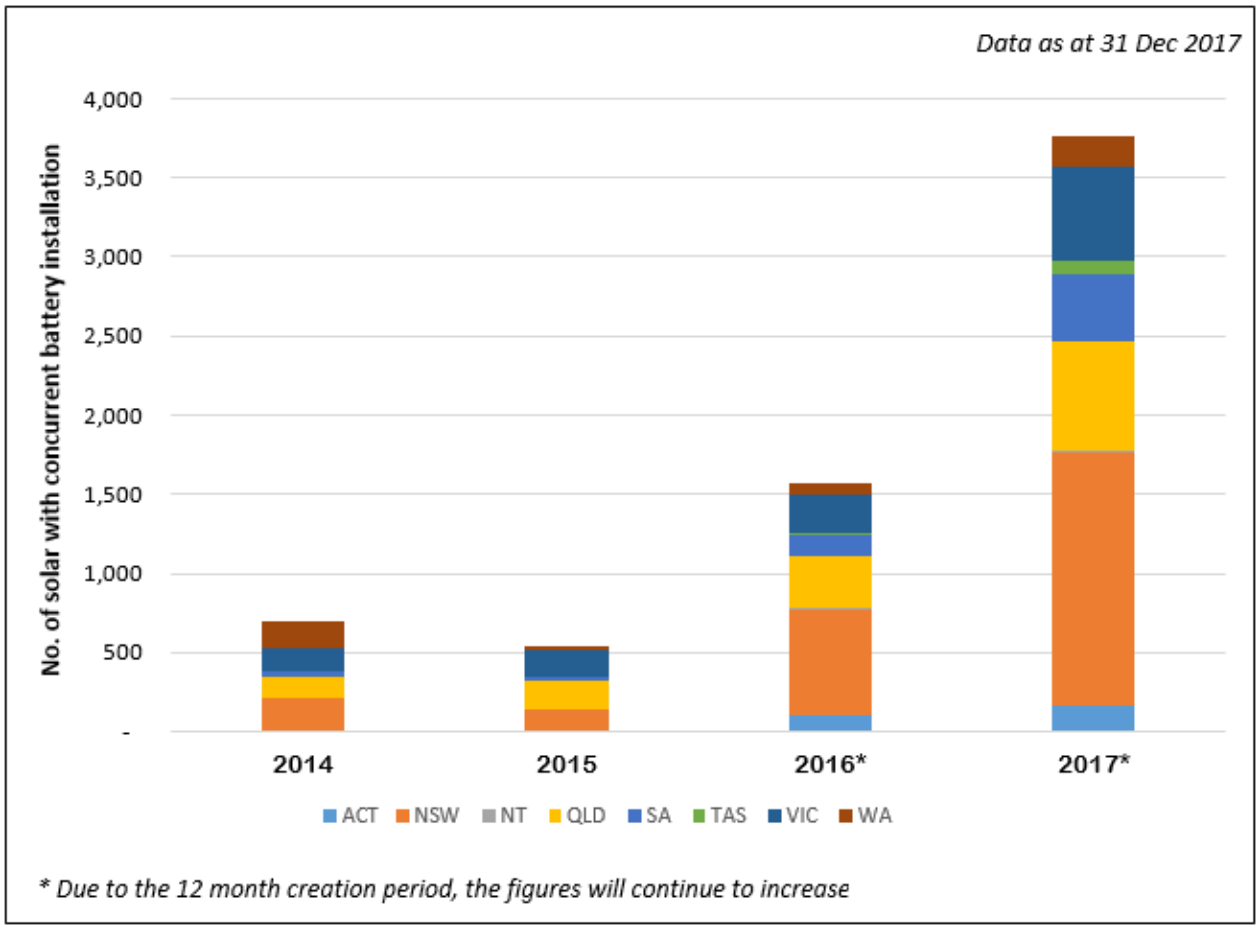


Table 1: Percentage growth of battery installations in 2017, compared to 2016 across all jurisdictions

	ACT	NSW	NT	QLD	SA	TAS	VIC	WA
Percentage growth (2016 - 2017)	54.3%	140.5%	166.7%	107.3%	223.1%	383.3%	149.2%	174.3%

