AUSTRALIAN ENERGY COUNCIL

SOLAR REPORT

QUARTER 2, 2018

Australian Energy Council

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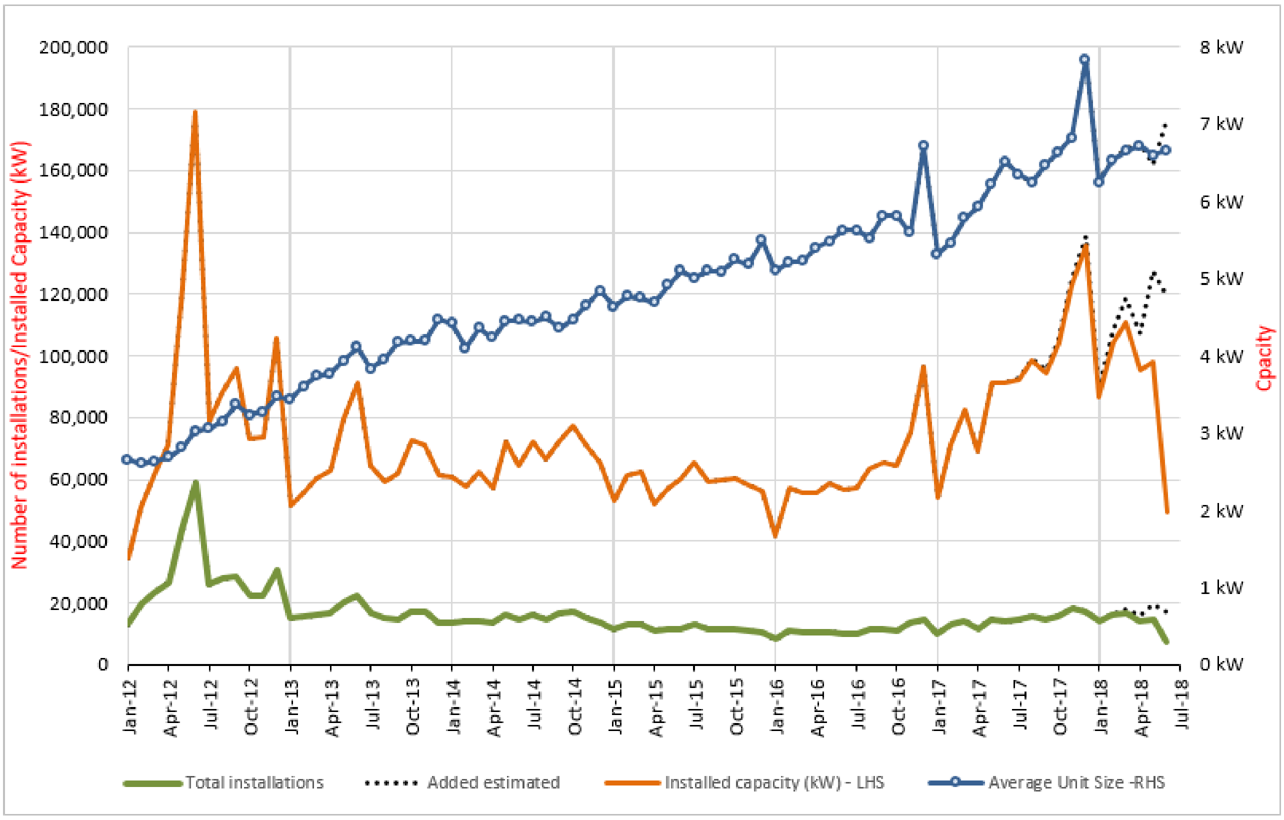
SECTION I: STATE OF SOLAR PV IN AUSTRALIA

As of end of June this year, Australia had nearly surpassed 1.9 million solar PV installations with a total of 1,898,373 installations on our rooftops.

Updated data from the Clean Energy Regulator (CER, 20 July 2018) shows that after a record-breaking year for solar in Australia in December, there was a dip in January[i]. The two most recent months of May and June also show an apparent sharp drop in installed capacity and total installations (Figure 1), although this is likely to be due to a 12-month reporting lag for solar system data, which does not reflect the actual capacity uptake in more recent months as of 30 June 2018[1].

