SOLAR REPORT

JANUARY 2019

Australian Energy Council

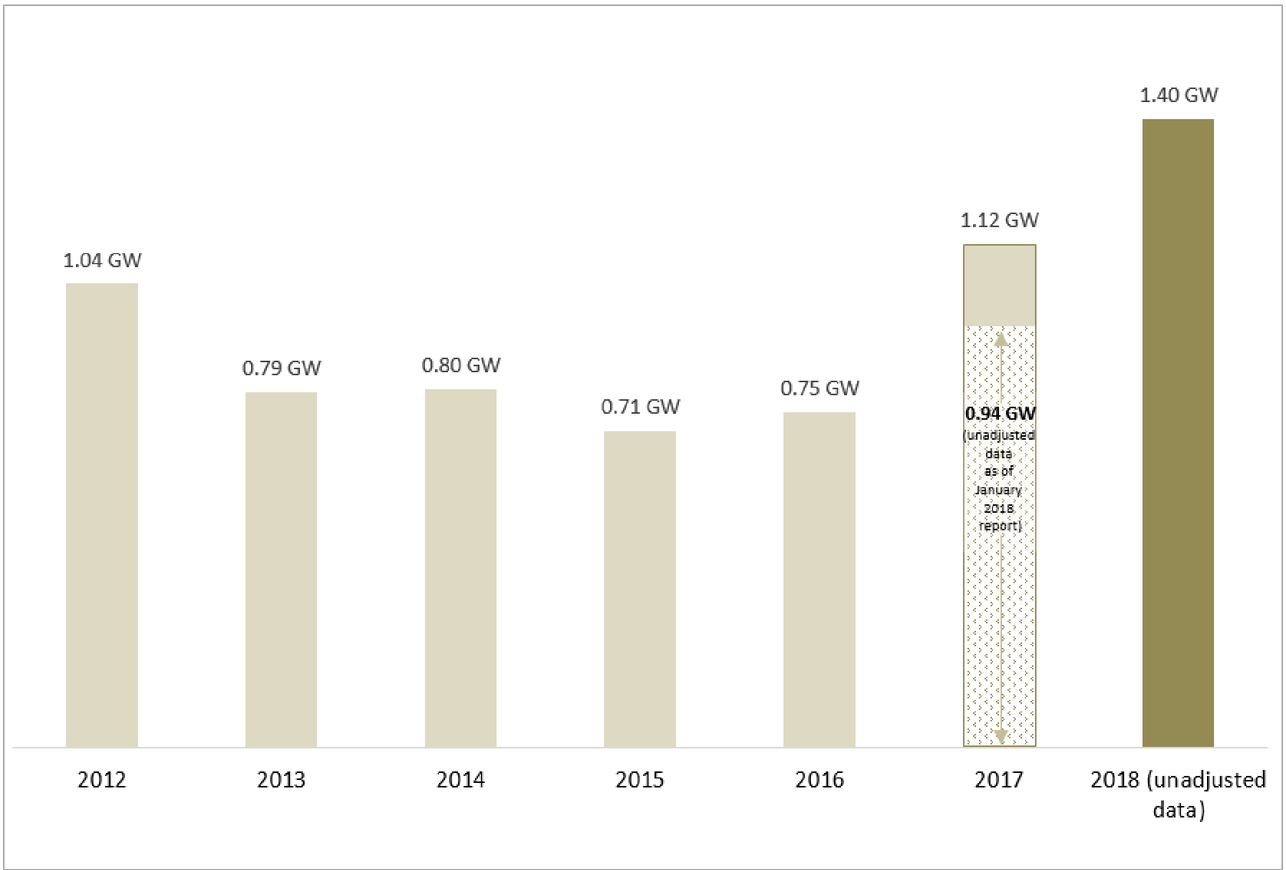
Table of contents

SECTION I: STATE OF SOLAR PV IN AUSTRALIA

Updated data from the Clean Energy Regulator (CER) on 14 January 2019 shows that 2018 was another record-breaking year for solar in Australia, with residential installed capacity increasing by at least 20 per cent from 2017 (figure 1)[i].

By the end of 2018, cumulative installed capacity for solar photovoltaic (PV) systems stood at 7,982 MW with more than 2 million installations across the nation. This is up from 6,580 MW and 1.82 million installations at the same time in the previous year - illustrating the continued strong growth in solar. The amount of rooftop PV capacity installed during 2018 is estimated to have reached over 1.4 GW, making 2018 a record year for Australian rooftop solar PV. It is worth noting that due to a 12-month reporting lag for solar systems, the raw 31 December 2018 data underestimates the total number of installations and installed capacity[1], so we would expect the final number to be higher.

Figure 1: Total installed capacity (GW) since 2012 in Australia



Source: Clean Energy Regulator data, Australian Energy Council analysis, January 2019

In the same way last year's January Solar Report estimated that the total installed capacity for 2017 reached over 1 GW (the report showed a total of 0.94 GW based on the available data), due to the