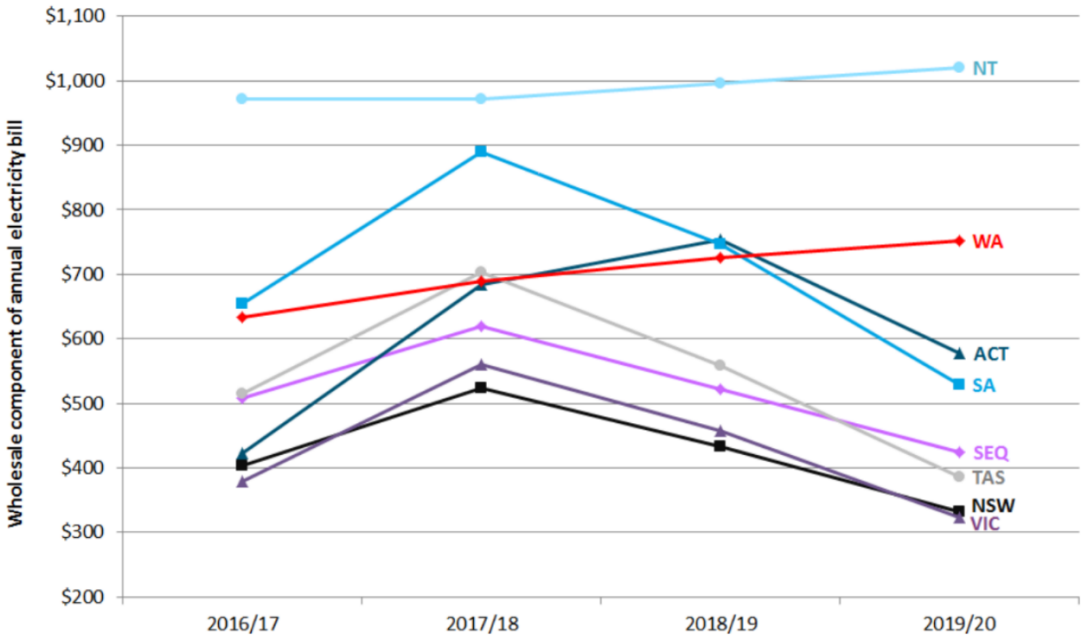
Source: Australian Energy Council analysis on Clean Energy Regulator data, 30 January 2018

In 2017, rooftop solar hit its highest level (over 1 GW) with installers reporting that interest is continuing to grow. Battery storage technology enables households and businesses to optimise the use of their solar power and benefit the grid by better balancing peak demand and generation, as well as delaying or avoiding the need for network upgrades.

The Australian Energy Market Commission's latest 2017 Residential Electricity Price Trends report states that the change in residential prices and bills were primarily driven by an increase in wholesale costs, following the retirements of the Northern (546 MW) and Hazelwood (1,600 MW) coal-fired power stations coupled with high domestic gas prices. This is expected to continue into 2018 across the country; prices will rise sharply in the first quarter of 2018 and then drop to an average of 6.2 per cent in the next two financial years[ii].

Figure 5 shows the trends in the wholesale cost component over the period 2016/17 to 2019/20. The change in wholesale costs is the primary driver of the change in retail electricity prices and bills in all jurisdictions.

Figure 5: Trends in wholesale component of residential annual electricity bill across jurisdictions, 2016/17 to 2019/20



Source: AEMC's 2017 Residential Electricity Price Trends, December 2017

The Australian Competition and Consumer Commission's Gas Inquiry 2017-2020 Interim Report, shows that the supply-demand outlook for the east coast gas market remains tight. During the last quarter of 2017, the Federal Government intervened in the gas market to increase supply; including restricting the amount of gas for export. Australia Pacific LNG Pty Ltd diverted gas to the domestic market during planned outages. QGC Pty Ltd had effectively diverted gas originally intended for LNG export to the domestic market. Gladstone LNG and Santos had entered into an agreement with ENGIE to supply the local east coast market over 2018 and 2019, using gas that would otherwise have been exported as LNG.