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



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

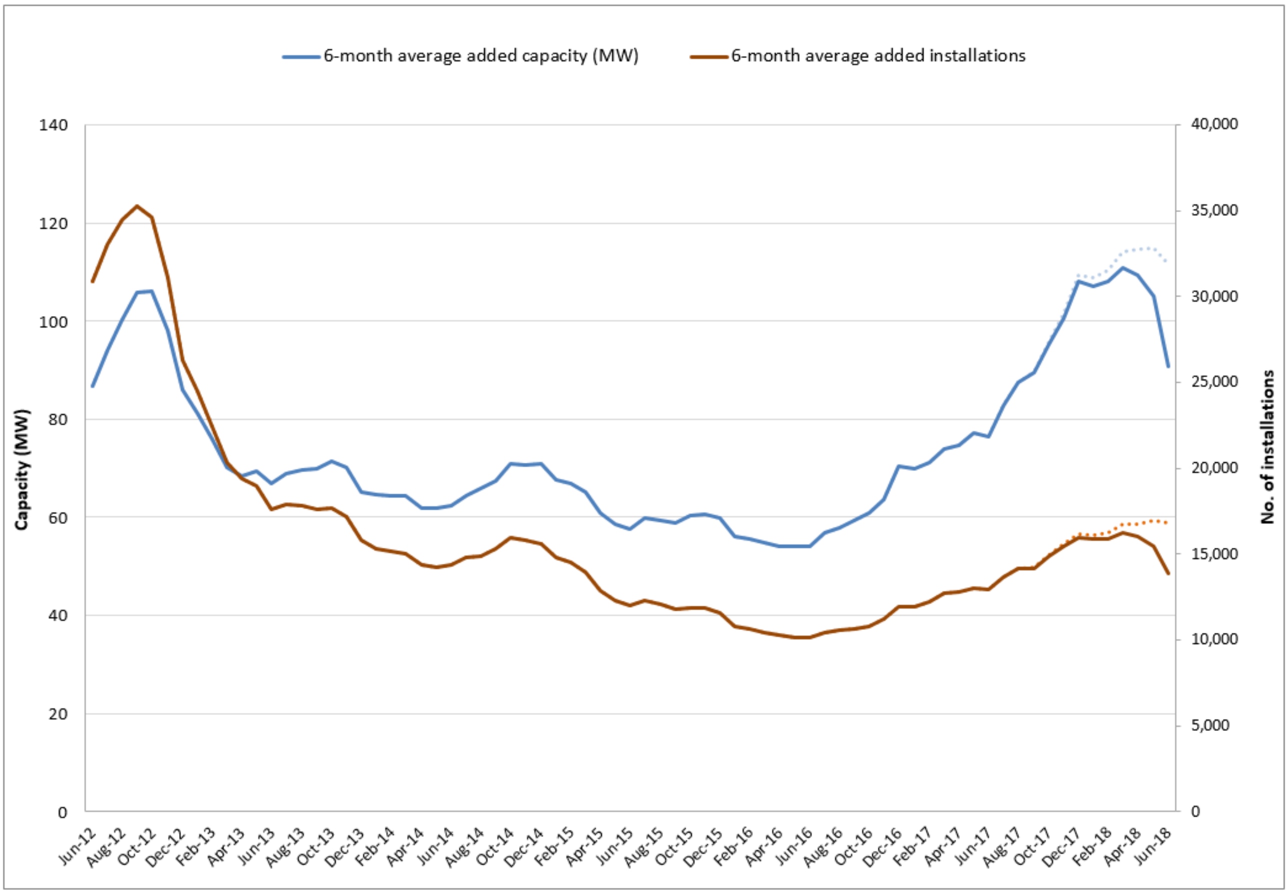
Previously we have seen the six-month rolling installed capacity average shift slightly downward from 106 MW in October 2012 to a low point of 54 MW in June 2016 (see figure 2), which was likely to be due to the looming higher electricity bills with the exit of many coal power plants. Since June 2016, along with the number of rooftop PV installations, the rolling average installed capacity has been steadily growing and reached a new peak of 114 MW in May 2018 and an estimated 112

[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.

MW in June this year[ii]. This illustrates the continued strong growth in Australian rooftop solar installations.

As shown in figure 2, since late 2016 the average added capacity has increased faster than the number of average installations which is likely due to households opting for a bigger solar systems with the continued price decline of solar panels.

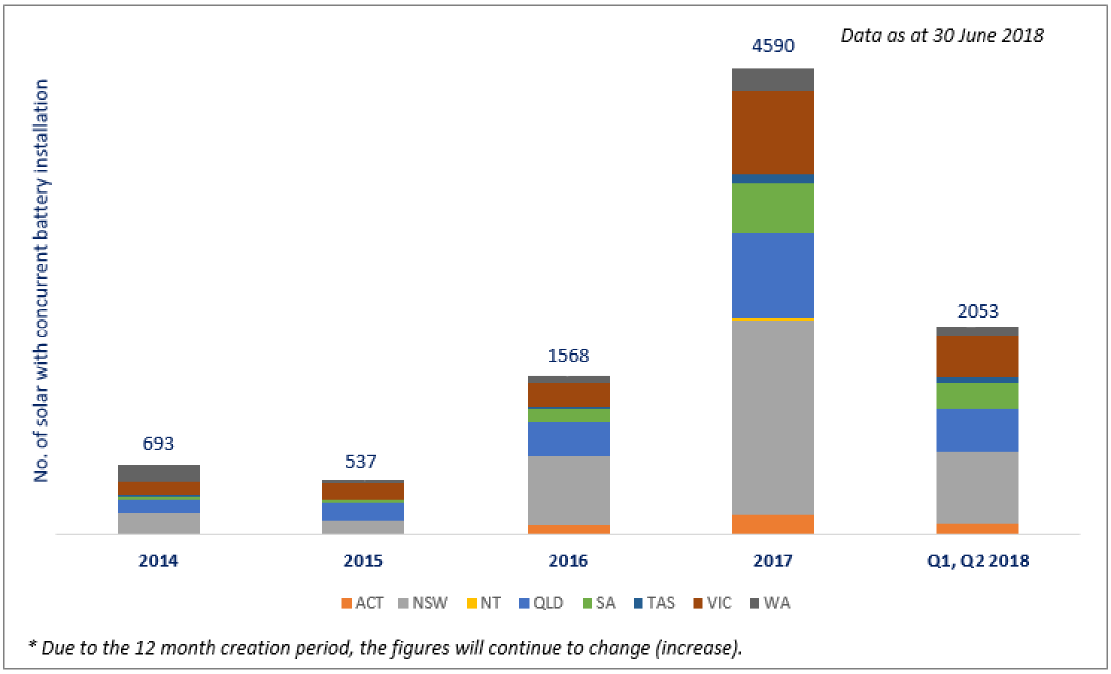
Figure 2: Rolling 6-month installed capacity and number of installations average



