AUSTRALIAN ENERGY COUNCIL

SOLAR REPORT

QUARTER 3, 2019

Australian Energy Council

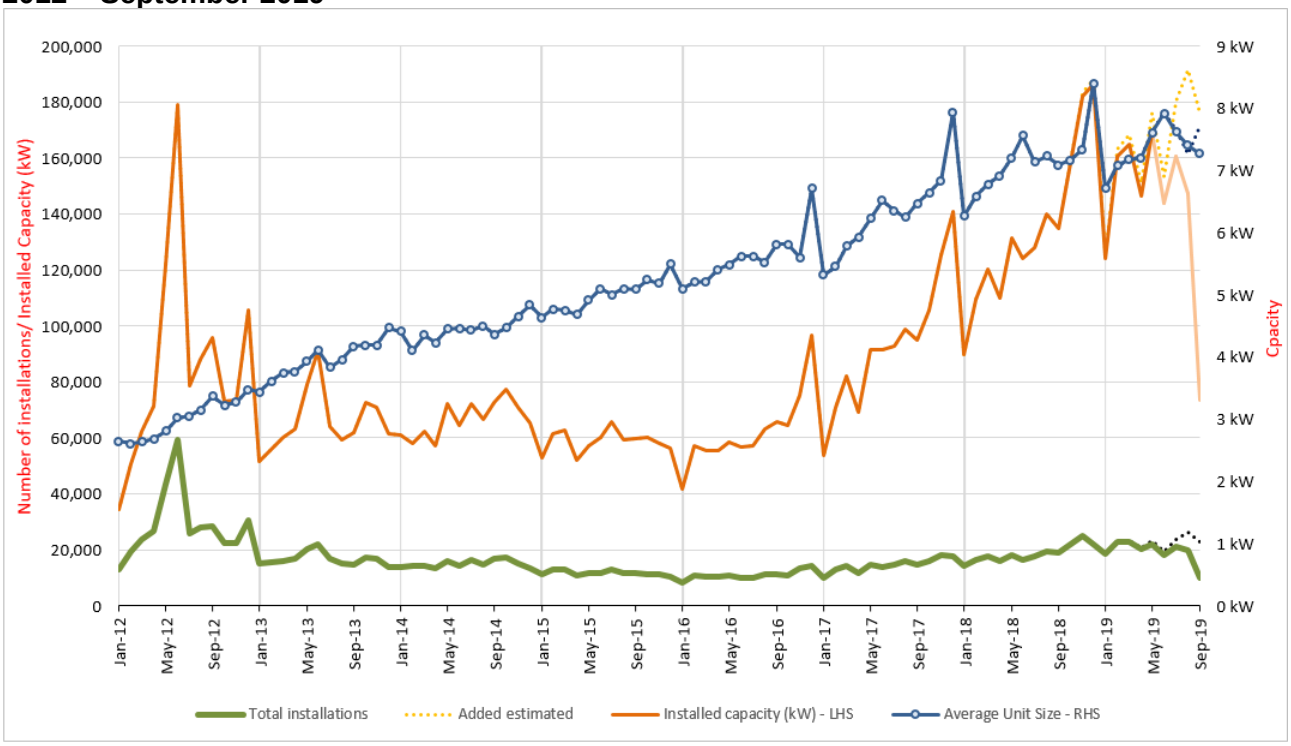
TABLE OF CONTENTS

SECTION I: STATE OF SOLAR PV IN AUSTRALIA

Latest data from the Clean Energy Regulator (CER) shows that the number of solar panel installations by postcode around Australia has surpassed 2.2 million, with close to 9.5 GW of installed small-scale solar PV capacity.

As can be seen in figure 1, the installed capacity of residential scale solar PV has steadily increased and has followed in a seasonal pattern since the end of 2016, whereby it dips in January each year and then progressively increases. In September this year there was an estimated 176 MW of solar capacity installed.

Figure 1: Monthly installations, installed solar PV capacity and average system size January 2012 – September 2019



Source: Clean Energy Regulator (adjusted data), Australian Energy Council analysis, data as at 30 September 2019

The average system size peaked at 7.95 kW in June this year, before a slight drop to 7.27 kW as of September 2019. The peak in system size at the end of 2019 financial year is expected to be due to a boost from the Victorian Government's Solar Home program, which provides a 50 per cent rebate for any solar panel system under 10kW, up to a maximum rebate of $2225[i]. The state scheme provided 32,000 rebates last financial year.

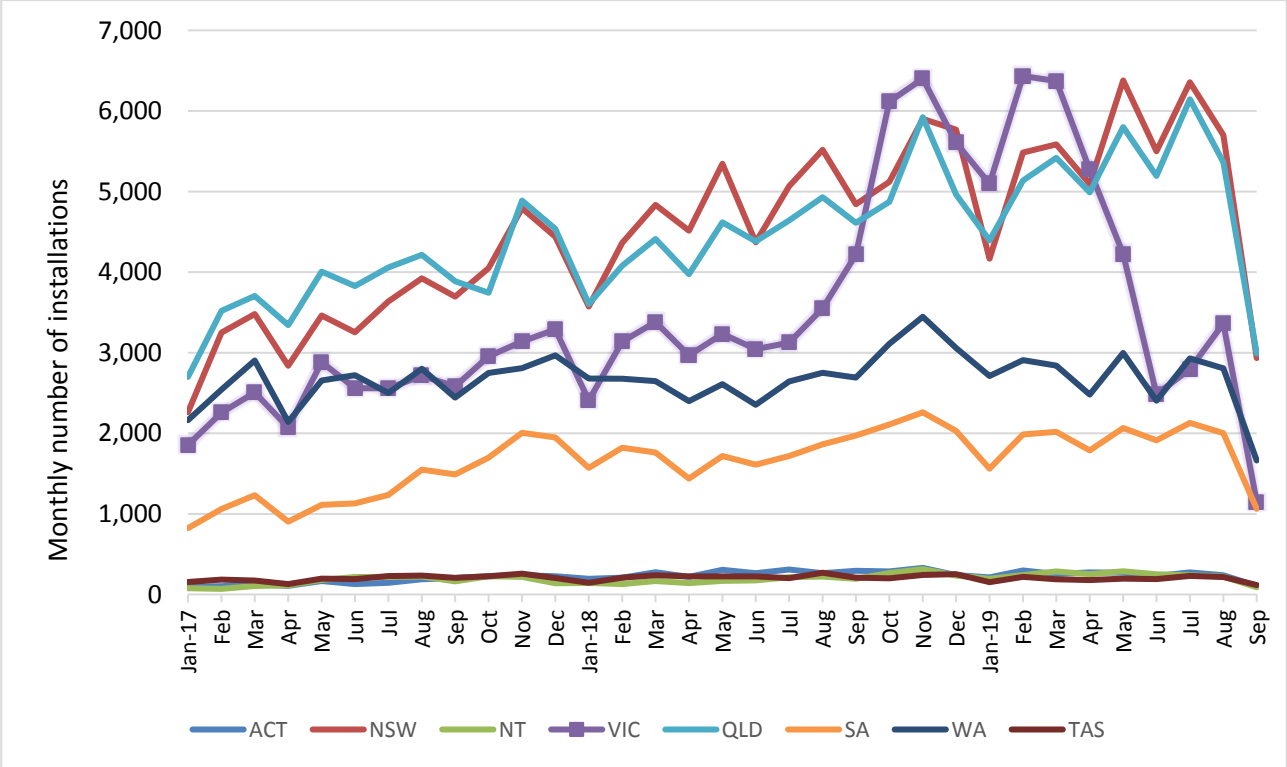
Illustrated in figure 2, Victoria's monthly rooftop installations shows an "m-shape". The trend line increased significantly when Victoria introduced the scheme and offered the rebate from August last year. In April this year the Victorian Government placed a temporary freeze because the scheme was so popular the rebates for the financial year had been fully subscribed and a cap of 3,333