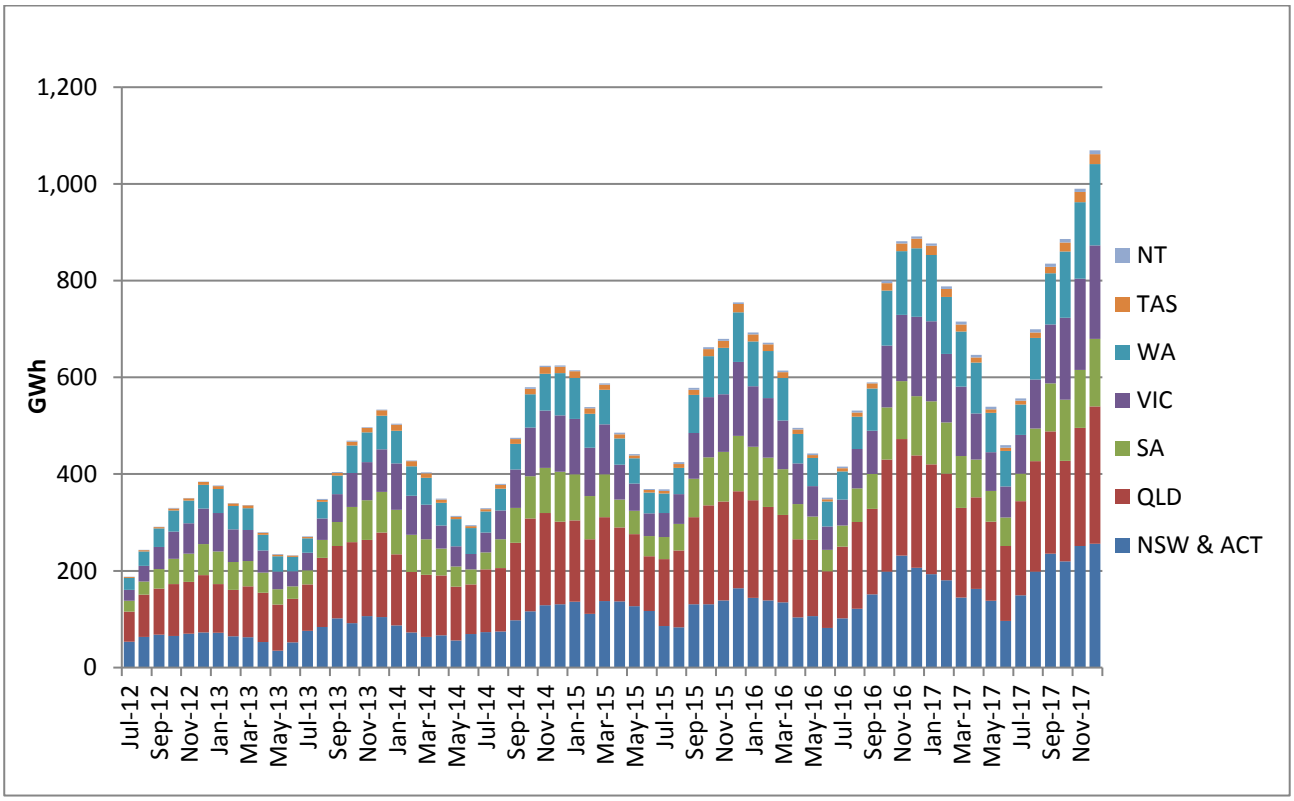
As electricity prices continue to rise, battery storage provides a solution for cheaper energy. This was seen recently, when the South Australian Government announced that at least 50,000 home solar panels and batteries will be rolled out over the next four and a half years to build the world's largest "virtual power plant" in the state.

SECTION III: ESTIMATED RESIDENTIAL PV GENERATION

Figure 6 illustrates the seasonal patterns of the estimated total output of solar systems, nationally. PV generation is low during May to July, while it unsurprisingly reaches a peak during summer each year. December is consistently the highest month for PV electricity generation. The PV output is obtained by multiplying the efficiency factor of systems with the estimated capacity (MW) in each state (as described in Section 2 of this report).

The efficiency factor is calculated from PVoutput 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 Clean Energy Regulator data may not accurately capture the rooftop PV generating capacity due to systems that have failed, and are no longer generating, or systems that have been upgraded but have not been notified to the Clean Energy Regulator. All systems which are reported to the Clean Energy Regulator are assumed to be residential.