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

Figure 3 shows the continued strong growth in home battery installations with rooftop PV in the first two quarters of 2018. New South Wales is currently leading the way and now accounts for 34 per cent of total battery storage installations in Australia. Victoria and Queensland are second and third respectively, with a combined total of 40.8 per cent of total installations. With new feed-in tariff rates rolling out in Victoria (see Section II for a detailed outline of the changes) it is expected there will be a higher growth rate for combined solar with battery installations in that state.

Figure 3: Number of solar with concurrent battery installations



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

SECTION II: A NEW TIME-OF-DAY FEED-IN TARIFF

The Essential Services Commission (ESC) has introduced a time-varying feed-in tariff (FiT) in Victoria, which commenced 1 July 2018.

Traditionally Victoria's FiT has been a minimum flat rate (depending on the retail offer), which means solar panel owners were paid the same price per kWh for the excess electricity they exported back into the grid. With the new changes, Victorian electricity retailers can now offer customers either a single-rate or time-varying FiT. The new time-varying FiT pays a different rate depending on the time of day electricity is fed-back into the grid. This new two-tier system came out of the Victorian Government's inquiry into the "true value" of distributed energy.

Victoria's time-varying solar tariffs

Victoria's previous minimum FiT was a flat 11.3c/kWh. The new single-rate and time-varying tariffs, which came into effect on 1 July, are detailed below in Table 1.

According to the ESC, the rates were calculated using methodology, which considers[iii]:

- forecast wholesale electricity market prices;
- distribution and transmission losses avoided by the supply of small renewable energy generation; and,
- avoided social costs of carbon and avoided human health costs attributable to a reduction in air pollution.

Table 1: Victoria's new solar feed-in tariffs

Tariff	Minimum rate to apply (all times) (c/kWh)
Single-rate minimum feed-in tariff:	9.9

The time-varying tariff is outlined in the table below.

Period	Weekday	Weekend	Rate: cents per kilowatt hour (c/kWh)
Off peak	10pm – 7am	10pm – 7am	7.1 c/kWh
Shoulder	7am – 3pm, 9pm – 10pm	7am – 10pm	10.3 c/kWh
Peak	3pm – 9pm	n/a	29.0 c/kWh

Source: 2018-19 feed-in tariffs, ESC[iv].

The 2018-19 single-rate tariff is 1.4 c/kWh lower than last year's FiT, which is primarily due to a reduction in forecast wholesale energy costs. Alternatively, through the new time-varying tariffs retailers are now required to offer a minimum of 7.1c/kWh for exports between 10pm - 7am; 10.3c/kWh between 7am - 3pm and 9pm - 10pm; and a minimum of 29c/kWh for the peak afternoon period from 3pm - 9pm.

When retailers buy electricity from solar PV households instead of sourcing it from the National Electricity Market, they avoid some direct financial costs[v]. These are:

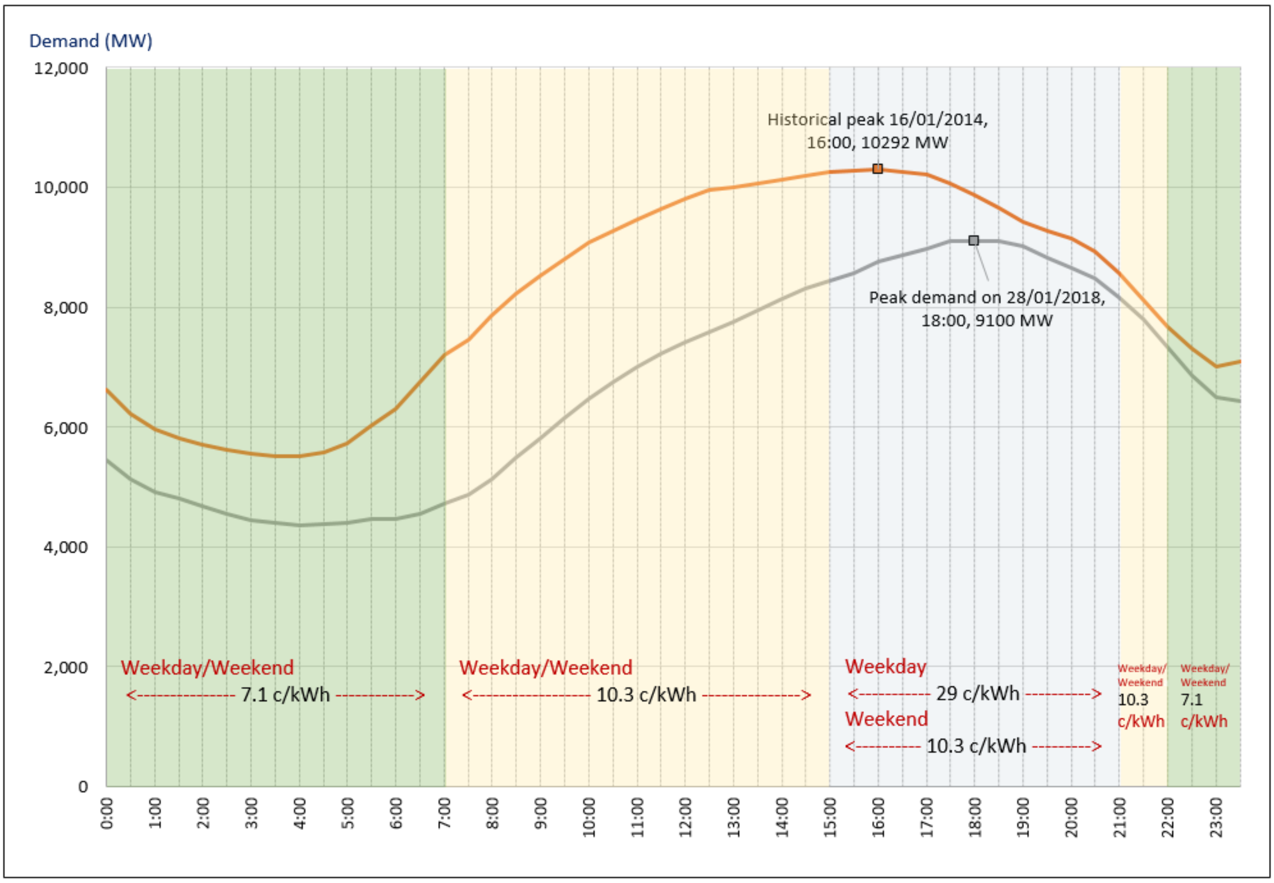
- wholesale energy costs;
- NEM management fees;
- ancillary services fees; and,
- transmission and distribution losses (energy losses).

However retailers still incur other costs associated with providing electricity services to customers, which include retail operating and network costs.

Peak Demand

Figure 4 below shows the demand shift in Victoria during the peak summer period as a result of the uptake of solar PV. When compared to the historical peak demand on 16 January 2014 (orange line), the demand curve on 28 January 2018 from 6am to midday is lower due to a higher rate of rooftop solar PV being fed-back into the grid.

Figure 4: Victoria's shifting demand



Source: Australian Energy Council's analysis on NEM-Review, August 2018.

Figure 4 shows that the most recent peak in Victoria occurred on 28 January 2018 (the grey line). This demand increases throughout the morning before slowing as more electricity is generation from rooftop solar panels. Given this tariff rates are set higher at the start and the end of the day, when solar is exporting less.

Around midday, even though both the single-rate FiT (9.9 c/kWh) and the ‘shoulder rate’ of the time-varying FiT (10.3c/kWh) are priced at broadly the same time of day, the single-rate FiT is lower simply because the forecast for wholesale electricity prices are lower for most of the day when solar exports are higher and the time varying FiT takes into account the fact that wholesale electricity costs are higher at the start and end of the day when there is little solar electricity exported to the grid.

From 10pm to early morning the two curves are almost parallel, reflecting the lack of electricity generated from rooftop solar PV. Similarly, the off peak period (10pm - 7am) is priced at a minimum of 7.1c/kWh, when electricity demand is low.

A value-reflective FIT

This shows that the peak tariff rates are priced to match peak demand and low electricity export periods from residential rooftop solar PV. Peak rates are higher than the shoulder rates because wholesale prices during the evening peak in 2018–19 are forecast to be notably higher than at other times of the day[vi].

