SOLAR REPORT

QUARTER 1, 2018

Australian Energy Council

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SECTION I: STATE OF SOLAR PV IN AUSTRALIA

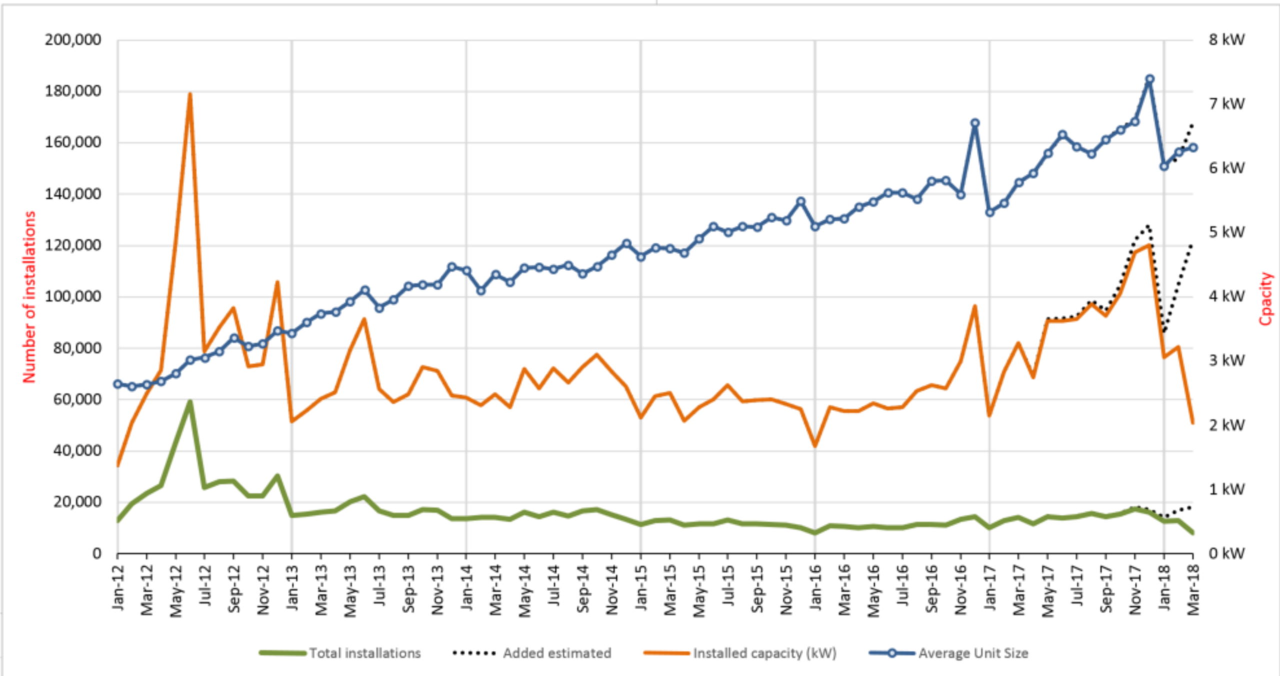
Updated data from the Clean Energy Regulator (CER) on 17 April 2018, shows that after a record-breaking year for solar in December there was a dip in January[i], likely due to a 12-month reporting lag[1].

In the first quarter of 2018, cumulative installed capacity for solar photovoltaic (PV) systems in Australia stood at 6,748MW with close to 1.846 million installations. In terms of average unit size, January has consistently been the lowest month for installing solar PV each year.

In January the average unit size was 6.04kW, an increase from 5.37kW for the same period last year. It illustrates the continued strong growth in Australian rooftop solar installations.

The raw 31 March 2018 data will under estimate the total number of installations and installed capacity. Again, this under estimation occurs because solar PV owners have up to 12 months to report their data to the CER, so we do not have access to the final reported capacity and number of installations for the most recent months until much later.

Figure 1: Monthly installations, installed solar PV capacity and average system size Jan 2012 – March 2018