installations was introduced in July and August 2019 (table 1). These measures caused a sudden drop in installations as shown in the chart.

When the allocation of rebates commenced in July, just the 3,333 rebates were available, less than the average number of systems already being installed in Victoria. Solar Victoria has since increased the number of rebates available, and almost tripled the September allocation to 9,750 rebates, and increasing the October allocation to 6,500[ii].

New South Wales and Queensland continue to rank in first and second place respectively, with an increase in monthly solar installations due to both states offering zero interest loans to purchase solar and battery systems.

Figure 2: Monthly rooftop PV installations by states



Note: The most recent three months in figure 3 underestimate the data and shall not be include in analysis.
Source: Clean Energy Regulator (unadjusted data), data as at 30 September 2019.

Table 1: Victorian Solar Panel Rebate numbers for 2019-20

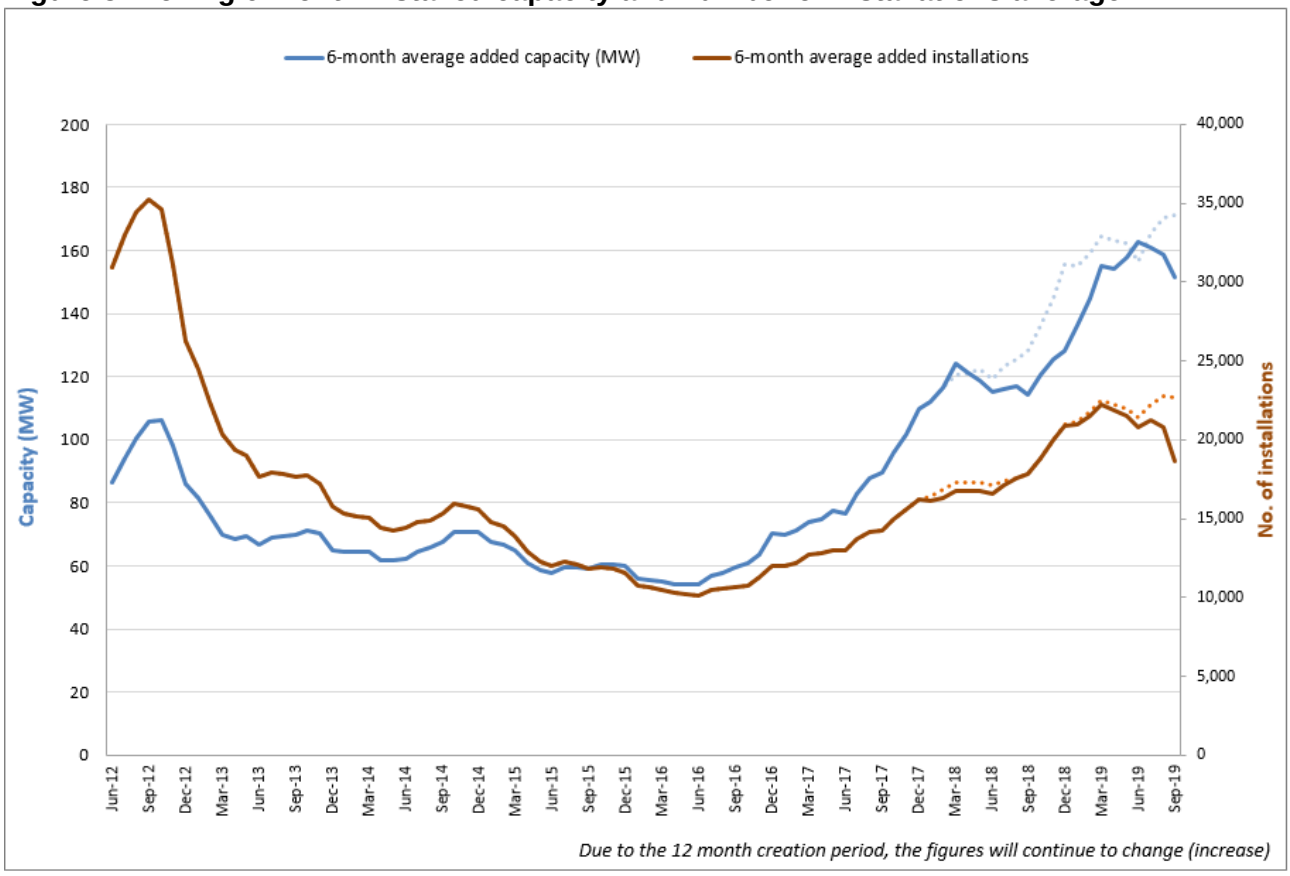
Solar Homes – Solar PV rebate releases for owner-occupier and community housing

Rebate per annum: 63,416* (*Some of this allocation may be withheld for manual allocations)

Month	Release 1	Release 2	Monthly total
July	3,333	N/A	3,333
August	3,333	N/A	3,333
September	6,500	3,250	9,750
October	3,250	3,250	6,500
November	3,250	3,250	6,500
December	2,500	2,500	5,000
January	2,000	2,000	4,000
February	2,500	2,500	5,000
March	2,500	2,500	5,000
April	2,500	2,500	5,000
May	2,500	2,500	5,000
June	2,500	2,500	5,000

Source: Solar Victoria

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



Source: Clean Energy Regulator data, Australian Energy Council analysis, data as at 30 September 2019