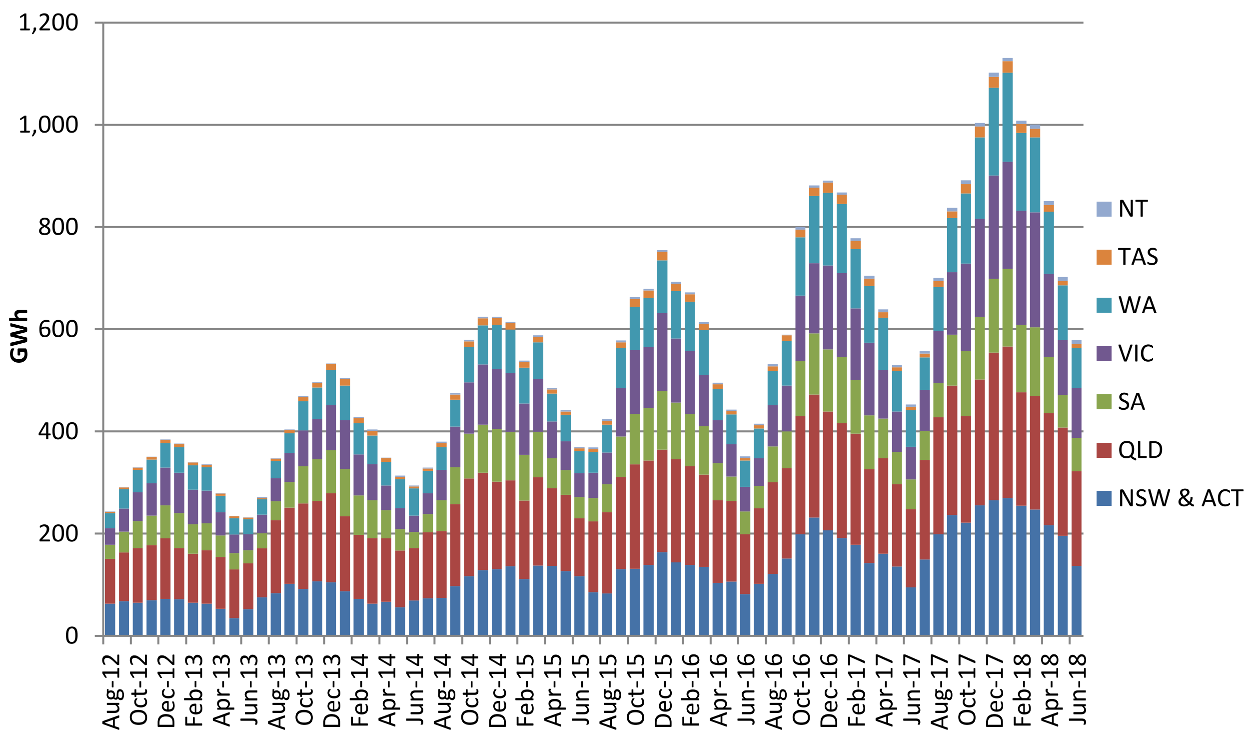
Figure 4 shows that the historical peak demand during summer 2013-14 in Victoria was at 4pm, while on 28 January 2018 the peak arrived at 6pm as solar generation falls away. The impact of further PV installations on this new peak time is expected to be negligible.

The introduction of time-varying FiTs is likely to encourage more households with rooftop solar PV systems to consider installing west-facing panels or battery storage without the need for any subsidies, which could also lead to a cut in electricity costs to other consumers’ bills. By offering fair value for electricity fed-back into the grid during peak periods, households can also take control of their own energy use and maximise the benefits of having solar panels installed.

SECTION III: ESTIMATED RESIDENTIAL PV GENERATION

PV output is obtained by multiplying the efficiency factor of systems with the estimated capacity (MW) in each state (as described in Section II 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 5: Estimated residential PV generation (GWh)



Source: Australian Energy Council analysis, June 2018

Figure 5 illustrates the seasonal patterns of the estimated total output of solar systems, nationally. PV generation is generally low during cold periods (May to July), while it unsurprisingly reaches a peak during summer each year. June 2018 is higher than the same time last year, generating around 579 GWh.

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. Both Hobart and Darwin see the drop in FiT offering from 8.9 c/kWh to 8.5 c/kWh in Hobart and from 25.7 c/kWh to 23.6 c/kWh in Darwin. Tables 2, 3 and 4 show the LCOE across major cities at different discount rates.

In Victoria a new minimum rate of 9.9c/kWh was introduced from 1 July 2018. Many retailers in Victoria are still offering the old rate of 11c/kWh and many have raised their solar FiT, which allows customers to shop around and choose the best deal. In many states, households 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.