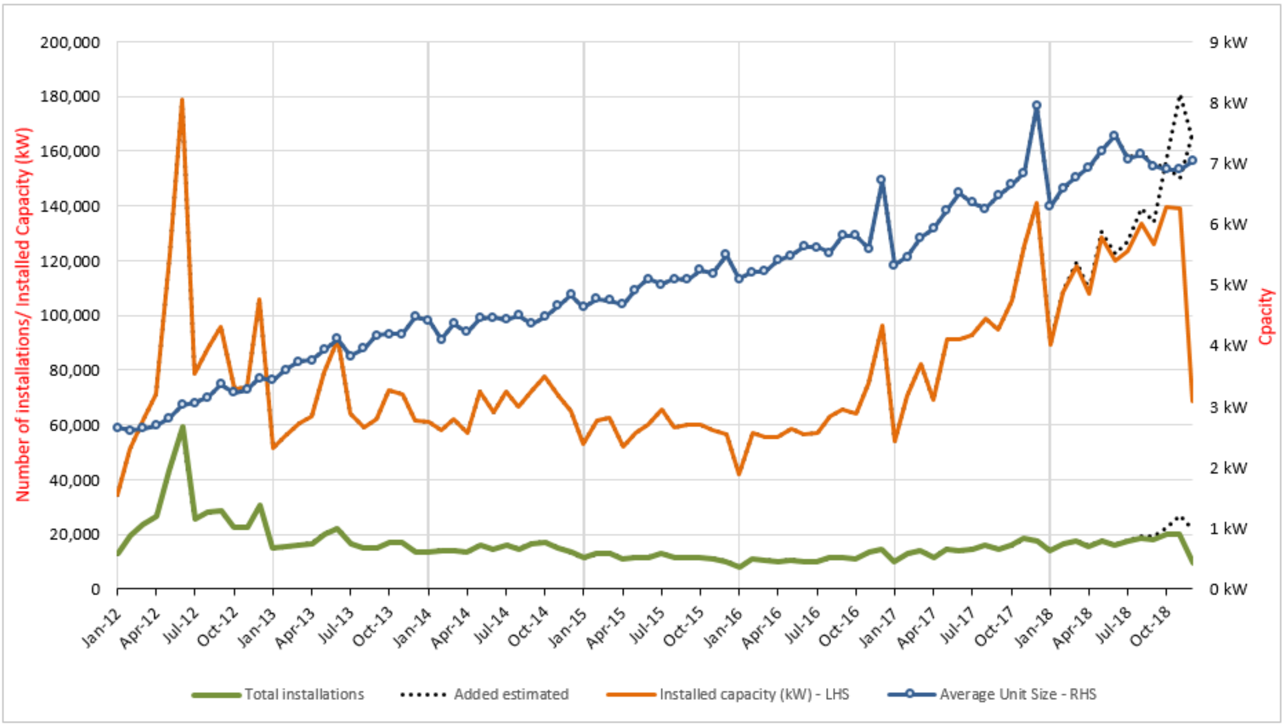
[1] Solar PV system owners have up to 12 months to report their data to the Clean Energy Regulator, so the reported data for the most recent months is likely to understate the number of actual installations, as well as the installed capacity.

lag in the reporting of data, the national 2017 total for solar PV installations has now been revised to 1.12 GW based on the reported data.

Although monthly rooftop installation and installed capacity has fluctuated, the trends are still clearly upward (figure 2). The combined installed capacity of 2017 and 2018 alone (at least 2,520 MW) is more than the combined capacity of the closed Northern and Hazelwood power stations (2,300 MW).

The two most recent months of November and December 2018 show an apparent sharp drop in installed capacity and total installations, again reflecting the 12-month lag in data[1], so it does not reflect the actual capacity uptake in more recent months as of 31 December 2018. The estimated installed capacity is shown as a dotted line in figure 2.

Figure 2: Monthly installations, installed solar PV capacity and average system size Jan 2012 – 2018



Source: Clean Energy Regulator (adjusted data), Australian Energy Council analysis, January 2019

Another trend in recent years has been an increasing percentage of households and small businesses opting for bigger system sizes, with one key driver being the rapid fall in solar PV costs[2]. This explains the continued increase in the average unit size of solar PV systems in figure 2.

The monthly average unit size in 2016 and 2017 is higher than the previous corresponding period and is especially evident in December of those years where the average installed unit size spikes. However, this trend changes during 2018. The unadjusted data shows that the average unit size peaks in August at 7.15kW, slightly decreases to 6.89 kW in November, before rising again

[2] March 2017 Solar Report, Australian Energy Council

marginally to 7.04 kW in December. The preferred system size is around 7.0 kW with residents not opting for a larger 8.0 kW system.

Table 1 further shows the percentage of different system sizes across Australian suburbs. In 2018, a system of up to 1.5 kW continues to be the most preferred. Residents are also opting for larger systems with 31.5 per cent installing a system of up to 7 kW. However, while 2016-17 saw a jump of 8.8 per cent, growth has slowed from 2017 to 2018 for systems up to 7 kW with a rise of only 1.8 per cent.

Table 1: Percentage of Australian suburbs installing different solar PV system sizes (kW), December 2015-2018

Up to (average system size)	*Dec-15*	*Dec-16*	*Dec-17*	*Dec-18*
1.5 kW	37.6%	33.0%	31.5%	44.0%
2 kW	1.2%	0.5%	0.2%	0.1%
3 kW	5.4%	2.1%	1.3%	0.4%
4 kW	12.8%	9.2%	3.6%	1.3%
5 kW	19.4%	17.6%	9.0%	3.8%
7 kW	14.0%	20.9%	29.7%	31.5%
10 kW	4.3%	7.5%	11.2%	12.7%
10+ kW	5.2%	9.3%	13.6%	6.4%

Source: Clean Energy Regulator data, Australian Energy Council analysis, January 2019
Note: Suburbs with more than one installation based on CER data; the average system size of that suburb is recorded. As such, the analysis focuses on trends rather than focusing on results for comparisons.

The following table shows the average unit size in suburbs that have at least 20 installations for November and December 2015 to 2018[ii] . As shown in table 2:

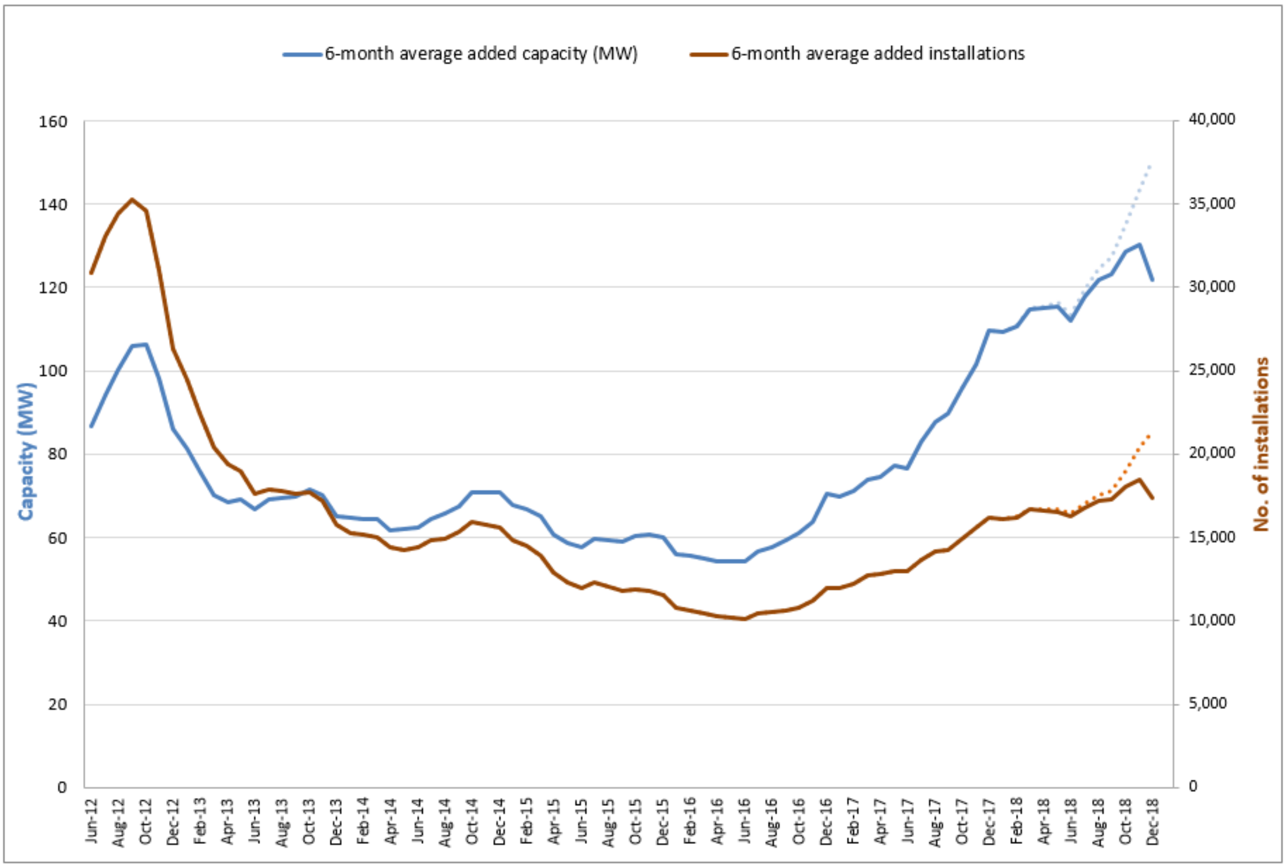
- New South Wales is the only state that shows continued growth in average unit size from 2016 to 2018 in both months. On average, the preferred solar PV size for New South Wales residents in 2018 is 8 kW or larger systems.
- Queensland, Victoria and Western Australia shows
  - In 2017 the trend was to install larger residential systems between 6-7 kW (when compared to the 2016 average).
  - From 2017 to 2018, the average system size is around 7.5kW for Queensland, and just above 6 kW for both Victoria and Western Australia.

Table 2: Average installed unit size (kW) of suburbs with more than 20 installations, November and December 2015-18

		November					December				
State	Number of suburbs	2015	2016	2017	2018	Trend	2015	2016	2017	2018	Trend
NSW	3	4.6	6.3	6.8	8.7		6.4	5.4	7.6	8.7	
QLD	25	5.0	6.2	7.0	7.4		5.9	6.6	7.5	7.5	
VIC	4	4.0	5.2	6.0	6.4		4.2	5.0	6.8	6.3	
WA	13	4.8	6.0	6.1	6.2		5.0	6.3	6.7	6.4	

Source: Clean Energy Regulator data, Australian Energy Council analysis, January 2019