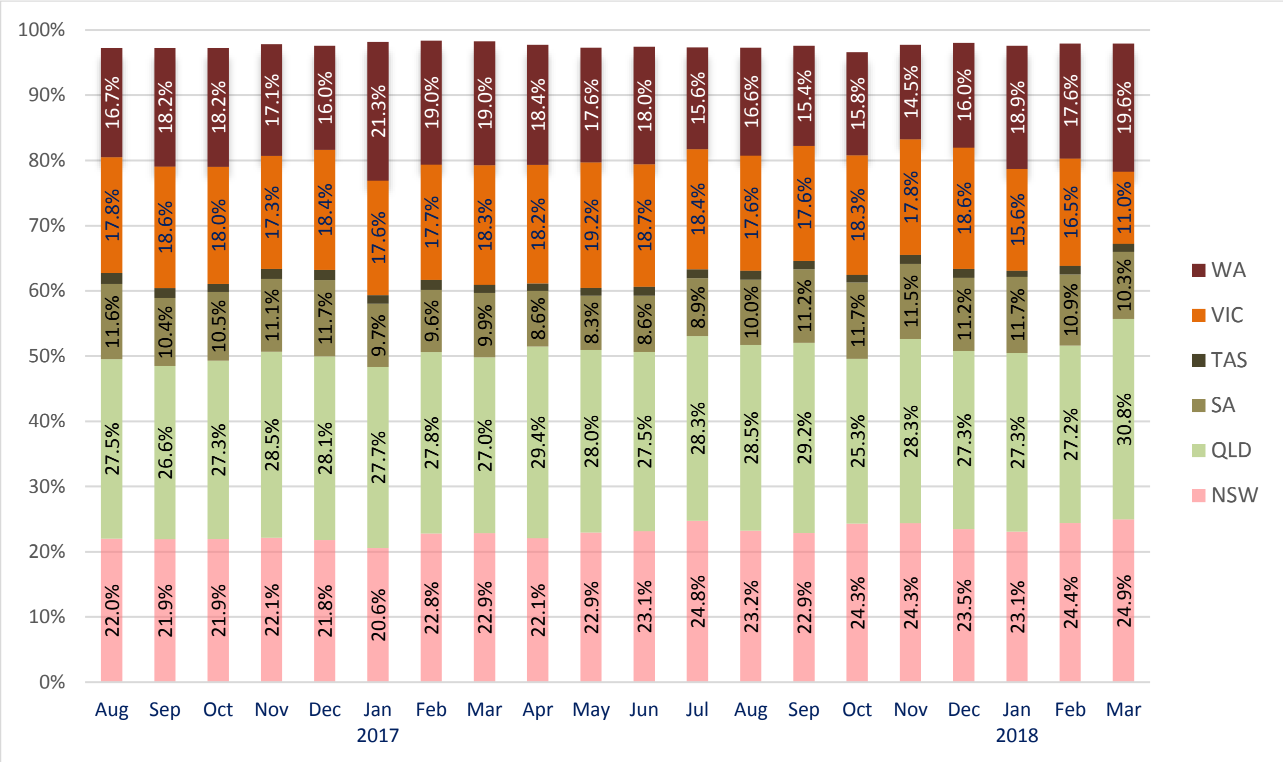
Source: Clean Energy Regulator (adjusted data), Australian Energy Council analysis, January 2018

In figure 1 the two most recent months of February and March show a sharp drop in installed capacity and total installations. This is again likely to be due to the 12-month lag in data[1], which does not

[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.

reflect the actual capacity uptake in more recent months as of 31 March 2017 and we expect the full data to show an increase as illustrated in the above graph.

Figure 2: Proportion of yearly solar PV installed capacity across jurisdictions

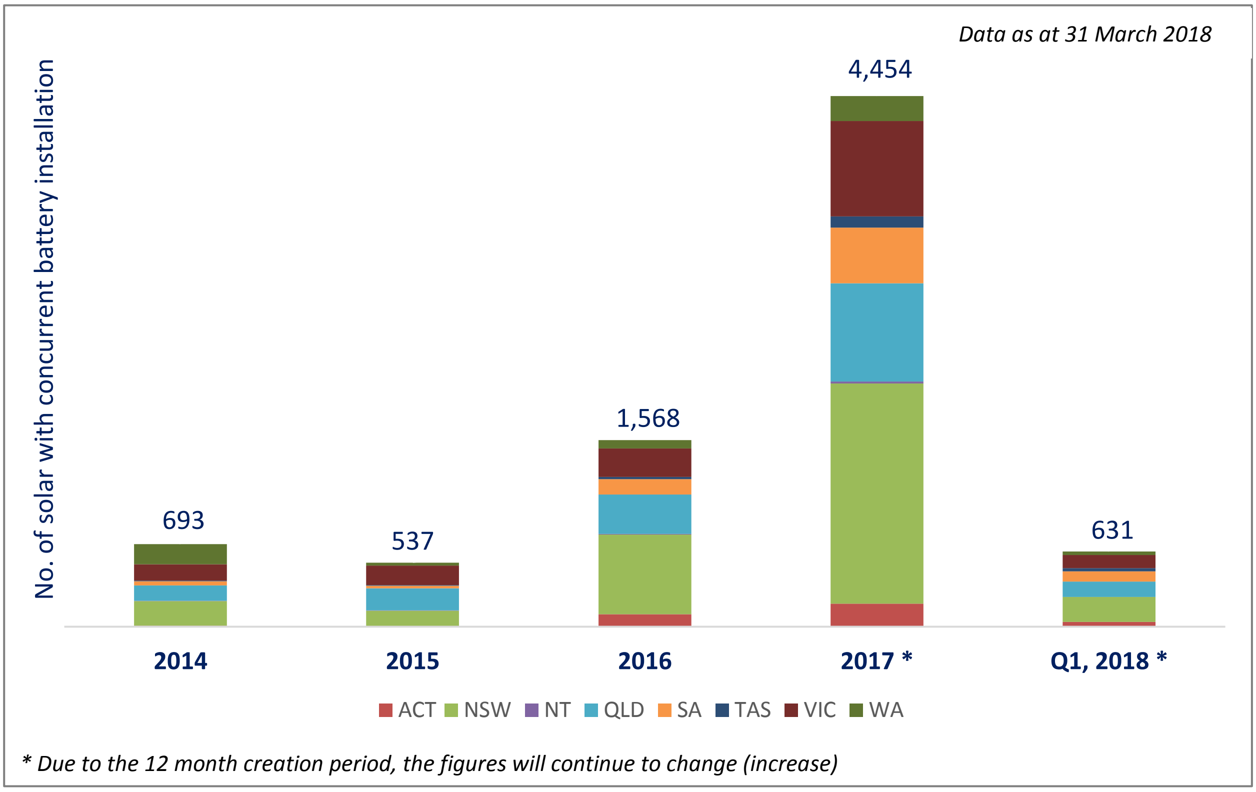


Source: Clean Energy Regulator data, Australian Energy Council analysis, March 2018

Drilling further into the data allows us to consider how uptake is shifting in each state and territory. Figure 2 shows the proportion of each month's solar PV capacity that has been installed in each state within the last two years.