Table 2: Central estimate: 6.32 per cent discount rate (ten-year average mortgage rate)

All figures in c/KWh	System Size						Retail prices	FIT
	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	$0.10	$0.10	$0.11	$0.48	$0.16
Brisbane	$0.15	$0.13	$0.12	$0.11	$0.11	$0.12	$0.33	$0.16
Canberra	$0.13	$0.12	$0.11	$0.10	$0.10	$0.12	$0.22	$0.13
Darwin	$0.24	$0.20	$0.18	-	$0.15	$0.13	$0.26	$0.24
Hobart	$0.20	$0.16	$0.16	$0.14	$0.15	$0.16	$0.25	$0.09
Melbourne	$0.18	$0.14	$0.14	$0.13	$0.13	$0.15	$0.26	$0.12
Sydney	$0.16	$0.13	$0.12	$0.12	$0.12	$0.13	$0.31	$0.13
Perth	$0.13	$0.11	$0.10	$0.10	$0.10	$0.12	$0.26	$0.07

Source: Australian Energy Council analysis, June 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 3: 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
	2.0 kW	3.0 kW	4.0 kW	5.0 kW	7.0 kW	10.0 kW		
Adelaide	$0.13	$0.11	$0.10	$0.10	$0.10	$0.11	$0.48	$0.16
Brisbane	$0.14	$0.12	$0.11	$0.10	$0.10	$0.11	$0.33	$0.16
Canberra	$0.13	$0.11	$0.10	$0.09	$0.09	$0.11	$0.22	$0.13
Darwin	$0.22	$0.19	$0.17	-	$0.14	$0.12	$0.26	$0.24
Hobart	$0.18	$0.15	$0.15	$0.14	$0.14	$0.15	$0.25	$0.09
Melbourne	$0.17	$0.14	$0.13	$0.12	$0.13	$0.14	$0.26	$0.12
Sydney	$0.15	$0.13	$0.12	$0.11	$0.11	$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, June 2018

Table 4: High cost of capital sensitivity: 13.56 per cent discount rate (indicative personal loan rate)

All figures in c/KWh	System Size						Retail prices	FIT
	2.0 kW	3.0 kW	4.0 kW	5.0 kW	7.0 kW	10.0 kW		
Adelaide	$0.19	$0.16	$0.14	$0.13	$0.13	$0.15	$0.48	$0.16
Brisbane	$0.21	$0.17	$0.16	$0.14	$0.15	$0.16	$0.33	$0.16
Canberra	$0.18	$0.16	$0.15	$0.12	$0.13	$0.16	$0.22	$0.13
Darwin	$0.35	$0.28	$0.25	-	$0.21	$0.18	$0.26	$0.24
Hobart	$0.27	$0.22	$0.22	$0.20	$0.21	$0.21	$0.25	$0.09
Melbourne	$0.25	$0.20	$0.18	$0.17	$0.18	$0.20	$0.26	$0.12
Sydney	$0.21	$0.18	$0.17	$0.15	$0.16	$0.17	$0.31	$0.13
Perth	$0.18	$0.15	$0.14	$0.13	$0.13	$0.16	$0.26	$0.07

Source: Australian Energy Council analysis, June 2018

Small and Large business - Levelised Cost of Electricity

Tables 5 and 6 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[vii].

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[viii].

Table 5: Central estimate: 7.12 per cent discount rate, ten-year average small business interest rate

All figures in c/KWh	System Size				
	10kW	30kW	50kW	70kW	100kW
Adelaide	$0.12	$0.11	$0.12	$0.12	$0.11
Brisbane	$0.12	$0.12	$0.12	$0.12	$0.11
Canberra	$0.12	$0.11	$0.12	$0.12	$0.11
Hobart	$0.18	$0.16	$0.16	$0.16	$0.16
Melbourne	$0.15	$0.14	$0.14	$0.14	$0.14
Sydney	$0.13	$0.12	$0.13	$0.13	$0.12
Perth	$0.12	$0.10	$0.12	$0.11	$0.11

Source: Australian Energy Council analysis, June 2018

Table 6: Central estimate: 5.06 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	$0.10	$0.11	$0.11	$0.11
Brisbane	$0.11	$0.11	$0.11	$0.11	$0.11
Canberra	$0.11	$0.10	$0.11	$0.11	$0.10
Hobart	$0.16	$0.15	$0.15	$0.15	$0.15
Melbourne	$0.14	$0.13	$0.13	$0.13	$0.13
Sydney	$0.12	$0.11	$0.12	$0.12	$0.11
Perth	$0.11	$0.09	$0.11	$0.10	$0.10