Figure 6: Estimated residential PV generation (GWh)



Source: Australian Energy Council analysis, January 2018

Table 2: Estimated of rooftop PV generation (GWh) across each states

	NSW & ACT	QLD	SA	VIC	WA	TAS	NT	Total
2016	1,721	2,221	1,008	1,198	1,048	139	43	7,378
2017	2,225	2,553	1,154	1,545	1,347	166	71	9,062

Source: Australian Energy Council analysis, January 2018

For the first time rooftop solar PV installations throughout Australia generated over 1,000GWh in December 2017. In 2017, residential rooftop PV generated an estimated of 9,062 GWh, increasing from 7,378 GWh in 2016, equivalent to a 22.8 per cent jump. The Northern Territory and Tasmania only accounted for a 2.6 per cent share of total rooftop generation for 2017. The increase in generation in these two states from 2016 is too insignificant. In 2016 they accounted for 2.5 per cent of total rooftop PV generation in Australia.

SECTION IV: LEVELISED COST OF ENERGY

The Levelised Cost of Energy (LCOE) is the cost of energy per kWh produced. When this is equal to or below the cost consumers pay directly to suppliers for electricity, this is called grid parity. Table 3 shows the LCOE for solar in Australia's major cities, indicative retail prices and current feed-in tariff (FiT) rates. The detailed methodology can be found in the Appendix.

The retail comparison rates are representative variable rates and do not include supply charges. For all capital cities, excluding Perth and Hobart, retail prices are based on the implied usage charges from St Vincent de Paul's tracking of market offers, which was last updated in July 2017. Perth prices are regulated and obtained from Synergy. Hobart prices were obtained from Aurora Energy's Tariff 31, while Darwin prices are obtained from Jacana Energy's regulated residential usage charges. Tables 4, 5 and 6 show the LCOE across major cities at different discount rates.

Many electricity retailers raised their solar FiT, which allows customers to shop around and choose the best price. In many states, householders will benefit from a steep increase in solar FiT from around 9c/kWh to a minimum of 12.8c/kWh for their exports fed back to the grid.

Table 3: Central estimate: 6.53 per cent discount rate (ten-year average mortgage rate)

	System Size						Retail prices	FIT
All figures in c/KWh	**2.0 kW**	**3.0 kW**	**4.0 kW**	**5.0 kW**	**7.0 kW**	**10.0 kW**		
Adelaide	$0.15	$0.13	$0.12	$0.11	$0.12	$0.12	$0.48	$0.17
Brisbane	$0.15	$0.13	$0.12	$0.11	$0.11	$0.12	$0.33	$0.12
Canberra	$0.14	$0.13	$0.12	$0.11	$0.12	$0.12	$0.22	$0.13
Darwin*	$0.24	$0.20	$0.18	-	$0.16	$0.13	$0.26	$0.26
Hobart	$0.21	$0.18	$0.17	$0.16	$0.16	$0.16	$0.25	$0.09
Melbourne	$0.20	$0.16	$0.15	$0.15	$0.16	$0.15	$0.26	$0.12
Sydney	$0.15	$0.13	$0.12	$0.12	$0.12	$0.13	$0.31	$0.13
Perth	$0.13	$0.11	$0.10	$0.10	$0.11	$0.11	$0.26	$0.07

Source: Australian Energy Council analysis, January 2018

* In Darwin, there is no 5kW pricing as installers prefer to list pricing for 4.5kW systems and as there are additional hurdles for connecting solar systems above that size to the grid.