Figure 3: Rolling 6-month installed capacity and number of installations average

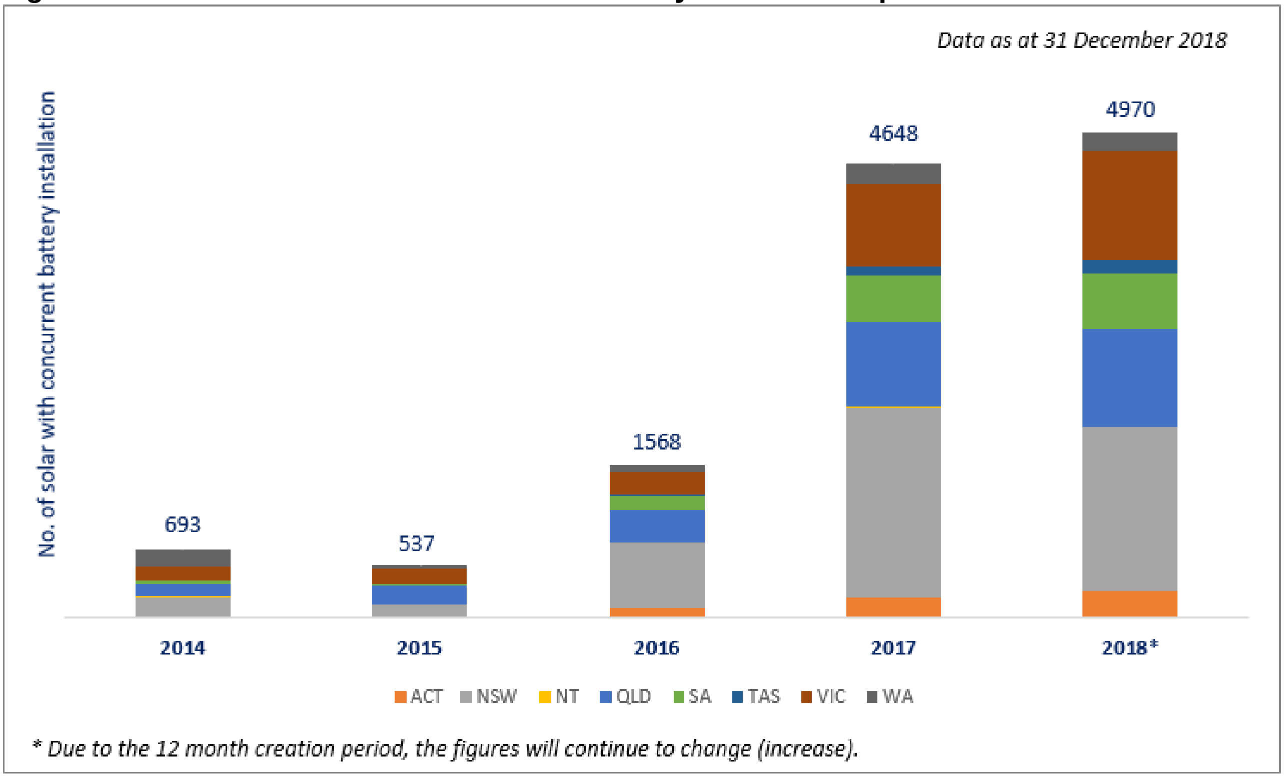


Source: Clean Energy Regulator data, Australian Energy Council analysis, January 2019

Figure 3 again illustrates the continued strong growth in Australian rooftop solar installations. The two trend lines continue to widen as bigger solar units are installed, specifically, the rolling average installed capacity (blue line) has been growing at an estimated six-month average rate of 150 MW installed capacity to December 2018[iii], which has surpassed the previous peak of 105.8 MW (in 2012).

2018 was also a strong year for the uptake of home batteries installed with rooftop solar PV (figure 4).

Figure 4: Number of solar with concurrent battery installations per state since 2014



Source: Clean Energy Regulator data, Australian Energy Council analysis, data as at 31 December 2018

New South Wales continues to lead the states with concurrent solar and battery installations. Victoria has moved up to second rank, beating Queensland, which dropped back to third place. This increase in Victoria is expected to be due to the new Solar Homes Program, which is offering the state's residents with a rebate of up to 50 per cent of the cost of a solar PV system (solar panels, solar hot water, or solar batteries) installed on or after 19 August 2018.

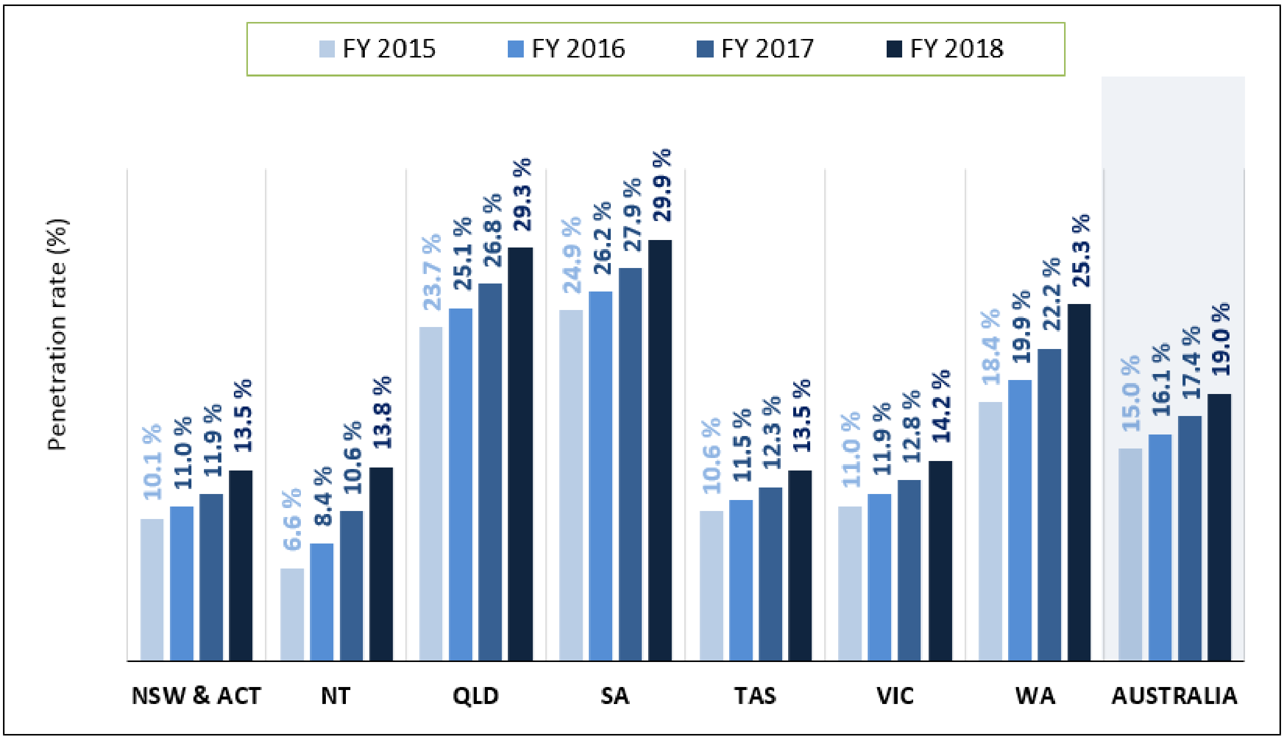
SECTION II: HIGHLIGHTS OF THE YEAR

Percentage of households with solar PV continues to grow each year

During the 2017-18 financial year, Australia gained just under 2 per cent in residential installations reaching a total penetration rate of 19 per cent (figure 5).

This trend spreads across all the states, particularly in South Australia and Queensland, where nearly 30 per cent of houses have an installed solar PV system. The Northern Territory and Western Australia had the greatest percentage jump from 2017-18, with just over 3 per cent of residential installations in both states.

Figure 5: Penetration rate of residential rooftop solar across financial years 2015 to 2018



Source: Australian Energy Council analysis, January 2019

Change in generation source

In table 3 below, the last quarter of 2018 shows that generation from large-scale solar farms in New South Wales for the first time had exceeded generation from gas-fired plants by 108 GWh.