Queensland's monthly installed capacity remains the largest share across the nation. Western Australia continues to have a strong uptake, reaching 19.6 per cent of total installed capacity in March 2018. Note that the Northern Territory and the ACT have been excluded, due to their small population size.

Figure 3: Number of solar with concurrent battery installations



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

Figure 3 shows a continued strong growth of home battery installations with rooftop PV in New South Wales, Victoria and Queensland during the first quarter of 2018. New South Wales accounts for one third of total solar PV with battery installations (3,065) as of March 2018, followed by Queensland and Victoria, accounting for 20.4 (1,599) and 17.4 (1,452) per cent respectively.

SECTION II: RENEWABLE ATTRACTIVENESS INDEX

Grids facing disruption

Last month, the Australian Energy Market Operator (AEMO) warned that while the surge in rooftop solar installations has helped to reduce power bills for many households, those on the grid are receiving higher electricity bills due to the number of Australians defecting from the grid. Electricity networks require a customer contribution to recover their capital, so when people defect from the grid by installing rooftop solar PV, it increases the costs for consumers solely receiving grid power for their electricity[ii].

Regardless of this, attention is increasingly turning to energy storage to address solar intermittency and reliability issues. This makes Australia retain 5th place as an attractive country for renewable energy investment[iii].

AEMO Chief Executive Audrey Zibelman also stated that the rise of rooftop solar PV has created problems for the management of energy demand in Australia. Due to the increasing role of solar power the market could lose 200-300 megawatts of power if the sky clouded over in a major city. AEMO believes there is potential for more efficient use of existing energy sources, such as working with consumers to reschedule some of their usage or providing financial incentives for private energy users to allow access to their power during peak public demand times[iv].

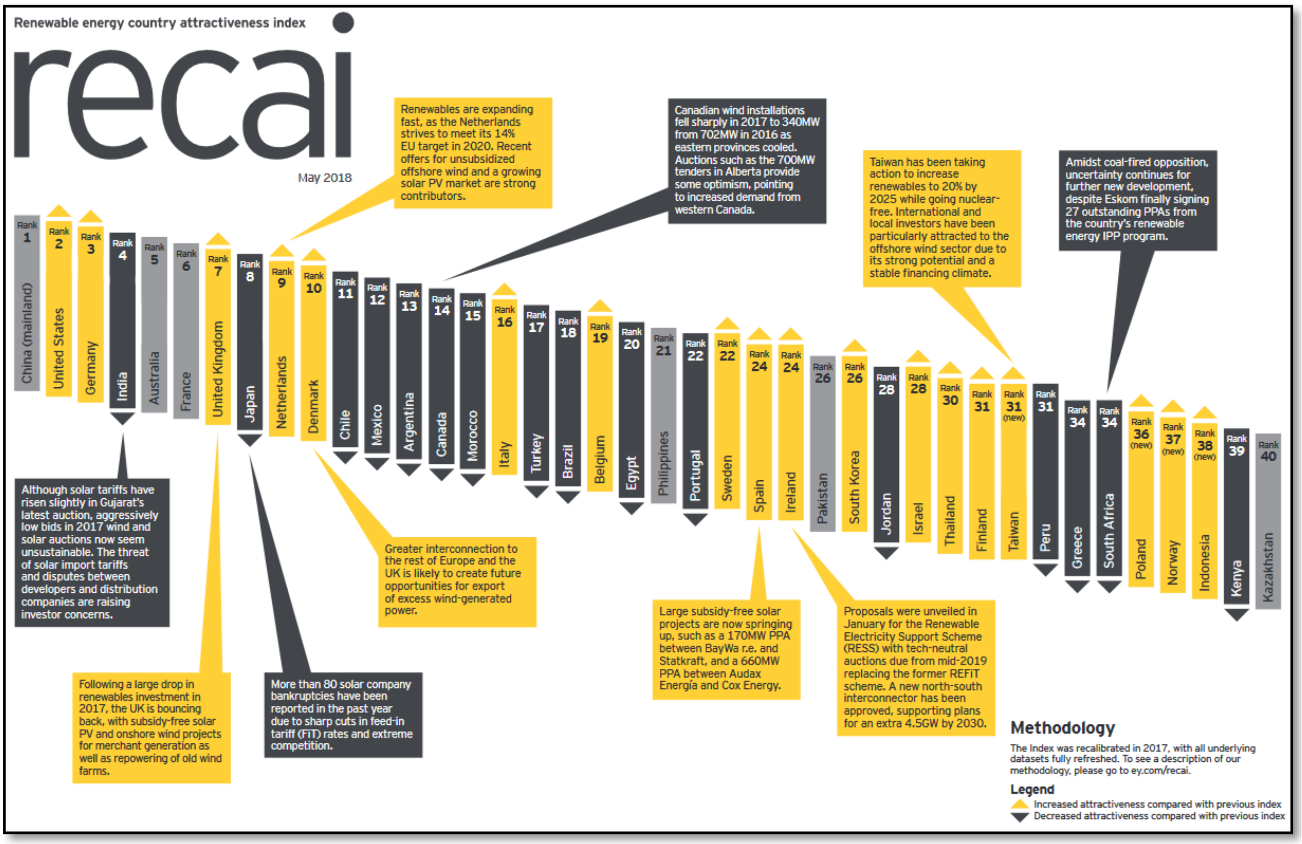
While more recently, there have been media reports that Australian rooftop solar PV has reached a new record in April. It is up 63 per cent compared to the same time last year, and has experienced seven consecutive months of more than 100 megawatts of new solar installed, providing more decentralised power each year[v].

