SOLAR REPORT
JANUARY 2021

Australian Energy Council

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SECTION I: STATE OF SOLAR PV IN AUSTRALIA

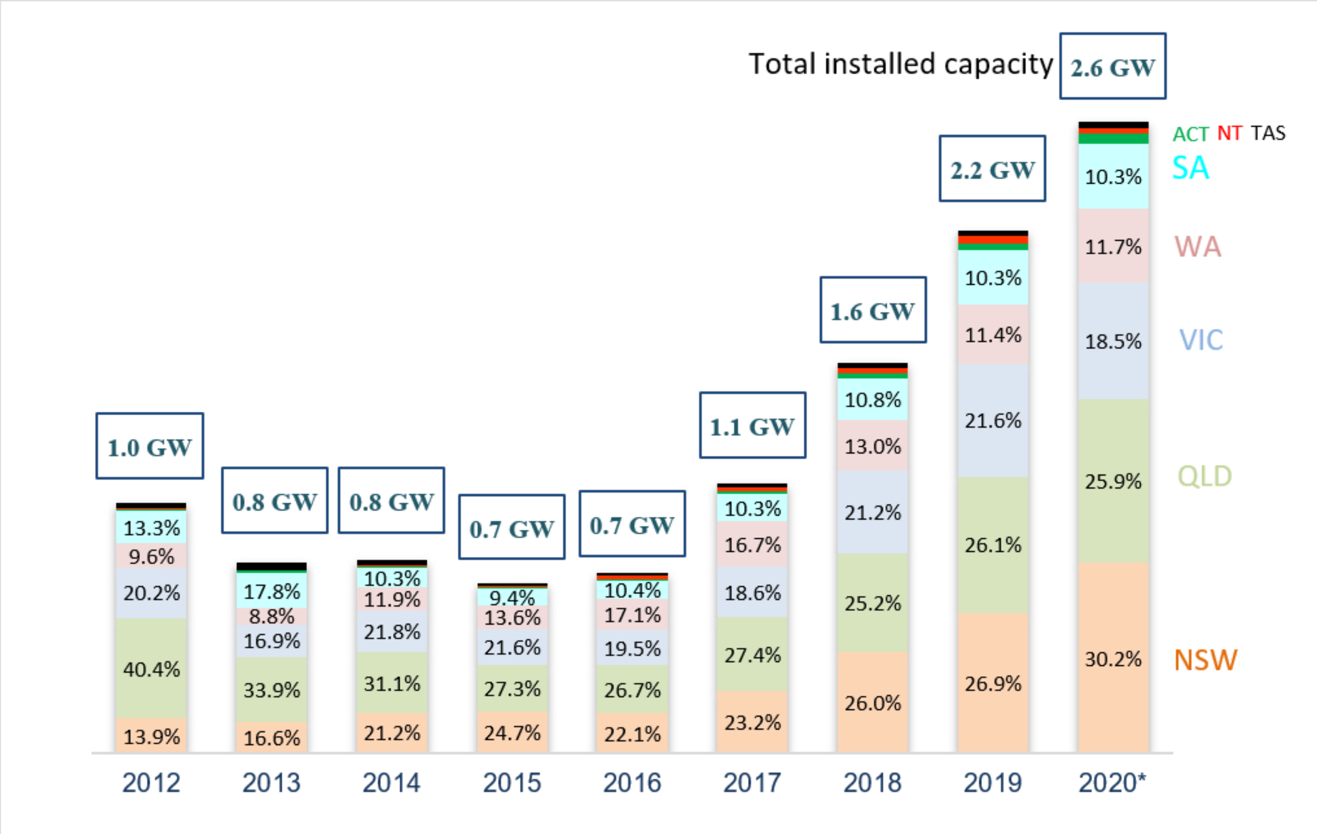
Latest data from the Clean Energy Regulator (CER) shows another record-breaking year for rooftop solar in Australia in 2020. Despite the global COVID-19 pandemic, Australia's rooftop PV market has been remarkably resilient with an additional 2.6 gigawatts (GW) and 333,978 installations added to the grid during the year – both the capacity and installations were around 18 per cent higher than 2019 (2.2GW and 284,000 installations). It is worth nothing that the final new installed rooftop capacity from 2020 is expected to be even higher than currently reported due to the fact that consumers have up to 12 months in which to register their installation.

By the end of 2020, an estimated 2.66 million Australian homes and businesses had a rooftop PV system.

Increasing consumer demand for greater energy independence during daylight hours is considered to be a factor behind the growth of rooftop PV, as more people work from home and seek to reduce their energy costs.