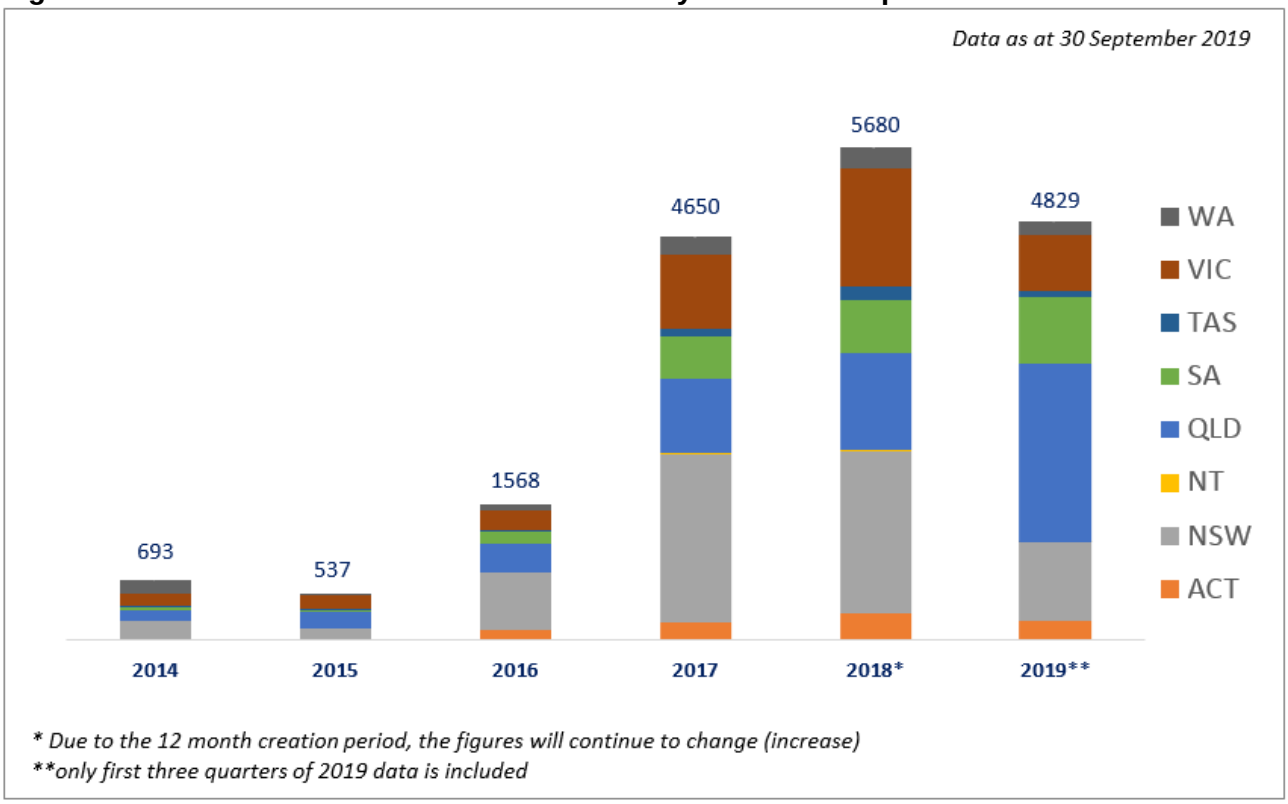
Shown in figure 3, since late 2016, the two trend lines of installed capacity and the average number of installations continue to widen - showing that bigger PV system units are being installed across the nation. Specifically, the rolling average installed capacity (blue line) has steadily grown, to reach an estimated six-month average of more than 171 MW on rooftops as of September 2019[iii], compared to an average of 156 MW in June 2019.

Battery installations with rooftop solar

Australia's market for home energy storage continues to grow. From 2016 to 2018 New South Wales and Victoria were the leading states in solar and battery storage installations. However, 2019 has seen a shift with Queensland now leading the way, followed by New South Wales (figure 5).

In 2019, Queensland accounts for 42.6 per cent of total installations at the time of reporting. This rise is due to the Queensland Government's solar battery scheme, introduced in November 2018, in which Queenslanders can apply for interest-free loans of up to $10,000 and grants of $3000 to purchase batteries or combined solar-battery systems[iv]. Approved applications will have six months to install an eligible system. The scheme closed at the end of the 2019 financial year and experienced high demand.

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



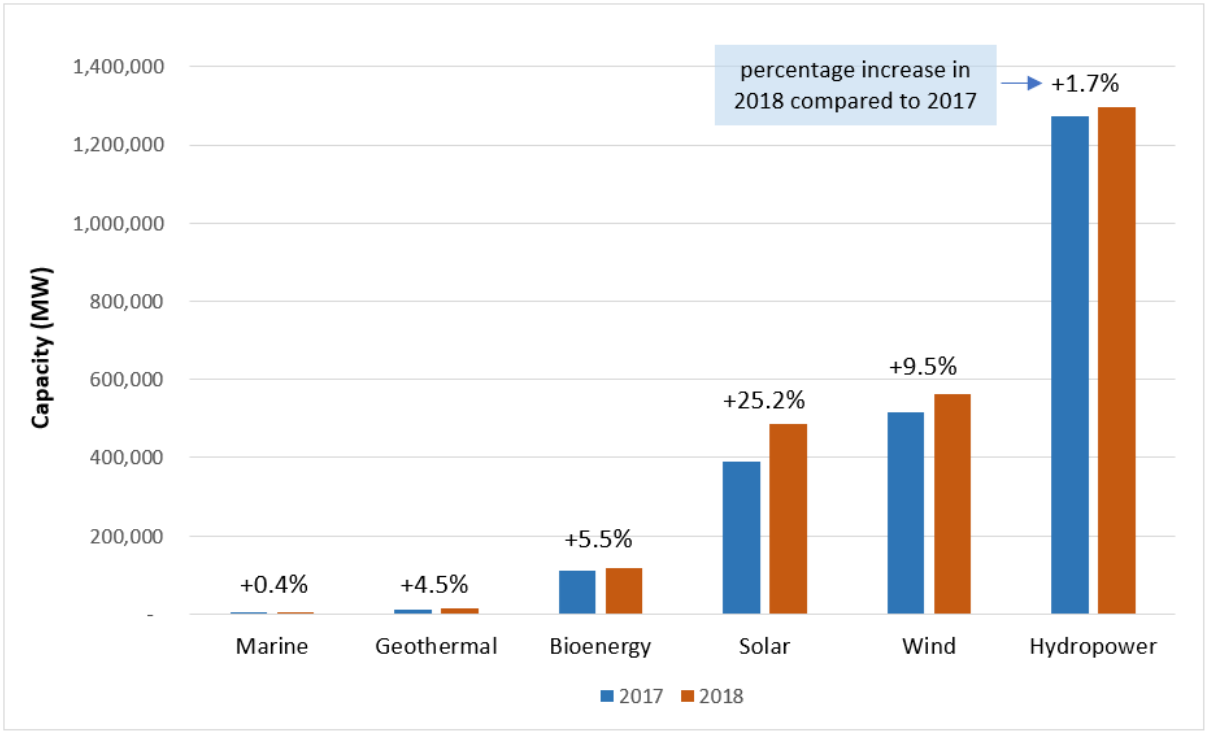
Source: Clean Energy Regulator data, Australian Energy Council analysis, data as at 30 September 2019

SECTION II: GLOBAL SOLAR ENERGY SECTOR

The recent release of *Renewable Capacity Statistics 2019* from the International Renewable Energy Agency (IRENA) shows that 2018 was another historic year for the global solar energy sector. Approximately 97.8 GW of solar was installed, which is twice as much capacity as the amount of wind power added (48.9 GW) in 2018.