Table 4: Low cost of capital sensitivity: 5.30 per cent discount rate (low current standard variable rate)

	System Size						Retail prices	FIT
All figures in c/KWh	**2.0 kW**	**3.0 kW**	**4.0 kW**	**5.0 kW**	**7.0 kW**	**10.0 kW**		
Adelaide	$0.14	$0.12	$0.11	$0.11	$0.11	$0.12	$0.48	$0.17
Brisbane	$0.15	$0.12	$0.12	$0.11	$0.11	$0.12	$0.33	$0.12
Canberra	$0.13	$0.12	$0.11	$0.11	$0.11	$0.12	$0.22	$0.13
Darwin	$0.22	$0.19	$0.17	-	$0.15	$0.12	$0.26	$0.26
Hobart	$0.20	$0.17	$0.16	$0.15	$0.15	$0.15	$0.25	$0.09
Melbourne	$0.18	$0.16	$0.15	$0.14	$0.15	$0.14	$0.26	$0.12
Sydney	$0.14	$0.13	$0.12	$0.11	$0.12	$0.12	$0.31	$0.13
Perth	$0.12	$0.11	$0.10	$0.09	$0.10	$0.11	$0.26	$0.07

Source: Australian Energy Council analysis, January 2018

Table 5: High cost of capital sensitivity: 13.07 per cent discount rate (indicative personal loan rate)

	System Size						Retail prices	FIT
All figures in c/KWh	**2.0 kW**	**3.0 kW**	**4.0 kW**	**5.0 kW**	**7.0 kW**	**10.0 kW**		
Adelaide	$0.20	$0.17	$0.16	$0.15	$0.15	$0.16	$0.48	$0.17
Brisbane	$0.21	$0.17	$0.16	$0.15	$0.15	$0.16	$0.33	$0.12
Canberra	$0.18	$0.17	$0.15	$0.14	$0.16	$0.16	$0.22	$0.13
Darwin	$0.34	$0.28	$0.25	-	$0.22	$0.17	$0.26	$0.26
Hobart	$0.29	$0.24	$0.22	$0.21	$0.21	$0.22	$0.25	$0.09
Melbourne	$0.27	$0.22	$0.20	$0.19	$0.21	$0.20	$0.26	$0.12
Sydney	$0.20	$0.18	$0.16	$0.15	$0.16	$0.17	$0.31	$0.13
Perth	$0.17	$0.15	$0.13	$0.13	$0.14	$0.15	$0.26	$0.07

Source: Australian Energy Council analysis, January 2018

Small and Large business - Levelised Cost of Electricity

Tables 6 and 7 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 6 and 7 would represent the cost per kWh of consumption from the energy generated from the different system sizes listed. For

businesses, installation occurs if the benefits of installation outweigh the cost. The average electricity bill for industrial businesses in 2014-15 was 10.72 c/kWh[iii].

The Clean Energy Regulator 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[iv].

Table 6: Central estimate: 7.30 per cent discount rate, ten-year average small business interest rate

	System Size				
All figures in c/KWh	**10kW**	**30kW**	**50kW**	**70kW**	**100kW**
Adelaide	$0.13	$0.12	$0.12	$0.12	$0.12
Brisbane	$0.13	$0.13	$0.12	$0.12	$0.12
Canberra	$0.13	$0.12	$0.11	$0.11	$0.11
Hobart	$0.19	$0.17	$0.16	$0.16	$0.16
Melbourne	$0.16	$0.15	$0.15	$0.14	$0.14
Sydney	$0.14	$0.13	$0.13	$0.13	$0.12
Perth	$0.12	$0.11	$0.12	$0.12	$0.11

Source: Australian Energy Council analysis, January 2018

Table 7: Central estimate: 5.26 per cent discount rate, ten-year average large business interest rate

	System Size				
All figures in c/KWh	**10kW**	**30kW**	**50kW**	**70kW**	**100kW**
Adelaide	$0.12	$0.11	$0.11	$0.11	$0.11
Brisbane	$0.12	$0.12	$0.11	$0.11	$0.11
Canberra	$0.12	$0.11	$0.10	$0.10	$0.10
Hobart	$0.17	$0.15	$0.15	$0.15	$0.14
Melbourne	$0.14	$0.14	$0.13	$0.13	$0.13
Sydney	$0.13	$0.12	$0.12	$0.12	$0.11
Perth	$0.11	$0.10	$0.11	$0.11	$0.10