Australia ranked 5th in renewables attractiveness index

Published earlier this month, Ernst & Young's (EY) Renewable Energy Country Attractiveness Index (RECAI) ranks the attractiveness of 40 different key jurisdictions for renewables investment. The renewable energy sector continues to mature and markets have expanded. At the same time, government subsidies for clean energy are being reduced or eliminated around the world, which is reflected in the movements in the Index.

The RECAI ranking shows that Australia remains in fifth position for a third consecutive year. China topped the list. The United States, Germany and India are at second, third and fourth, respectively. Japan fell one rank to eighth position.

Figure 4: Renewable Energy Country Attractiveness Index – May 2018



Source: RECAI Issue 51vi, EY

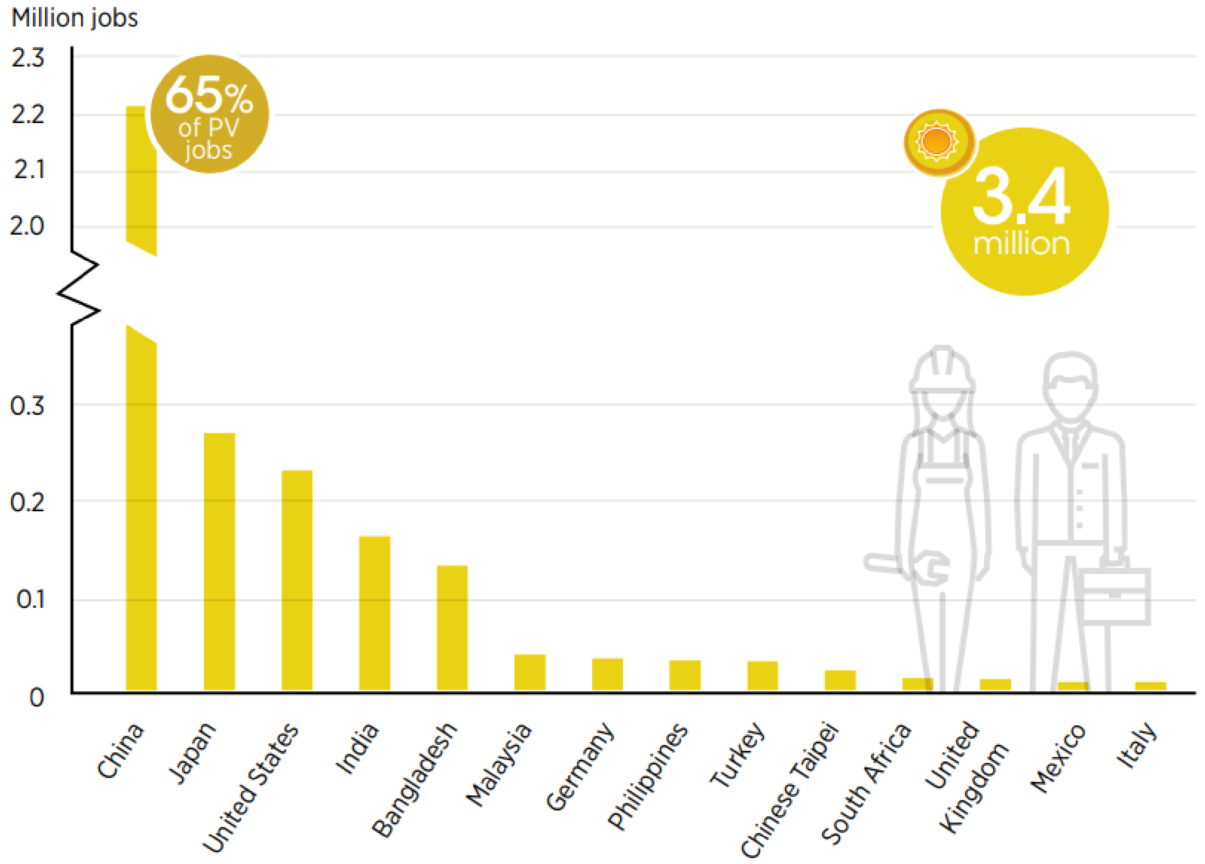
It was stated that only two developed markets, China and India, were attractive enough to compete with other more developed markets for renewable energy investments a decade ago. Now, many emerging markets represent half of the countries in the 40-strong index.