Figure 5 shows the total installed capacity globally of different renewable generation power. Compared to the previous year, 2018 solar PV had the greatest jump of a 25.2 per cent increase in its capacity, while wind generation ranked second adding an additional 9.5 per cent.

Figure 5: Global renewable installed capacity in 2017 and 2018

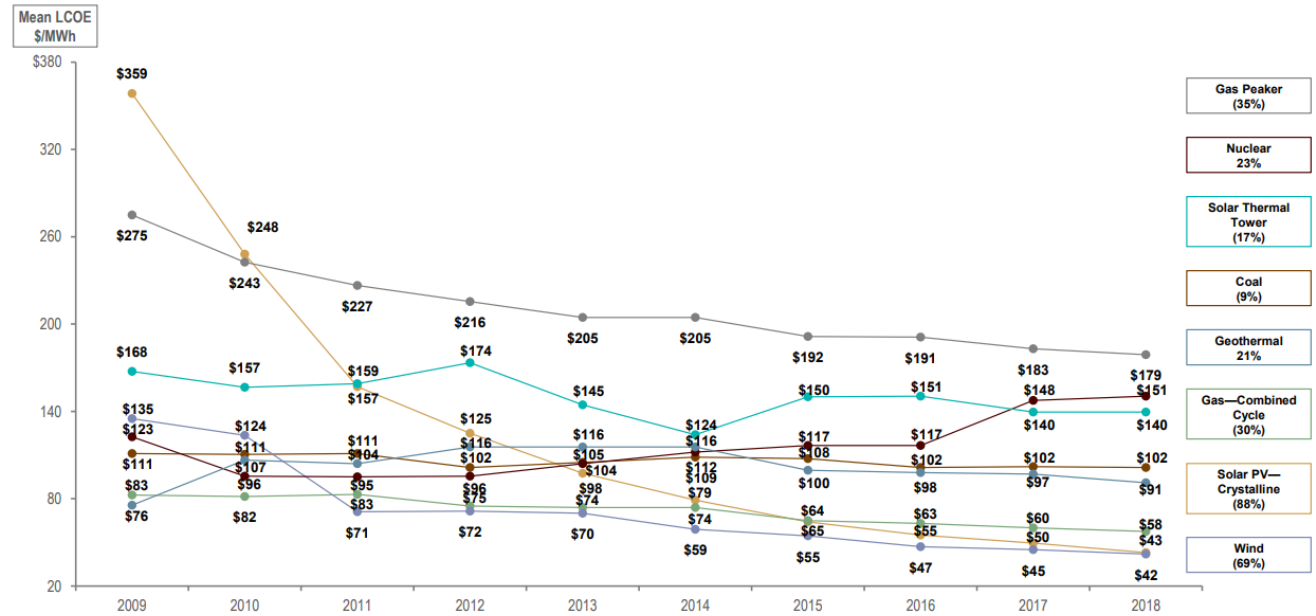


Source: AEC's analysis on IRENA RE Capacity Statistics (July 2019)

In light of material declines in the pricing of system components (e.g. panels, inverters, turbines, etc.) and improvements in efficiency, among other factors, wind and utility-scale solar PV have seen dramatic historical Levelised Cost of Energy (LCOE) declines; however, over the past several years the rate of such LCOE declines have started to flatten.

The boost in solar installations is largely explained by the continue decrease of solar power costs and price. In the LCOE Analysis, released in November 2018 by US investment bank Lazard, utility scale solar in 2018 continued to drop from $50/MWh in 2017 to $43/MWh in 2018 which increased the solar cost advantage compared to wind turbines.

Figure 6: Levelised Cost of Energy Comparison—Historical Utility-Scale Generation Comparison



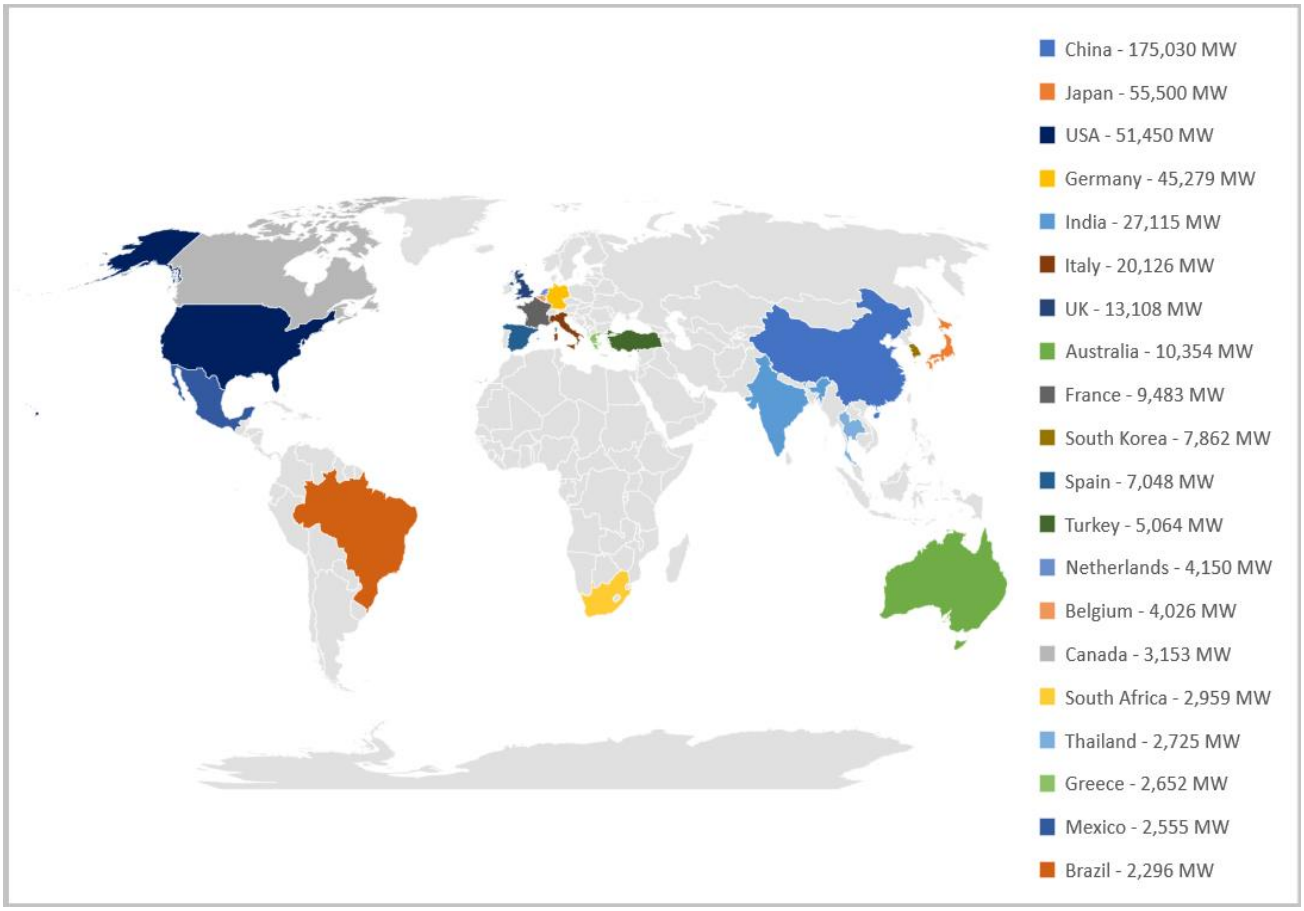
Source: Lazard (November 2018)