Source: Australian Energy Council analysis, January 2018

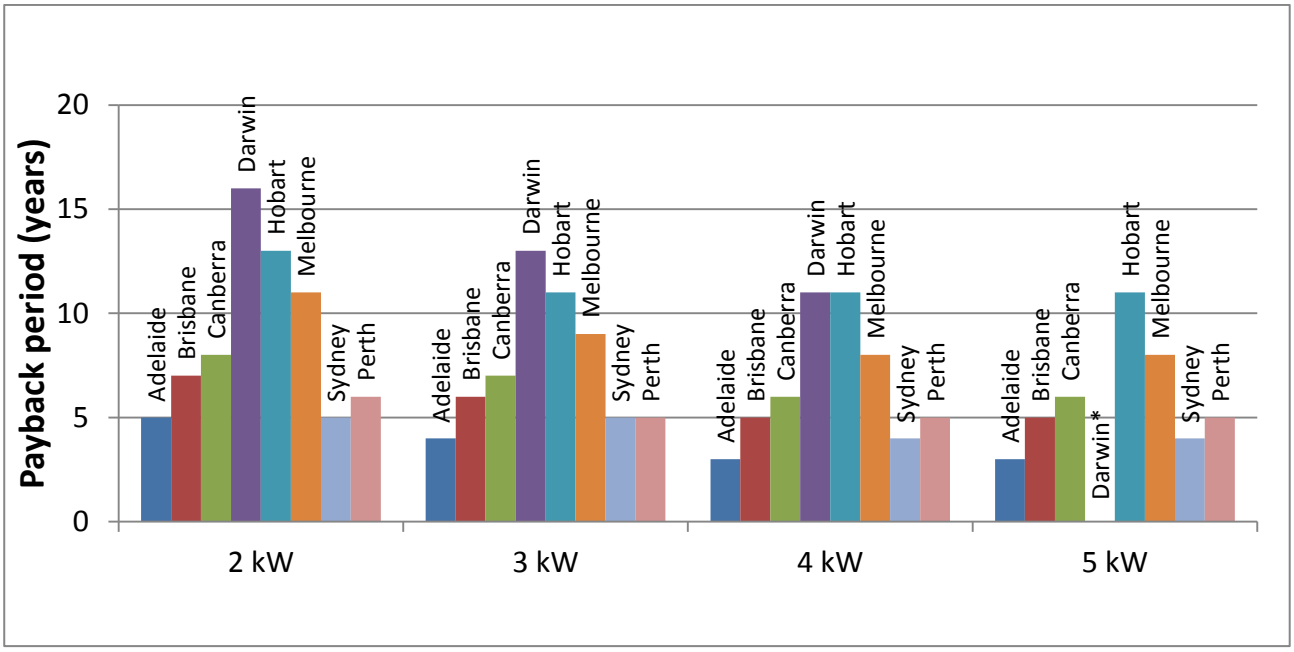
SECTION V: PAYBACK PERIOD, DETAILED MODEL

Using a similar methodology to that used to calculate the LCOE of solar PV in Australia (see Section 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 in Appendix 2.

Figure 7 highlights the payback period for different system sizes across Australia. Note that electricity prices are increased at CPI levels (currently 1.9 per cent, last updated December 2017) and any changes to CPI will affect the payback period.

Figure 7: Payback period for solar PV (5.30 per cent discount rate)