Renewable Energy Jobs Annual Review

The International Renewable Energy Agency's (IRENA) Renewable Energy Jobs Annual Review 2018, showed that the solar PV industry was the largest employer in 2017.

Shown in figure 5, an expansion took place in China and India, while job losses occurred in the United States and Japan. In addition to these countries, Australia, Germany, Turkey and Korea are said to be important markets contributing to the large number of record installations globally[vii].

Figure 5: Leaders in Solar PV employment



Source: Renewable Energy and Jobs: Annual Review 2018, IRENA, May 2018

China

China continues to top the index for the third consecutive year. Being the world's largest installation market and PV producers, the country accounted for around 90 per cent of solar PV employment globally.

Japan

Japan's attractiveness has been hampered due to a decline in demand for solar PV by 10 per cent in 2017, following a 23 per cent decline in 2016. The country experienced the decline due to reductions in feed-in tariffs, greater retailer competitions, land shortages and limited grid access for new projects. The IRENA report stated that 88 companies went bankrupt in Japan' solar industry and an estimated of 271,500 jobs lost in renewable energy sector.

India

High growth in new capacity additions lifted employment in India to an estimated growth of 164,000 jobs. The proposed 70 per cent safeguard duty on imported solar cells and modules in order to protect the local industry, concerned investors. This aided Germany and the United States to overtake India, which reached 3rd place in EY's RECAI.

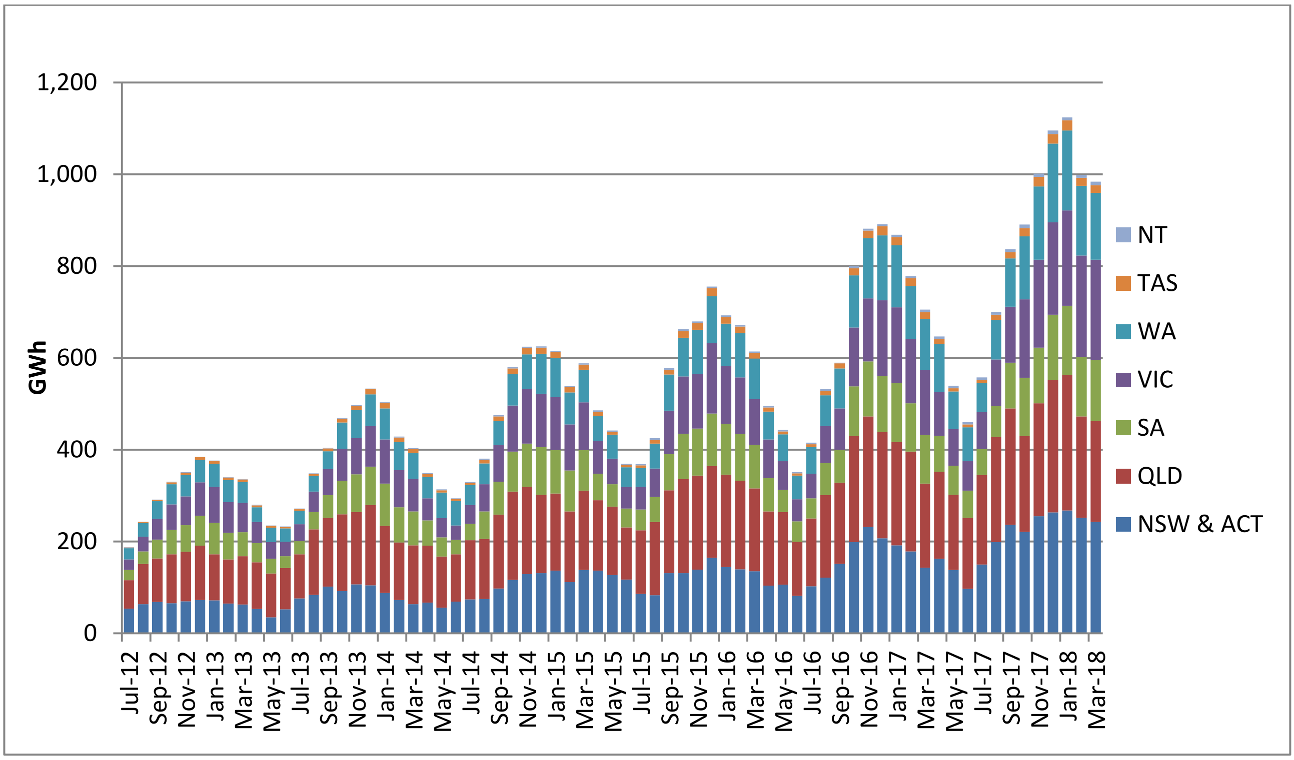
Other significant solar markets

The United States increased in the ranking even though the country imposed a 30 per cent tariff on imported solar panels. The United Kingdom bounced up by three places subject to the market adapting to subsidy-free solar PV and onshore wind projects. While strong growth in the solar PV market helped the Netherlands to move up from fifteenth to ninth position.

SECTION III: ESTIMATED RESIDENTIAL PV 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 (CER) 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 CER. All systems which are reported to the CER are assumed to be residential.