Top 20 countries with highest solar installations (MW) in 2018

In 2018, Asia continued to lead global solar capacity with China, Japan, and India accounting largely for the increase. China continues to dominate the global solar market installation with a total of 175 GW of solar capacity. China added the greatest solar capacity (44.2 GW) to its grid, an additional of 33.8 per cent. It is followed by Japan that added 11.3 GW of new solar capacity, and India 8.96 GW.

Australia continues to rank eighth in the world for solar installations. During 2018, Australia added an additional 3 GW of solar. Interestingly, such solar addition comes mostly from residential rooftop PV, with utility solar scale accounting for 14 per cent of total solar capacity (1,421 MW of total solar capacity of 10,354 MW).

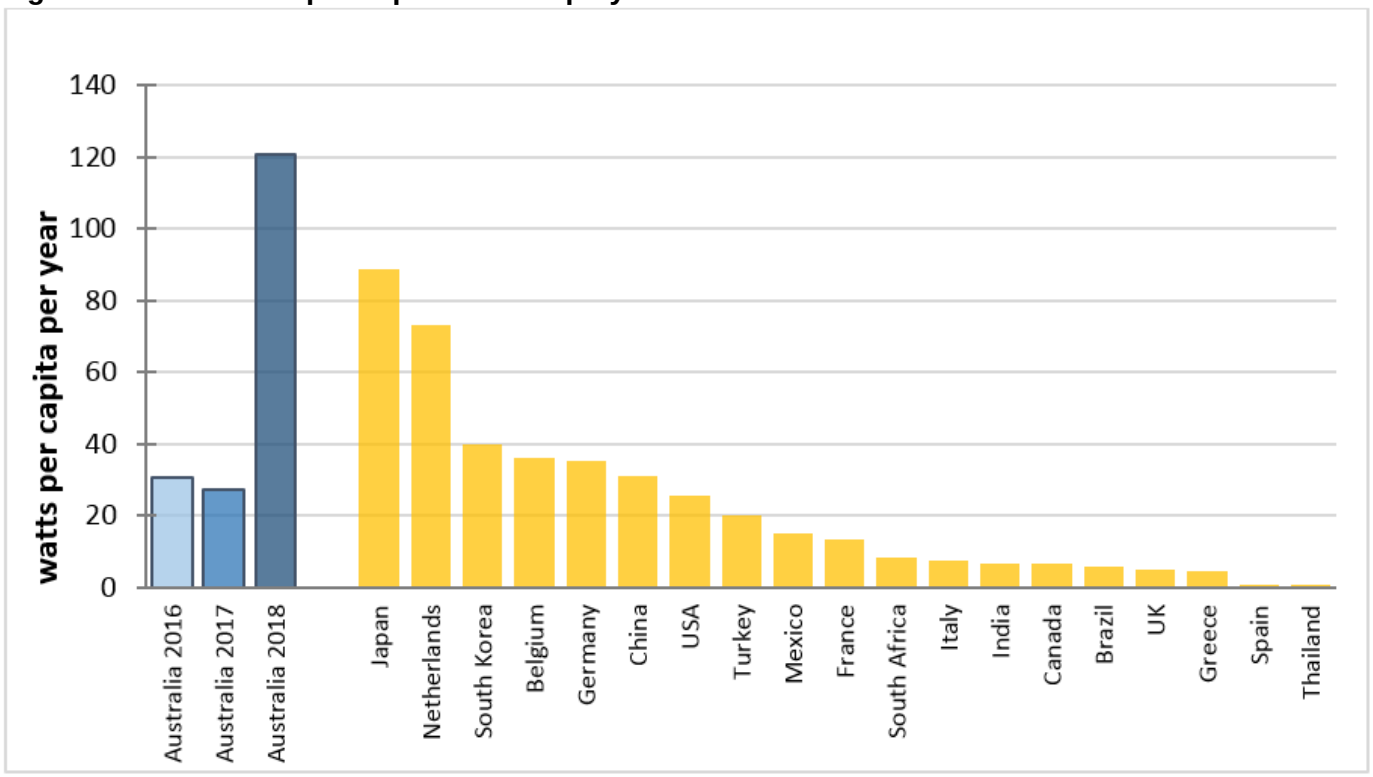
Figure 7: World top 20 countries with highest of solar PV installed in 2018



Source: AEC's analysis on IRENA RE Capacity Statistics (July 2019)

However when taking into account nation's population, Australia is leading the world in the rate of solar deployment installation per capita, tracking at 120 watts per person in 2018 (up from 27 watts in 2017) this is followed by Japan, the Netherlands and South Korea. The world's top three greatest populations - China, India and USA - are ranked seven, 14 and eight respectively, in terms of solar deployment rate per capita.