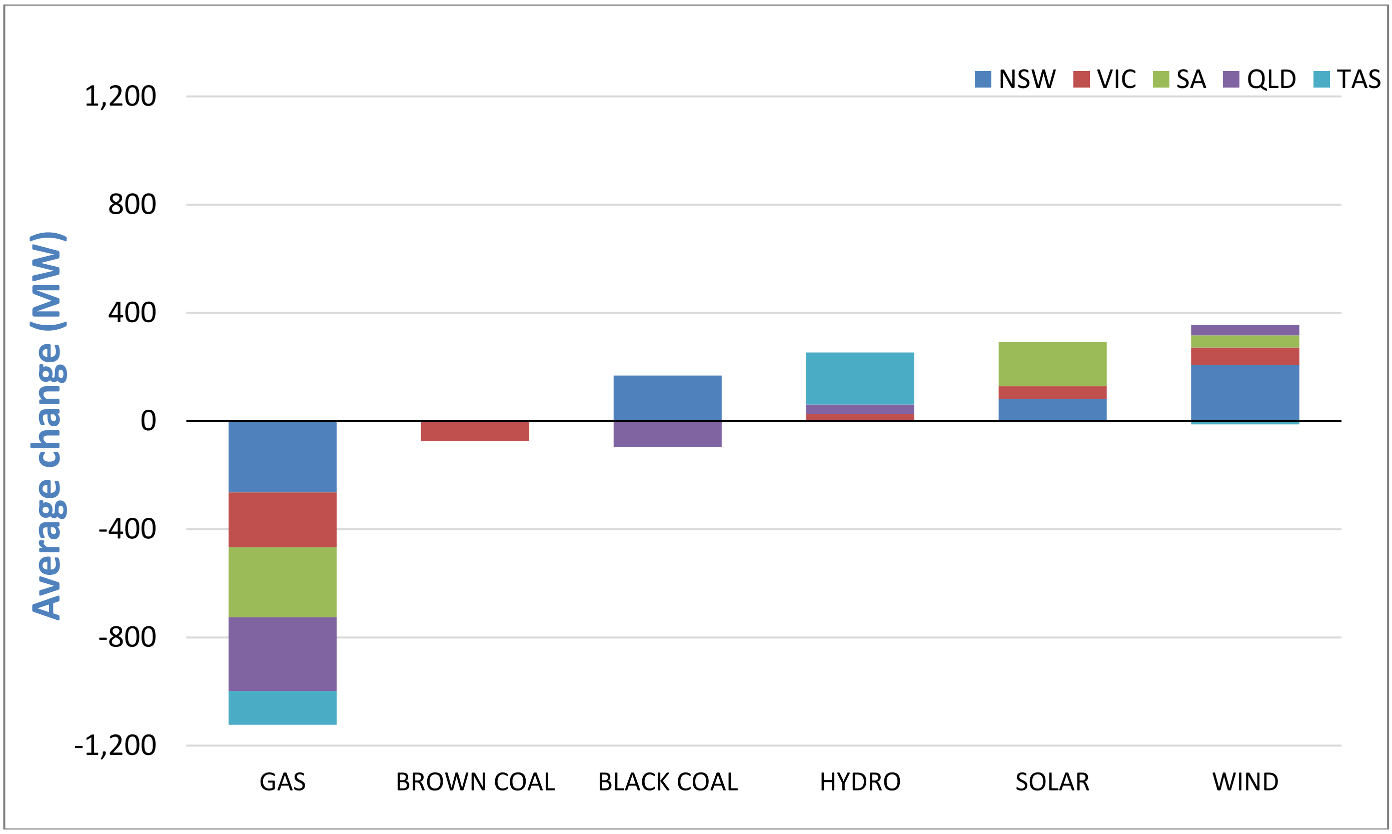
Table 3: Quarterly electricity generation in NSW by fuel types

Generation (GWh)	Black Coal	Solar	Wind	Natural Gas	Diesel	Hydro
Q3 2017	14,019	142	748	747	5.04	518
Q4 2018	14,305	372	922	264	0.03	362
Q1 2018	15,311	174	553	251	0.06	781
Q2 2018	13,912	168	642	278	0.08	961
Q3 2018	13,886	200	952	528	0.15	792
Q4 2018	**14,305**	**372**	**922**	**264**	**0.03**	**362**

Source: Australian Energy Council analysis, January 2019
Note: Solar includes generation from large-scaled solar farms, excluding rooftops.

At a state level, in the last quarter of 2018, gas fired-generation experienced the biggest drop in electricity output in the National Electricity Market (NEM), while non-synchronous generation (large-scale wind and solar farms) increased their contributions compared to the previous corresponding period (see figure 6).

Chart 6: Change in supply of Q4 2018 vs Q4 2017



Source: NEO Express, January 2019
Note: Solar does not include rooftop PV

The chart above shows that South Australia and Victoria experienced jumps in electricity supply from large-scale solar farms. This reflects that these two states had electricity fed into the grid from solar farms during the 2018 quarter, but in Q4 2017, 0MW of output from solar farms was recorded as they were still under development.