Figure 6: Estimated residential PV generation (GWh)



Source: Australian Energy Council analysis, March 2018

For the first time rooftop solar PV installations throughout Australia generated over 1,000GWh in December 2017. 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 has always been the highest month for PV electricity generation each summer period, however, in summer 2017/18, January reaches the highest record of 1,124 GWh, roughly 29 GWh higher compared to the previous month or a 256 GWh compared to January 2017.

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 the solar FiT from around 9c/kWh to a minimum of 12.8c/kWh for their exports fed back to the grid. In Victoria, a new rate will be introduce in July 2018 to update the current minimum feed-in-tariff rate of 11.3 c/kWh scheme.

Table 3: Central estimate: 6.43 per cent discount rate (ten-year average mortgage rate)

All figures in c/KWh	System Size							Retail prices	FIT
	1.5 kW	2.0 kW	3.0 kW	4.0 kW	5.0 kW	7.0 kW	10.0 kW		
Adelaide	$0.16	$0.16	$0.13	$0.12	$0.11	$0.11	$0.12	$0.48	$0.17
Brisbane	$0.17	$0.16	$0.13	$0.12	$0.11	$0.11	$0.12	$0.33	$0.16
Canberra	$0.17	$0.15	$0.13	$0.12	$0.12	$0.12	$0.12	$0.22	$0.13
Darwin	$0.20	$0.19	$0.18	$0.16	-	$0.13	$0.13	$0.26	$0.26
Hobart	$0.21	$0.22	$0.18	$0.17	$0.15	$0.16	$0.16	$0.25	$0.09
Melbourne	$0.21	$0.20	$0.16	$0.15	$0.14	$0.14	$0.15	$0.26	$0.12
Sydney	$0.17	$0.16	$0.14	$0.12	$0.12	$0.12	$0.13	$0.31	$0.13
Perth	$0.13	$0.12	$0.11	$0.10	$0.10	$0.10	$0.12	$0.26	$0.07

Source: Australian Energy Council analysis, March 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: 5.09 per cent discount rate (low current standard variable rate)

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

Source: Australian Energy Council analysis, March 2018

Table 5: High cost of capital sensitivity: 14.14 per cent discount rate (indicative personal loan rate)

All figures in c/KWh	System Size							Retail prices	FIT
	1.5 kW	2.0 kW	3.0 kW	4.0 kW	5.0 kW	7.0 kW	10.0 kW		
Adelaide	$0.22	$0.23	$0.18	$0.17	$0.15	$0.15	$0.17	$0.48	$0.17
Brisbane	$0.25	$0.22	$0.18	$0.17	$0.15	$0.16	$0.17	$0.33	$0.16
Canberra	$0.24	$0.21	$0.18	$0.17	$0.17	$0.16	$0.17	$0.22	$0.13
Darwin	$0.29	$0.28	$0.25	$0.23	-	$0.17	$0.19	$0.26	$0.26
Hobart	$0.31	$0.32	$0.25	$0.24	$0.21	$0.22	$0.22	$0.25	$0.09
Melbourne	$0.29	$0.28	$0.22	$0.20	$0.19	$0.20	$0.21	$0.26	$0.12
Sydney	$0.24	$0.23	$0.19	$0.17	$0.16	$0.16	$0.17	$0.31	$0.13
Perth	$0.19	$0.16	$0.15	$0.14	$0.13	$0.13	$0.16	$0.26	$0.07

Source: Australian Energy Council analysis, March 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[viii.]

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[ix].

Table 6: Central estimate: 7.19 per cent discount rate, ten-year average small business interest rate

All figures in c/KWh	System Size				
	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	$0.10
Hobart	$0.18	$0.17	$0.16	$0.16	$0.16
Melbourne	$0.15	$0.15	$0.14	$0.14	$0.14
Sydney	$0.13	$0.13	$0.13	$0.12	$0.12
Perth	$0.12	$0.11	$0.12	$0.11	$0.11

Source: Australian Energy Council analysis, March 2018

Table 7: Central estimate: 5.14 per cent discount rate, ten-year average large business interest rate

All figures in c/KWh	System Size				
	10kW	30kW	50kW	70kW	100kW
Adelaide	$0.11	$0.11	$0.11	$0.11	$0.11
Brisbane	$0.12	$0.12	$0.11	$0.11	$0.11
Canberra	$0.11	$0.11	$0.10	$0.10	$0.10
Hobart	$0.16	$0.15	$0.15	$0.15	$0.14
Melbourne	$0.14	$0.14	$0.13	$0.13	$0.12
Sydney	$0.12	$0.12	$0.12	$0.11	$0.11
Perth	$0.11	$0.10	$0.11	$0.10	$0.10