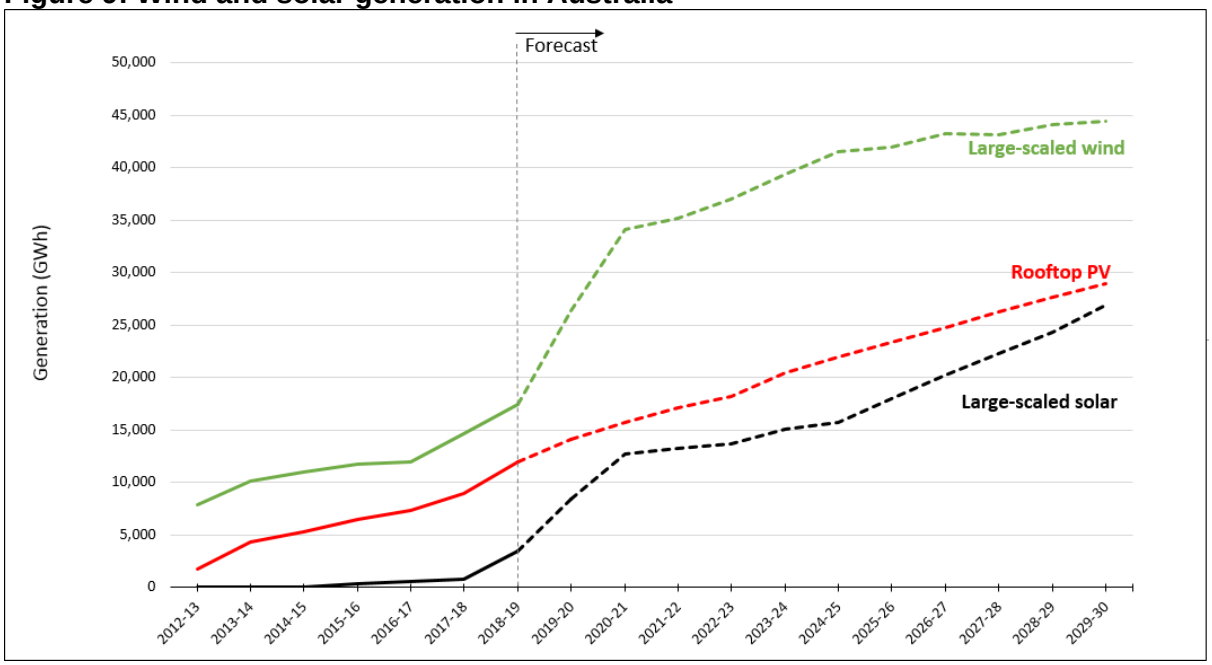
Figure 8: 2018 Global per capita solar deployment rate



Source: AEC's analysis on IRENA RE Capacity Statistics (July 2019) and StatisticsTimes

Looking forward, according to the Clean Energy Council's 2019 report, investment in large-scale renewable energy projects was double that of the record-breaking year of 2017, increasing from $10 billion in 2017 to $20 billion in 2018. At the end of 2018, 14.5 GW of new generation was under construction or financially committed. Large-scale wind and solar generation is forecasted to see a sharp electricity output in Australia by 2020-21.

Figure 9: Wind and solar generation in Australia



Source: NEO Express data, AEC Quarterly Solar report, Reputex's AEC Generation Outlook Report

SECTION III: 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. The calculation for LCOE takes into account initial cost, maintenance cost, Consumer Price Index (CPI), degradation rate, discount rate and average daily output which is based on AEMO estimates of daily output from PV rooftops. The initial cost of systems is updated monthly; discount rates are updated with any change in interest rates while all other factors are constant.

Table 1 shows the LCOE for solar in Australia's major cities, indicative retail prices and current feed-in tariff (FiT) rates. 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 2019 for most states, with Victorian offer was last updated in January 2019. 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 2, 3 and 4 show the LCOE across major cities at different discount rates.

The most cost efficient city to install solar is Perth, where it is the cheapest for all system sizes. At the lowest discount rate, mortgage adjusted 4.84 per cent 3 kW systems have an LCOE range of $0.13 to $0.19 while 5kW systems have a range of $0.09 to $0.14. As the system becomes larger the LCOE decreases as shown in tables 2 to 6.

Table 2: Central estimate: 6.11 per cent discount rate (ten-year average mortgage rate)

All figures in $/KWh	System Size							Retail prices	FIT
	1.5 kW	3 kW	4 kW	5 kW	6 kW	7 kW	10 kW		
Adelaide	$0.15	$0.11	$0.10	$0.09	$0.09	$0.09	$0.09	$0.42	$0.16
Brisbane	$0.18	$0.12	$0.12	$0.11	$0.10	$0.11	$0.11	$0.28	$0.16
Canberra	$0.17	$0.12	$0.12	$0.10	$0.09	$0.10	$0.09	$0.24	$0.13
Darwin	$0.28	$0.19	$0.16	$0.15	$0.14	$0.14	$0.11	$0.26	$0.24
Hobart	$0.21	$0.15	$0.15	$0.14	$0.14	$0.14	$0.14	$0.27	$0.09
Melbourne	$0.20	$0.15	$0.13	$0.12	$0.12	$0.13	$0.13	$0.28	$0.15
Sydney	$0.18	$0.12	$0.11	$0.10	$0.10	$0.11	$0.10	$0.29	$0.15
Perth	$0.14	$0.09	$0.09	$0.08	$0.08	$0.09	$0.09	$0.29	$0.07

Source: Australian Energy Council analysis, October 2019

Table 3: Low cost of capital sensitivity: 4.84 per cent discount rate (low current standard variable rate)

All figures in $/KWh	System Size							Retail prices	FIT
	1.5 kW	3 kW	4 kW	5 kW	6 kW	7 kW	10 kW		
Adelaide	$0.14	$0.10	$0.09	$0.09	$0.08	$0.09	$0.09	$0.42	$0.16
Brisbane	$0.17	$0.12	$0.11	$0.10	$0.10	$0.10	$0.10	$0.28	$0.16
Canberra	$0.16	$0.12	$0.11	$0.09	$0.09	$0.10	$0.09	$0.24	$0.13
Darwin	$0.26	$0.17	$0.15	$0.14	$0.13	$0.13	$0.11	$0.26	$0.24
Hobart	$0.20	$0.14	$0.14	$0.13	$0.13	$0.13	$0.13	$0.27	$0.09
Melbourne	$0.19	$0.14	$0.12	$0.12	$0.11	$0.12	$0.12	$0.28	$0.15
Sydney	$0.17	$0.12	$0.11	$0.10	$0.09	$0.10	$0.10	$0.29	$0.15
Perth	$0.13	$0.09	$0.08	$0.07	$0.07	$0.08	$0.09	$0.29	$0.07

Source: Australian Energy Council analysis, October 2019

Table 4: High cost of capital sensitivity: 13.32 per cent discount rate (indicative personal loan rate)