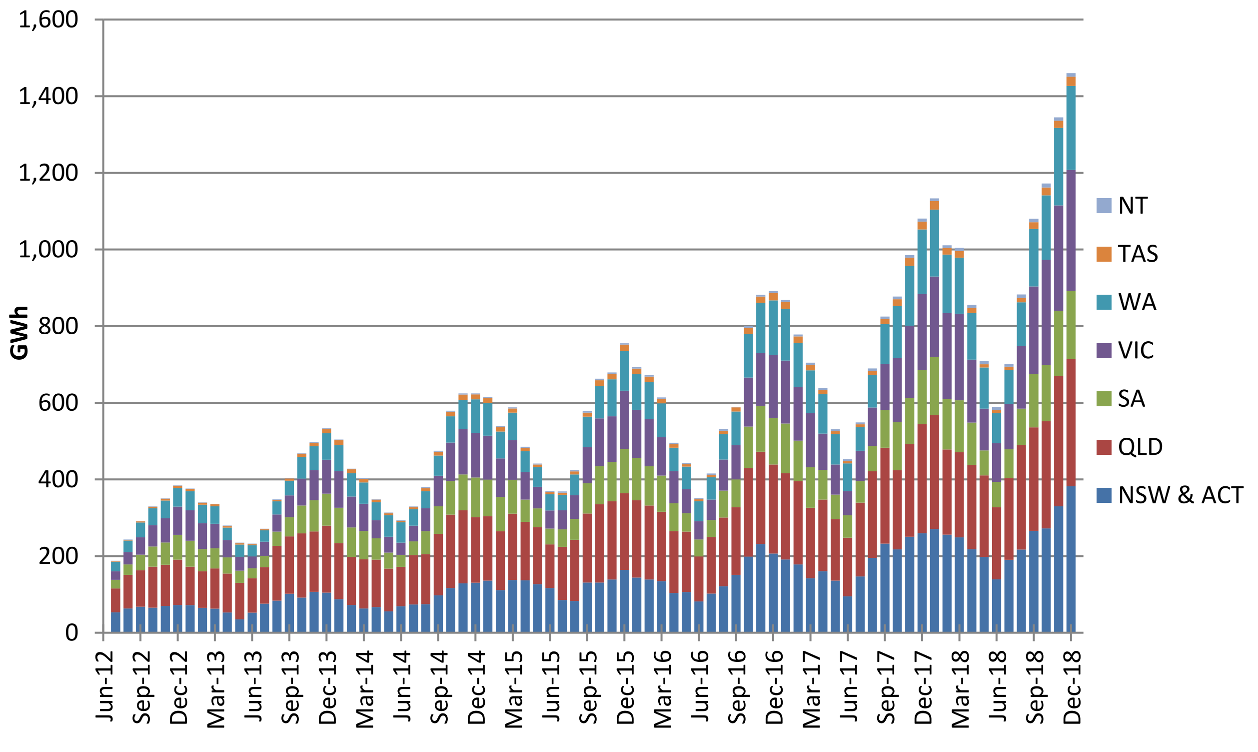
New South Wales and Queensland experienced the greatest change in large-scale solar generation. Queensland experienced an 80 per cent increase from 214 GWh in Q3 2018, to 386 GWh in Q4. New South Wales jumped 86 per cent, from 200 GWh in Q3 2018 to 372 GWh in Q4. Together, both states recorded a total of 758 GWh in Q4, 2018, an 82 per cent increase from the previous quarter of 2018.

SECTION III: ESTIMATED RESIDENTIAL PV GENERATION

Figure 7 below 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 7: Estimated residential PV generation (GWh)



Source: Australian Energy Council analysis, January 2019

Rooftop solar PV installations throughout Australia in 2018 generated close to 12,000 GWh (a 33 per cent jump from 2017) with December alone generating 1,459 GWh. The Northern Territory and Tasmania only account for a 2.4 per cent share of total rooftop generation in 2018.

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 2018. 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, households will benefit from a steep increase in solar FiTs from around 9c/kWh to a minimum of 12.8c/kWh for their exports fed back to the grid. In Victoria, many retailers have offered time-varying FiTs ranging from a minimum of 9.9c/KWh to a maximum of 25c/kWh.

Table 4: Central estimate: 6.16 per cent discount rate (ten-year average mortgage rate)

	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	$0.10	$0.48	$0.17
Brisbane	$0.15	$0.12	$0.11	$0.10	$0.10	$0.10	$0.33	$0.12
Canberra	$0.13	$0.11	$0.10	$0.10	$0.10	$0.08	$0.22	$0.13
Darwin	$0.14	$0.11	$0.10	$0.09	$0.09	-	$0.26	$0.24
Hobart	$0.19	$0.16	$0.14	$0.13	$0.14	$0.15	$0.25	$0.09
Melbourne	$0.18	$0.15	$0.13	$0.13	$0.13	$0.13	$0.26	$0.12
Sydney	$0.15	$0.13	$0.11	$0.11	$0.11	$0.11	$0.31	$0.13
Perth	$0.12	$0.10	$0.09	$0.08	$0.09	$0.09	$0.26	$0.07

Source: Australian Energy Council analysis, January 2019
Note: In Darwin, cost for 10kW system is not available

Table 5: Low cost of capital sensitivity: 5.30 per cent discount rate (low current standard variable rate)

	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	$0.10	$0.48	$0.17
Brisbane	$0.14	$0.12	$0.11	$0.10	$0.10	$0.10	$0.33	$0.12
Canberra	$0.13	$0.11	$0.10	$0.09	$0.10	$0.08	$0.22	$0.13
Darwin	$0.13	$0.10	$0.09	$0.08	$0.09	-	$0.26	$0.24
Hobart	$0.18	$0.15	$0.14	$0.13	$0.13	$0.15	$0.25	$0.09
Melbourne	$0.17	$0.14	$0.13	$0.12	$0.12	$0.12	$0.26	$0.12
Sydney	$0.15	$0.12	$0.11	$0.10	$0.11	$0.11	$0.31	$0.13
Perth	$0.11	$0.10	$0.09	$0.08	$0.08	$0.09	$0.26	$0.07

Source: Australian Energy Council analysis, January 2019

Table 6: High cost of capital sensitivity: 13.56 per cent discount rate (indicative personal loan rate)

	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	$0.13	$0.48	$0.17
Brisbane	$0.21	$0.16	$0.15	$0.14	$0.14	$0.14	$0.33	$0.12
Canberra	$0.18	$0.15	$0.14	$0.13	$0.13	$0.11	$0.22	$0.13
Darwin	$0.19	$0.15	$0.13	$0.11	$0.12	-	$0.26	$0.24
Hobart	$0.27	$0.22	$0.19	$0.18	$0.19	$0.21	$0.25	$0.09
Melbourne	$0.25	$0.20	$0.18	$0.17	$0.17	$0.17	$0.26	$0.12
Sydney	$0.21	$0.17	$0.15	$0.14	$0.15	$0.14	$0.31	$0.13
Perth	$0.16	$0.13	$0.12	$0.11	$0.11	$0.12	$0.26	$0.07

Source: Australian Energy Council analysis, January 2019

Small and Large business - Levelised Cost of Electricity

Tables 7 and 8 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[iv].