Source: Australian Energy Council analysis, March 2018

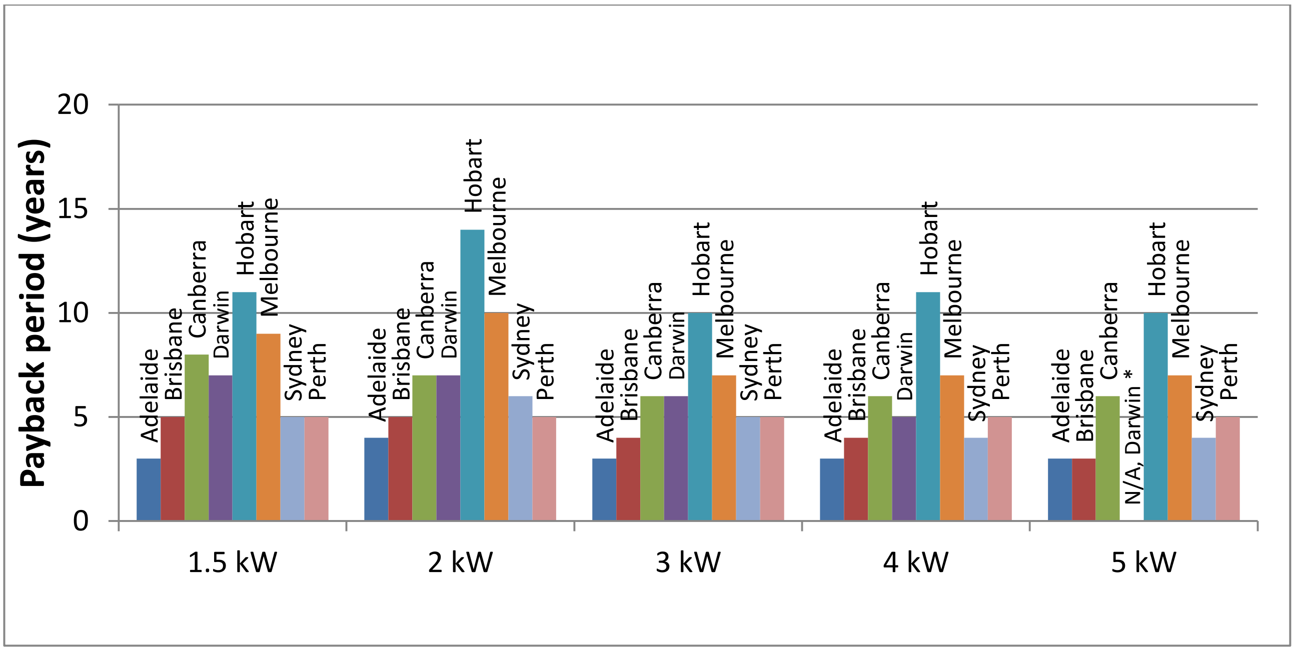
SECTION V: PAYBACK PERIOD, DETAILED MODEL

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 consumer price index (CPI) levels (currently 1.9 per cent, last updated March 2018 according to the Reserve Bank of Australia website) and any changes to CPI will affect the payback period. 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.

Figure 7: Payback period for solar PV (5.09 per cent discount rate)



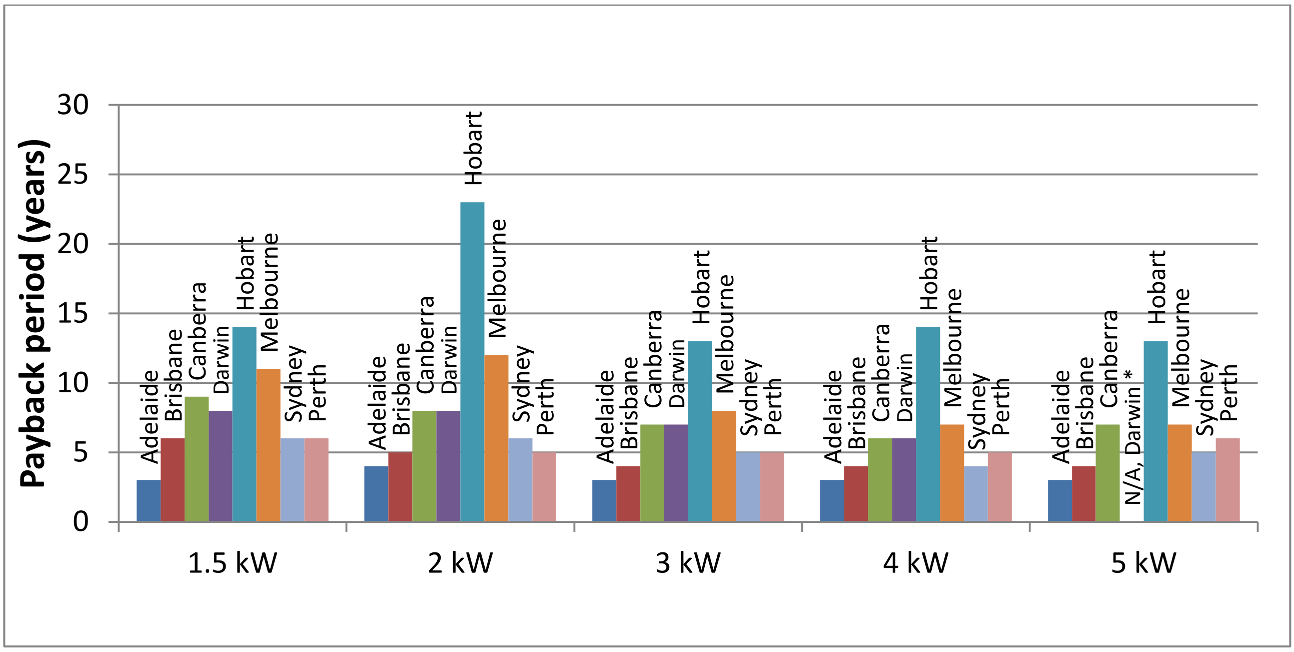
* In Darwin, there is no 5kW pricing as Darwin installers prefer to list pricing for 4.5kW systems instead and as there are additional hurdles for connecting solar systems above that size to the grid.