All figures in $/KWh	System Size							Retail prices	FIT
	1.5 kW	3 kW	4 kW	5 kW	6 kW	7 kW	10 kW		
Adelaide	$0.21	$0.14	$0.13	$0.12	$0.11	$0.12	$0.12	$0.42	$0.16
Brisbane	$0.25	$0.16	$0.15	$0.14	$0.13	$0.14	$0.14	$0.28	$0.16
Canberra	$0.23	$0.17	$0.16	$0.13	$0.12	$0.13	$0.12	$0.24	$0.13
Darwin	$0.40	$0.27	$0.23	$0.21	$0.19	$0.19	$0.15	$0.26	$0.24
Hobart	$0.29	$0.21	$0.20	$0.18	$0.18	$0.18	$0.19	$0.27	$0.09
Melbourne	$0.28	$0.20	$0.17	$0.16	$0.16	$0.17	$0.17	$0.28	$0.15
Sydney	$0.26	$0.16	$0.15	$0.13	$0.13	$0.14	$0.13	$0.29	$0.15
Perth	$0.19	$0.12	$0.11	$0.10	$0.09	$0.11	$0.12	$0.29	$0.07

Source: Australian Energy Council analysis, October 2019

Small and large business - Levelised Cost of Electricity

Tables 5 and 6 show the estimated cost of electricity production for commercial-size 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 5 and 6 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. For comparison, the average electricity bill for industrial businesses in 2014-15 was 10.72 c/kWh[v].

The Clean Energy Regulator (CER) sets out 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[vi].

Table 5: Central estimate: 6.81 per cent discount rate, ten-year average small business interest rate

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

Source: Australian Energy Council analysis, October 2019

Table 6: Central estimate: 4.74 per cent discount rate, ten-year average large business interest rate

All figures in $/KWh	System Size				
	10kW	30kW	50kW	70kW	100kW
Adelaide	$0.12	$0.11	$0.11	$0.11	$0.10
Brisbane	$0.12	$0.11	$0.11	$0.11	$0.10
Canberra	$0.10	$0.09	$0.10	$0.10	$0.10
Hobart	$0.15	$0.14	$0.14	$0.14	$0.12
Melbourne	$0.13	$0.12	$0.13	$0.12	$0.12
Sydney	$0.12	$0.12	$0.12	$0.12	$0.11
Perth	$0.12	$0.11	$0.11	$0.11	$0.10

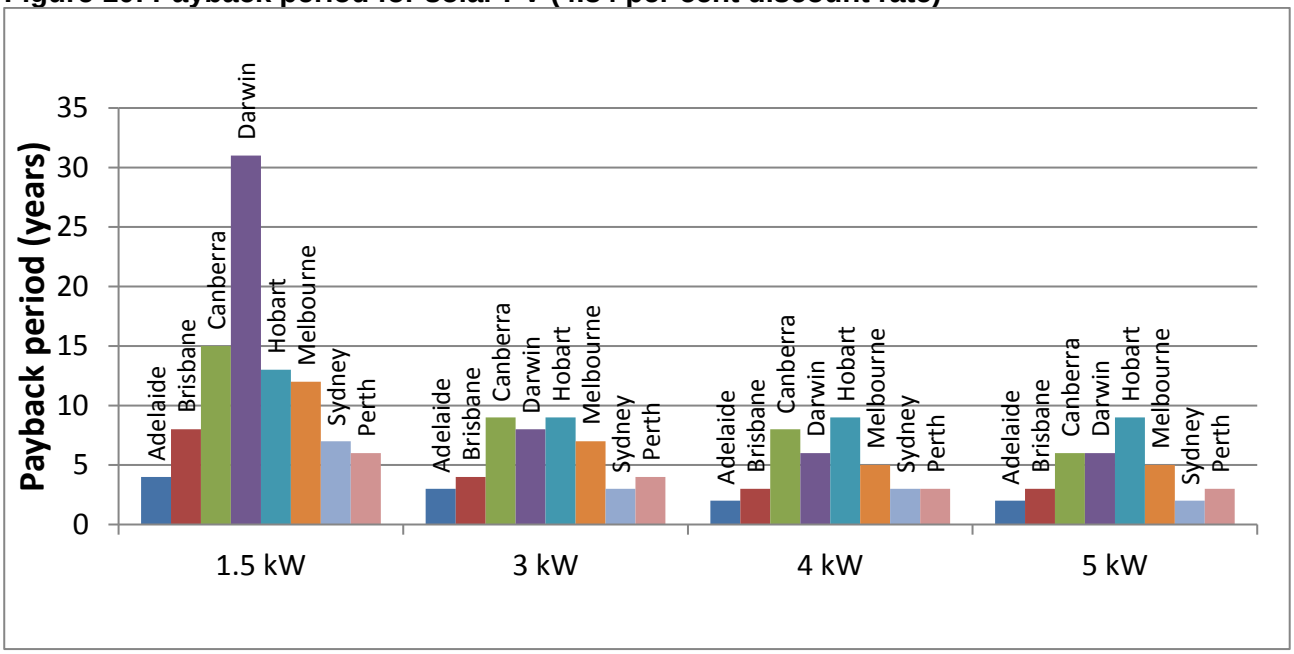
Source: Australian Energy Council analysis, October 2019

SECTION IV: 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 10 highlights the payback period for different system sizes across Australia. Note that electricity prices are increased at consumer price index (CPI) levels (currently 1.6 per cent, last updated June 2019 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, where the offered FiT is 23.7 c/kWh.

Figure 10: Payback period for solar PV (4.84 per cent discount rate)