Figure 1 below shows annual grid-connected capacity as well as the share of installed capacity by state and territory since 2012. New South Wales, Queensland and Victoria remain the dominant states and they have accounted for three-quarters of newly installed capacity for three consecutive years since 2018.

Figure 1: Annual grid-connected capacity (GW) and share (%) of installed capacity by states since 2012 in Australia



** Due to the 12-month creation period, the figures will continue to change (increase)*

Source: Clean Energy Regulator data, Australian Energy Council analysis, January 2021

Table 1: Total installed capacity by states in 2019 and 2020 and percentage change

	NSW	QLD	VIC	WA	SA	ACT	NT	TAS
2019	582.7	564.9	467.9	246.6	223.1	30.1	28.8	20.5
2020*	790.1	678.2	483.4	305.7	270.5	40.9	24.0	23.7
% change	36%	20%	3%	24%	21%	36%	-17%	16%

** Due to the 12-month creation period, the figures will continue to change (increase)*

Source: Clean Energy Regulator data, Australian Energy Council analysis, January 2021

Despite Victoria accounting for more than 18.5 per cent of installed capacity nationally in 2020, it grew just over 3 per cent higher in 2020 compared to 2019 - with new installed capacity increasing from 468MW reported in 2019 to 483MW in 2020 (see table 1 above). Installations in Victoria were impacted by the state's Stage 4 COVID-19 restrictions which saw rooftop installations fall by 56 per cent in August and September compared to June and July (6,161 installations compared to 14,091 installations, see figure 2). The enforced restrictions in Melbourne and Mitchell Shire areas only allowed installers with Work Permits to attend up the three sites per week and solar systems could not be installed on occupied homes, except for new-builds or when the home was fully vacated. As a result, installations in Melbourne Metropolitan and Mitchell Shire area saw a low of only 490 installations (16 per cent of Victoria's total installation) in September 2020.

Table 2: Number of rooftop PV installations by regions from June to September 2020

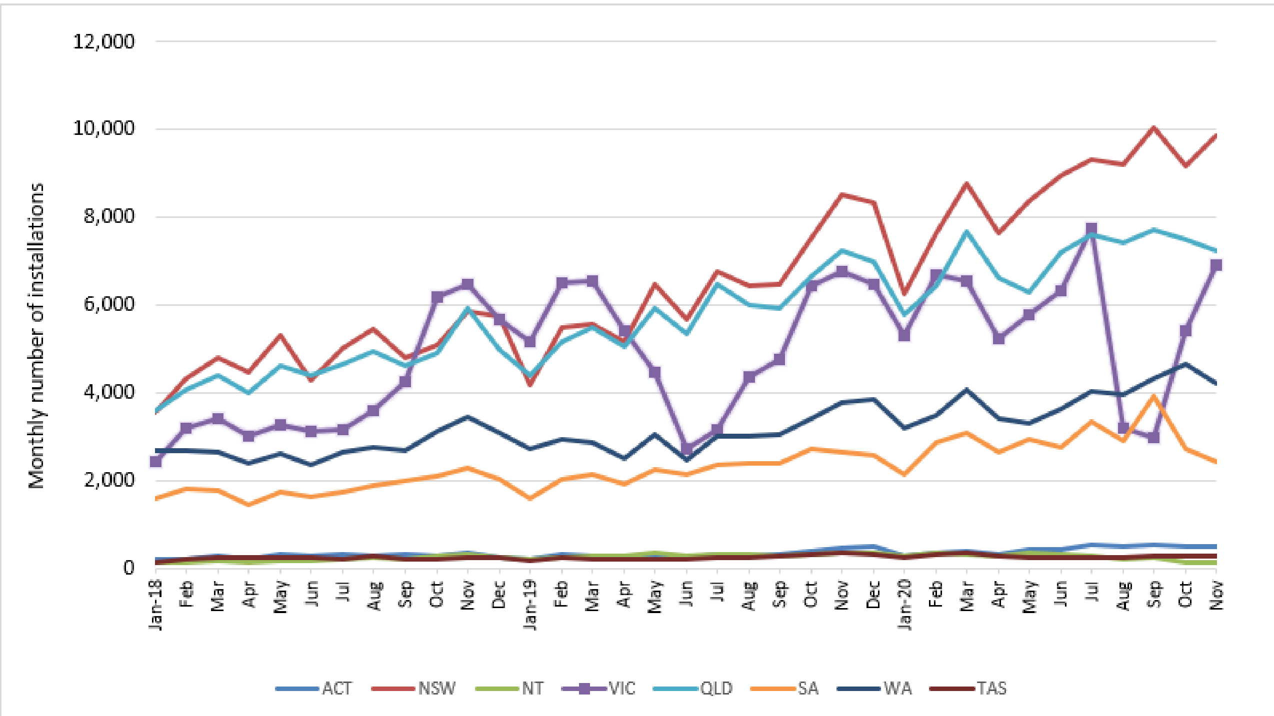
	June	July	August	September
Melbourne Metropolitan & Mitchell Shire	3606	4510	1074	490
Others Victoria regional areas	2723	3252	2100	2497
Total installations	**6329**	**7762**	**3174**	**2987**