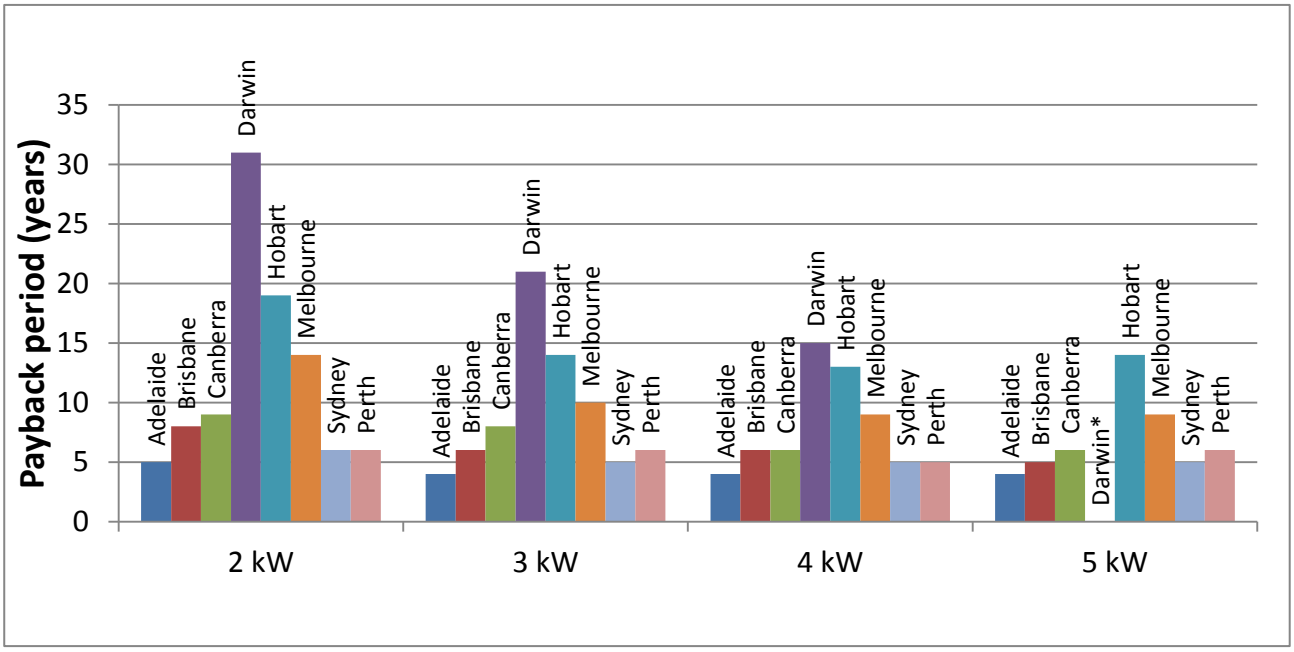
* In Darwin, there is no 5kW pricing as Darwin installers prefer to list pricing for 4.5kW systems instead and as there are additional hurdles for connecting solar systems above that size to the grid.

Source: Australian Energy Council analysis, 2017

Many retailers offer higher solar FiTs, which help to offset the impact of higher prices in some states and deliver savings to customers with solar panels, for example, in Darwin, the offered FiT is 25.7 c/kWh, which significantly helps lower the payback periods by at least five years if compared to a FiT of 12.8 c/kWh. Perth, once the leading state with the lowest payback years, has been surpassed by Adelaide. Adelaide is currently having the constant lowest payback period of three years for 3kW, 4kW and 5kW systems.

Figure 8 shows the expected payback period for systems with a 6.53 per cent discount rate (10-year average home loan rate).

Figure 8: Payback period for solar PV (6.53 per cent discount rate)



* In Darwin, there is no 5kW pricing as Darwin installers prefer to list pricing for 4.5kW systems instead and as there are additional hurdles for connecting solar systems above that size to the grid.

Source: Australian Energy Council analysis, 2017

As many residential customers are now considering a larger PV system size, the trends in both figures 7 and 8 show the bigger the system, the lower the number of years a customer will have to pay back the loan for installation.

However, under the scenario where customers are buying a bigger system (such as a 7kW with an assumed export rate of 90 per cent back to the grid) the payback period is higher than the 5kW system across all cities with an interest rate of 6.53 per cent. This is due to the higher costs of the 7kW system (at least 43 per cent higher than a 5kW system across Australia) which explains why this system size is still unaffordable.

SECTION VI: METHODOLOGY APPENDIX

1. Solar installations methodology

Analysis from the Clean Energy Regulator's (CER) monthly released data allows us to estimate the amount of solar PV installed in Australia. Since November 2015, the CER has consistently released data dated as at the first [t] of each 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, however, the CER data takes up to 12 months to be finalised.

2. 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[v], 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 (6.53 per cent).

The low discount rate sensitivity is based on the minimum variable home loan mortgage rate offered by the Big Four banks (currently 5.3 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 (13.07 per cent).

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 5.26 per cent and the small business discount rate is 7.30 per cent.

The discount rate also takes into account the Consumer Price Index (CPI); this has been given a constant value of 1.9 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[vi]. The efficiency figure represents the average daily output for a 1 kW 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.