Source: Australian Energy Council analysis, June 2018

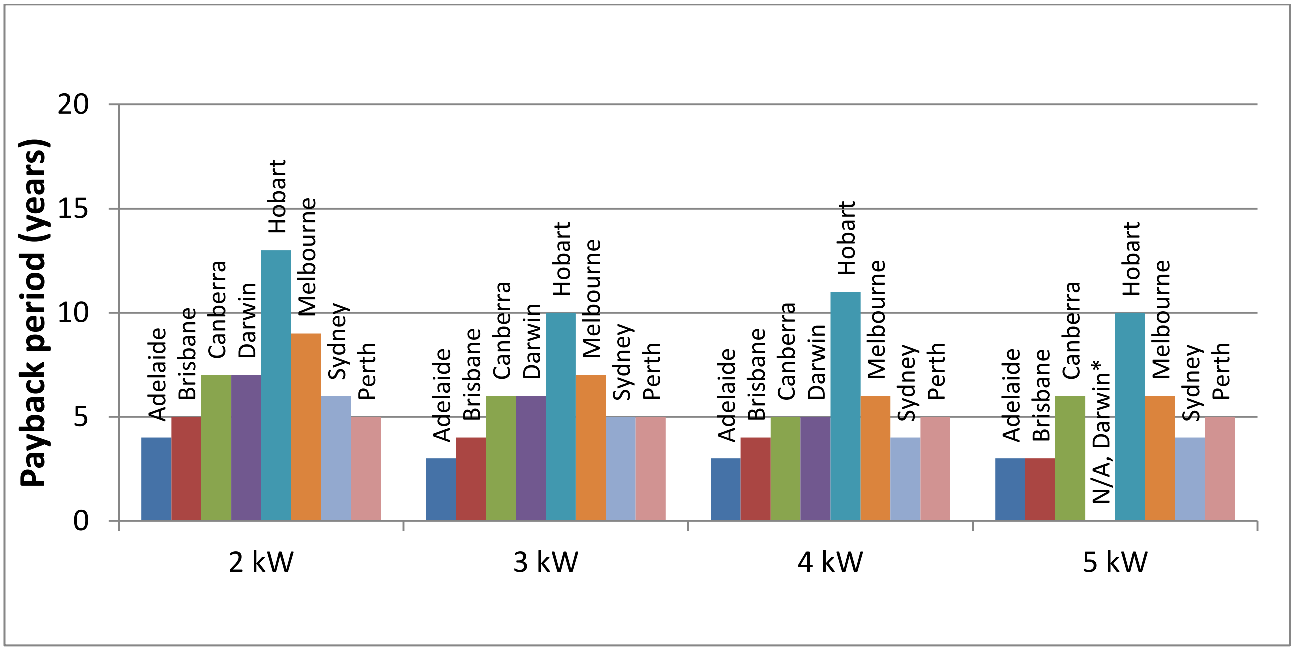
SECTION V: PAYBACK PERIOD, DETAILED MODEL

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 6 highlights the payback period for different system sizes across Australia. Note that electricity prices are increased at consumer price index (CPI) levels (currently 2.1 per cent, last updated June 2018 according to the Reserve Bank of Australia) 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 23.6 c/kWh.

Figure 6: Payback period for solar PV (5.09 per cent discount rate)



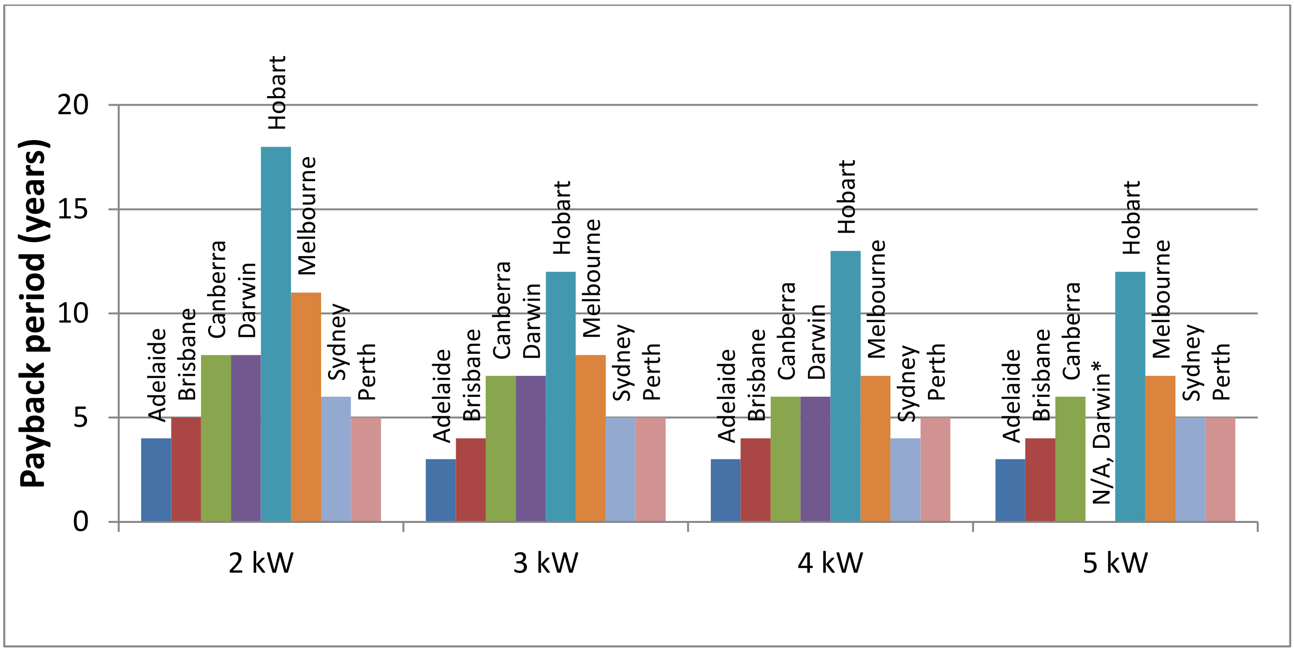
* In Darwin, there is no 5kW pricing as Darwin installers prefer to list pricing for 4.5kW systems instead and as there are additional hurdles for connecting solar systems above that size to the grid.