Source: Clean Energy Regulator data, Australian Energy Council analysis, January 2021

The Northern Territory is the only region to record a decrease in solar PV installations, which were down 17 per cent (24MW compared to 28.8MW in 2019). The NT's installed capacity is relatively small and as such any change in its installed capacity does not have a significant impact on Australia's total overall installed capacity.

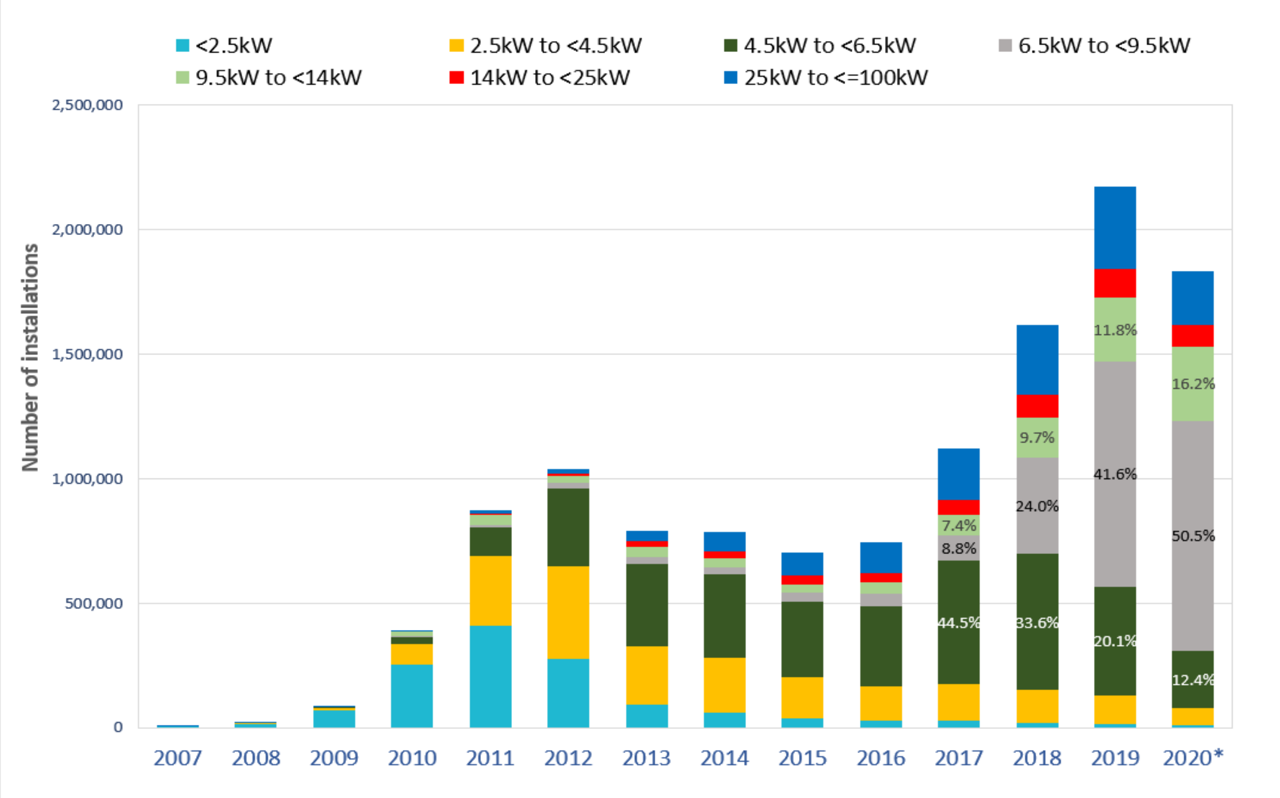
Overall, there was a noticeable dip in installations in April 2020 which marks the impact of COVID-19. Since then, the general trend has been continued growth. New South Wales reported the highest monthly installations, while Queensland took over the second spot from Victoria in the last quarter of 2020. Western Australia saw remarkable growth in 2020, recording a 24 per cent increase in new installed capacity (adding 60MW to its grid) while the number of new installations increased 22 per cent.