3. 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 ∑ savings > ∑ cost

Where:

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

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

t = years

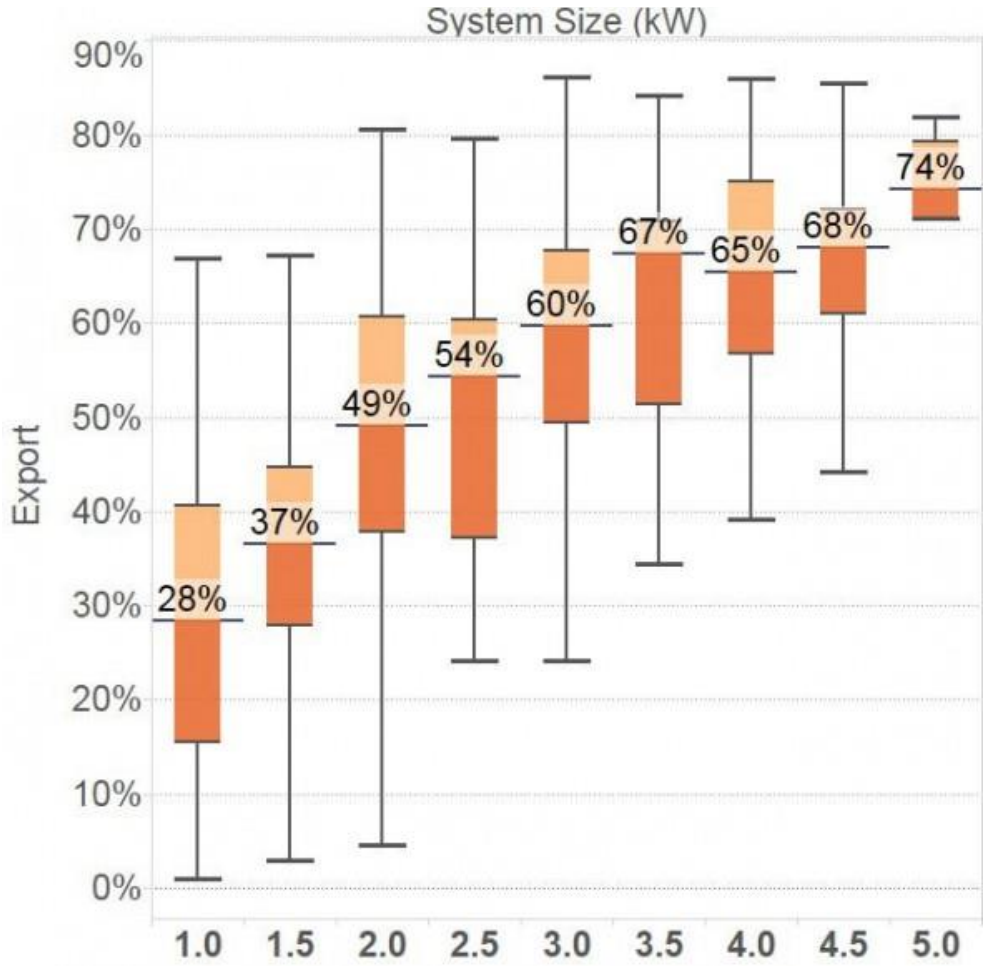
Avoided cost and FiT

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[vii]. See Figure 6 below.

Figure 9: Export rate of residential solar PV at different system sizes



Source: Sunwiz analysis, 2015

[i] Postcode data for small-scale installations, Clean Energy Regulator, 30 January 2018
[ii] 2017 Residential Electricity Price Trends, Australian Energy Market Commission, December 2017.
[iii] BCA, "Impact of Green Energy Policies on Electricity Prices", June 2014
[iv] 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
[v] estimate based on, RenewEconomy, 26 August 2013, http://reneweconomy.com.au/2013/hidden-cost-of-rooftop-solar-who-should-pay-for-maintenance-99200
[vi] Clean Energy Council, http://www.solaraccreditation.com.au/dam/cec-solar-accreditation-shared/guides/Guide-to-installing-solar-PV-for-households.pdf
[vii] Sunwiz, Solar Pays Its Way on Networks. Last accessed 17 June 2015.