Source: Australian Energy Council analysis, June 2018

Perth used to be the leading state with the lowest payback years, however the state has been surpassed by Adelaide and Brisbane. Adelaide is currently having the constant lowest payback period of three years for all systems, except the 2kW system.

Figure 7 shows the expected payback period for systems with a 6.32 per cent discount rate (10-year average home loan rate).

Figure 7: Payback period for solar PV (6.32 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, June 2018

As many residential customers are now considering a larger PV system size, the trends in both figures 6 and 7 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[ix], 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 (6.32 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 (13.56 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 5.06 per cent and the small business discount rate is 7.12 per cent.

The discount rate also takes into account the Consumer Price Index (CPI); this has been given a constant value of 2.1 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[x]. 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

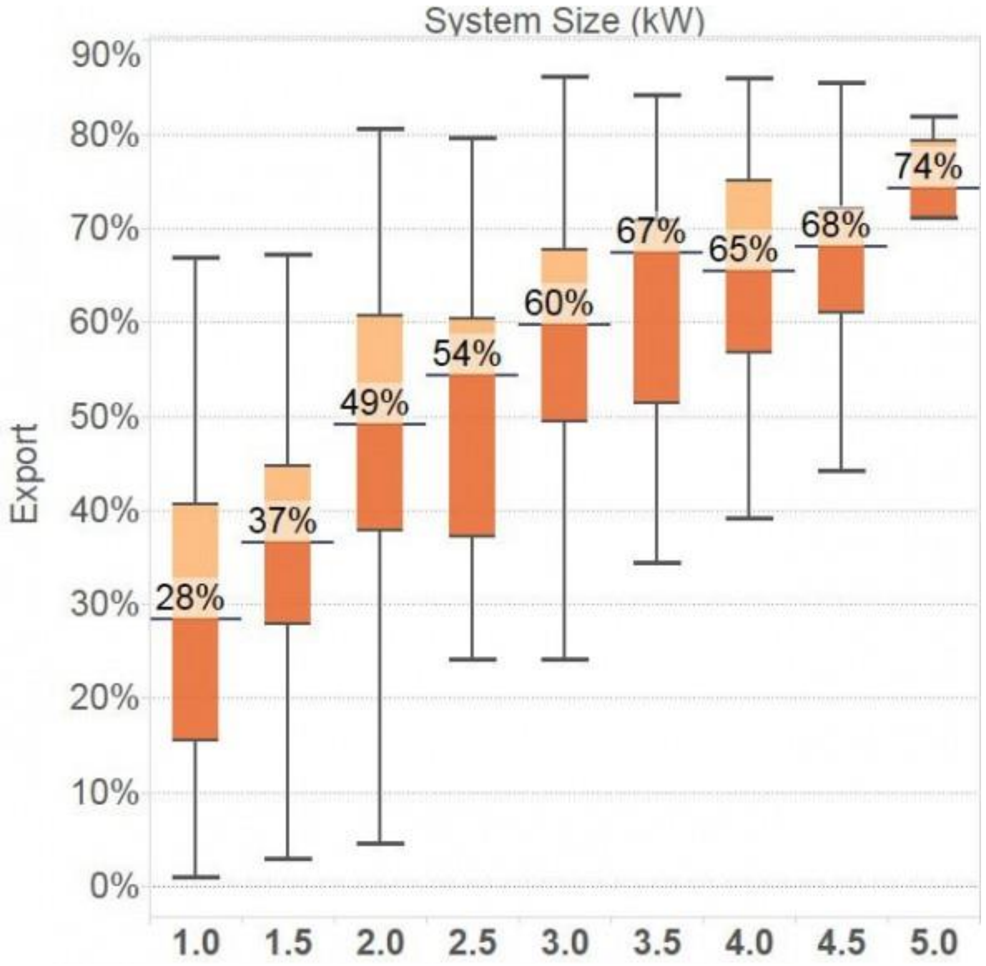
Avoided cost and FiT

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[xi]. 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 This is based on estimations of capacity, allowing for the lag in reported data
iii https://www.esc.vic.gov.au/media-centre/minimum-feed-tariffs-2018-19
iv 2018-19 feed-in tariffs, ESC
v 2018-19 Solar feed-in tariff, Queensland Competition Authority, May 2018
vi 2018-19 feed-in tariffs, ESC
vii BCA, "Impact of Green Energy Policies on Electricity Prices", June 2014
viii 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
ix estimate based on, RenewEconomy, 26 August 2013, http://reneweconomy.com.au/2013/hidden-cost-of-rooftop-solar-who-should-pay-for-maintenance-99200

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

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