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

Table 7: Central estimate: 6.90 per cent discount rate, ten-year average small business interest rate

	System Size				
	10kW	**30kW**	**50kW**	**70kW**	**100kW**
Adelaide	$0.12	$0.11	$0.12	$0.11	$0.11
Brisbane	$0.12	$0.12	$0.12	$0.12	$0.11
Canberra	$0.14	$0.12	$0.11	$0.11	$0.11
Hobart	$0.17	$0.16	$0.16	$0.16	$0.16
Melbourne	$0.14	$0.13	$0.14	$0.13	$0.13
Sydney	$0.13	$0.12	$0.12	$0.12	$0.12
Perth	$0.12	$0.11	$0.11	$0.11	$0.11

Source: Australian Energy Council analysis, January 2019

Table 8: Central estimate: 4.83 per cent discount rate, ten-year average large business interest rate

	System Size				
	10kW	**30kW**	**50kW**	**70kW**	**100kW**
Adelaide	$0.11	$0.10	$0.11	$0.11	$0.10
Brisbane	$0.11	$0.11	$0.11	$0.11	$0.10
Canberra	$0.12	$0.11	$0.10	$0.10	$0.10
Hobart	$0.16	$0.14	$0.15	$0.15	$0.15
Melbourne	$0.13	$0.12	$0.13	$0.12	$0.12
Sydney	$0.12	$0.11	$0.11	$0.11	$0.11
Perth	$0.11	$0.10	$0.10	$0.10	$0.10

Source: Australian Energy Council analysis, January 2019

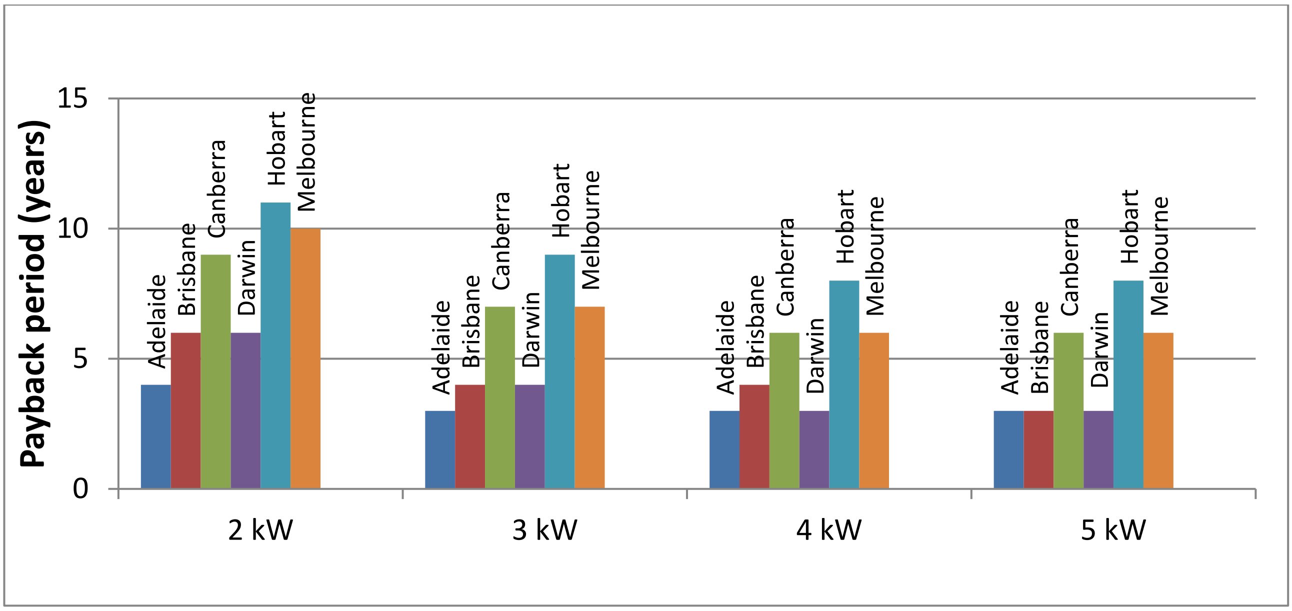
SECTION V: PAYBACK PERIOD, DETAILED MODEL

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 8 highlights the payback period for different system sizes across Australia. Note that electricity prices are subject to change with CPI levels (currently 1.8 per cent, last updated December 2018) and thus 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. The low payback periods across many cities further highlights the greater encouragement for customers to install solar PV.

Figure 8: Payback period for solar PV (5.27 per cent discount rate)