Source: Australian Energy Council analysis, 2018

Perth used to be 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 all systems, except the 2kW system.

Figure 8 shows the expected payback period for systems with a 6.43 per cent discount rate (10-year average home loan rate).

Figure 8: Payback period for solar PV (6.43 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, 2018

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.

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[x], 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 (6.43 per cent).

The low discount rate sensitivity is based on the minimum variable home loan mortgage rate offered by the Big Four banks (currently 5.09 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 (14.14 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 5.14 per cent and the small business discount rate is 7.19 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[xi]. 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 $(1+\text{CPI})^t$ x consumption / 100) + (Export x FiT)

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

t = years

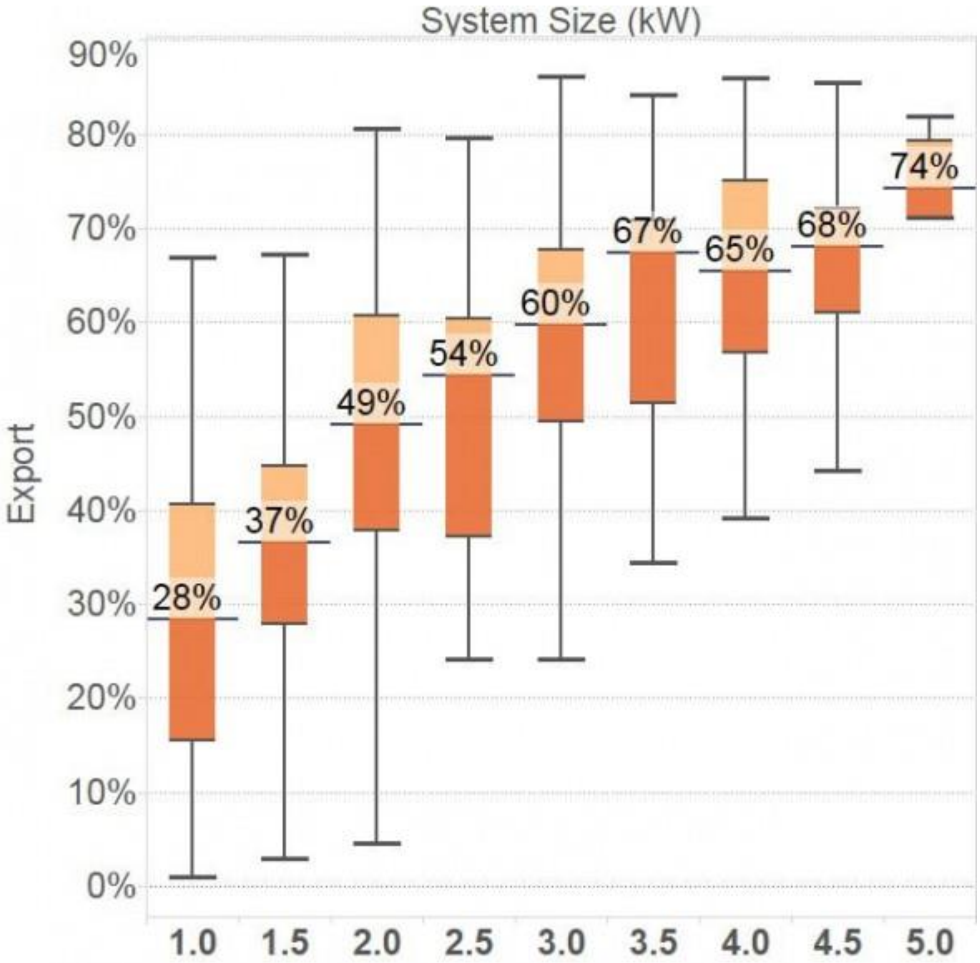
Avoided cost and FiT

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[xii]. See Figure 6 below.

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



Source: Sunwiz analysis, 2015

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[i] Postcode data for small-scale installations, Clean Energy Regulator, 30 January 2018
[ii] Solar Surge Driving Up Power Bills, 26th April 2018.
[iii] Renewable Energy Country Attractiveness Index, May 2018, issue 51, EY, page 17
[iv] Solar panel popularity 'a big disrupter': AEMO chief
[v] Solar Installations still setting records, 9 May 2018
[vi] Renewable Energy Country Attractiveness Index, May 2018, issue 51, EY
[vii] Renewable Energy and Jobs – Annual Review 2018, IRENA, page 7
[viii] BCA, "Impact of Green Energy Policies on Electricity Prices", June 2014
[ix] Clean Energy Regulator, "How to have STCs assigned to you as a Registered Agent"
[x] Estimate based on, RenewEconomy, 26 August 2013,
[xi] Clean Energy Council, http://www.solaraccreditation.com.au/dam/cec-solar-accreditation-shared/guides/Guide-to-installing-solar-PV-for-households.pdf
[xii] Sunwiz, Solar Pays Its Way on Networks. Last accessed 17 June 2015.