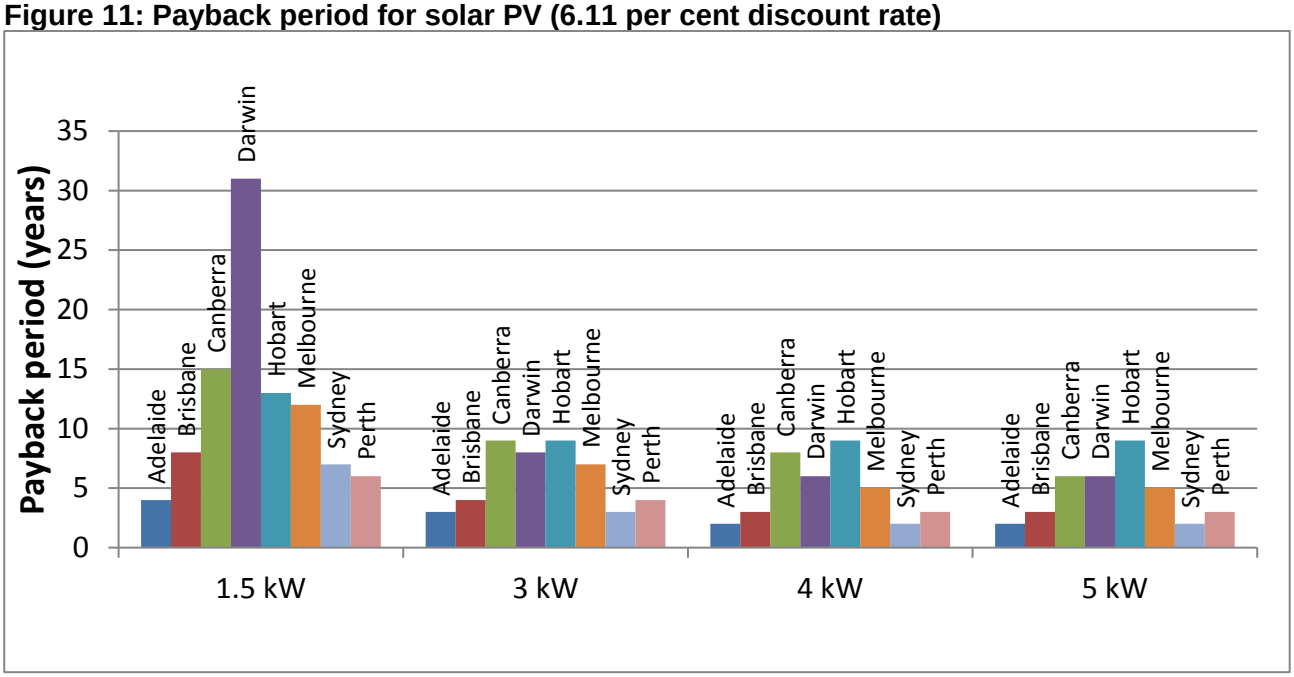


Source: Australian Energy Council analysis, October 2019

Figure 10 shows a bigger system unit will cost more initially with the range of FiTs offered from retailers, though the cost will be recovered faster than a 1.5 kW system, hence lowering the payback periods through the credits from the energy export back to the grid.

Figure 11 shows that the expected payback period for systems with a 6.11 per cent discount rate (10-year average home loan rate). Similarly, the trends in both figures 10 and 11 show that the bigger the system, the lower the number of years a customer will have to pay back the costs of installation.

Figure 11: Payback period for solar PV (6.11 per cent discount rate)



Source: Australian Energy Council analysis, October 2019

SECTION V: 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[vii], and the average sized solar panel in our calculations to be 200 W.

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 (6.11 per cent).

The low discount rate sensitivity is based on the minimum variable home loan mortgage rate offered by the Big Four banks (currently 4.84 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 (13.32 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 4.74 per cent and the small business discount rate is 6.81 per cent.

The discount rate also takes into account the Consumer Price Index (CPI); this has been given a constant value of 1.6 per cent (according to Australian Bureau of Statistics, June 2019).

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[viii]. 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

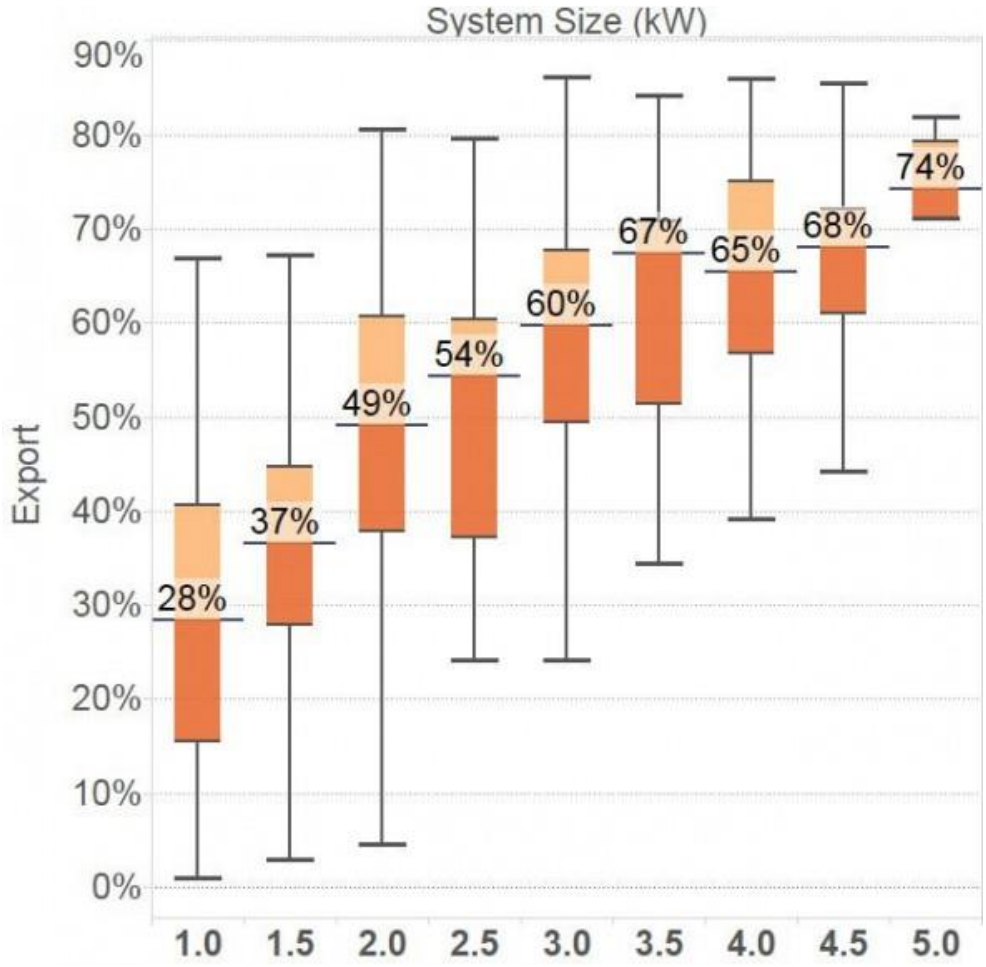
Avoided cost and FiT

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[ix] (see figure 10)

Figure 12: Export rate of residential solar PV at different system sizes



Source: Sunwiz analysis, 2015

[i] https://environmentvictoria.org.au/2018/08/20/solar-for-650000-victorian-homes-could-yours-be-one-of-them/?gclid=EAIaIQobChMI7ui_jemh5QIViJOPCh0tAwUuEAAYASAAEgK0nvD_BwE

[ii] https://www.solarquotes.com.au/blog/victoria-solar-rebate-boost-mb1192/

[iii] This is based on estimations of capacity, allowing for the lag in reported data

[iv] https://www.qld.gov.au/community/cost-of-living-support/concessions/energy-concessions/solar-battery-rebate/about-the-program

[v] BCA, "Impact of Green Energy Policies on Electricity Prices", June 2014

[vi] 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

[vii] 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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