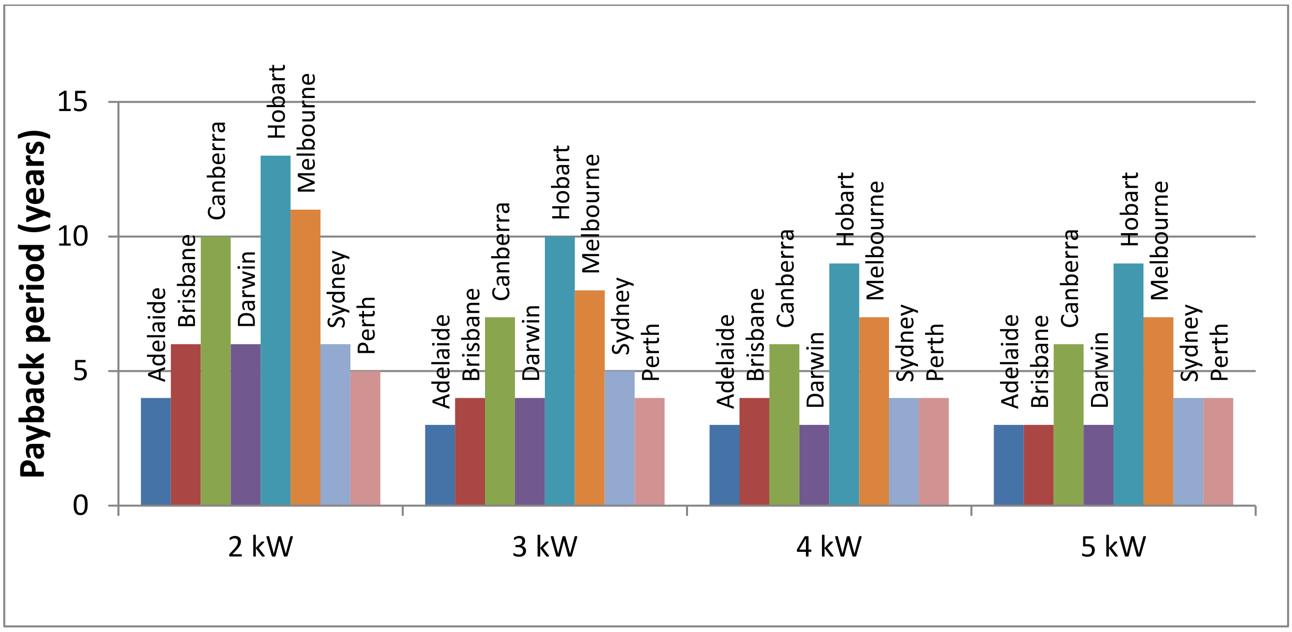


Source: Australian Energy Council analysis, January 2019

For example, a year ago, Darwin had the highest FiT of minimum 25.7c/kWh. Its payback period was 6 years for a 2kW system or 4 years for a 3kW system at 5.30 per cent discount rate. In 2018 the FiT has been lowered to a minimum of 23.6c/kWh.

Figure 9 shows the expected payback period for systems with a 6.16 per cent discount rate (10-year average home loan rate).

Figure 9: Payback period for solar PV (6.16 per cent discount rate)



Source: Australian Energy Council analysis, January 2019

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[vi], 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 (6.16 per cent).

The low discount rate sensitivity is based on the minimum variable home loan mortgage rate offered by the Big Four banks (currently 5.27 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 4.83 per cent and the small business discount rate is 6.90 per cent.

The discount rate also takes into account the Consumer Price Index (CPI); this has been given a constant value of 1.8 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[vii]. 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 $\sum$ 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

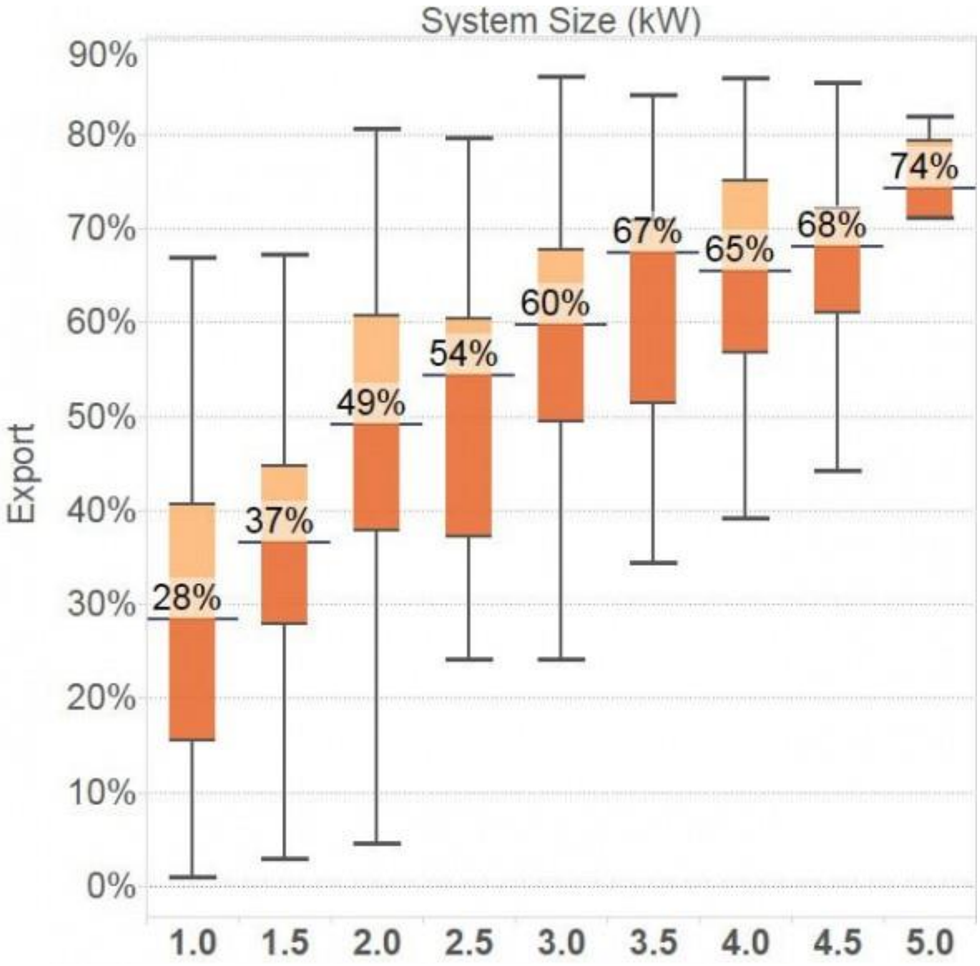
Avoided cost and FiT

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[viii]. See Figure 10 below.

Figure 10: 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, 14 January 2019
ii We don't record suburbs with a small sample size, with less installations one large PV system can affect the overall average unit size.
iii This is based on estimations of capacity, allowing for the lag in reported data
iv BCA, "Impact of Green Energy Policies on Electricity Prices", June 2014
v 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
vi estimate based on, RenewEconomy, 26 August 2013, http://reneweconomy.com.au/2013/hidden-cost-of-rooftop-solar-who-should-pay-for-maintenance-99200
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