Figure 2: Monthly installations by states



Source: Clean Energy Regulator data, Australian Energy Council analysis, January 2021

Figure 3: Total small-scale solar installations by size in kW



Source: APVI data, Australian Energy Council analysis.
*Note that 2020 includes data from January to September 2020 only.

Though the data is incomplete for 2020, the most common installation size for household PV systems was between 6.5kW and 9.5kW, accounting for slightly more than half of total installations. Larger system sizes of 9.5kW to 14kW also accounted for a higher proportion of installations than reported for 2019.

Battery installations with rooftop solar

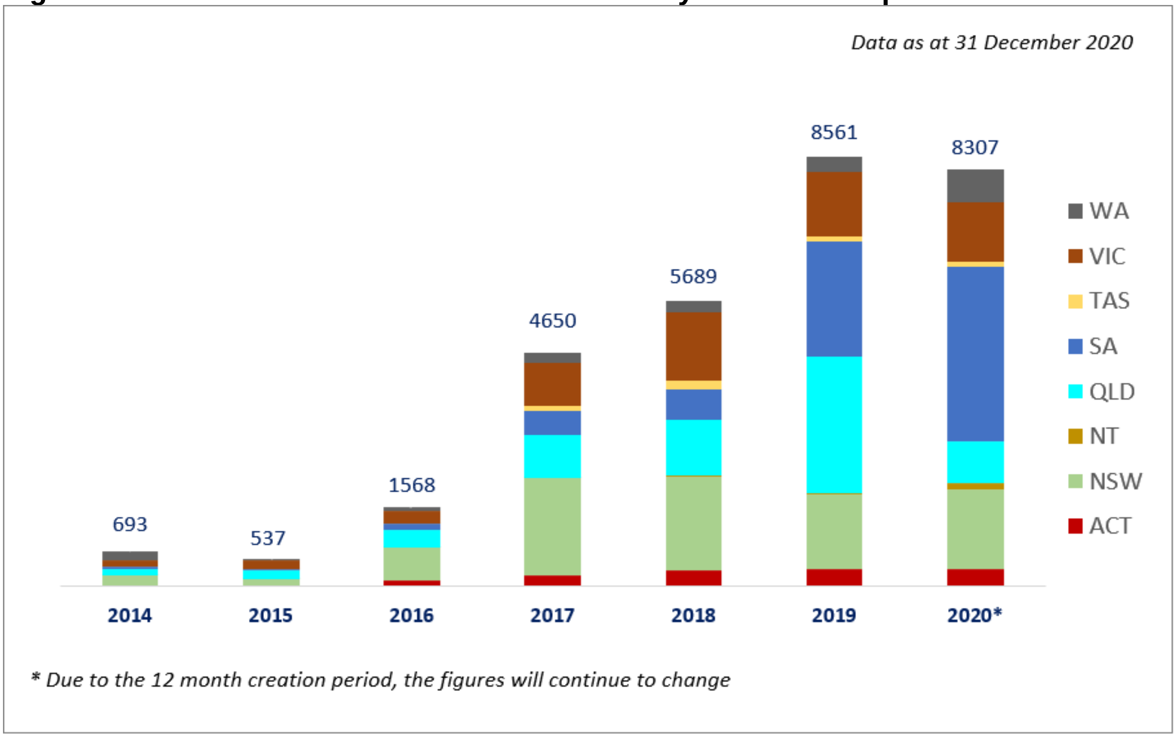
2020[1] also marked a strong year for home battery installations with rooftop solar PV systems. Queensland which led this trend in 2019 (32 per cent of market share for the year) was overtaken by South Australia in 2020 (42 per cent of market share for the year). That take-up of batteries is undoubtedly being helped along by state-based schemes. The Queensland Government's scheme, introduced in November 2018, lifted the state's level of adoption of battery-with-solar installations in 2019. Under that scheme Queenslanders could apply for interest-free loans of up to $10,000 and grants of $3000 to purchase batteries or combined solar-battery systems[i]. Queensland currently has no incentive rebate scheme for battery-with-solar installations. South Australia's Home Battery Scheme reduced its grant of up to $6,000 to $4,000 in April then to $3000 in September for a home

[1] Solar PV system owners have up to 12 months to report their data to the Clean Energy Regulator.

solar battery. The subsidy has been reduced over time due to increasing competition in the market and the continued reduction in the cost of home battery systems. As such, the state's Home Battery Scheme remains a generous scheme.

Current data shows that Queensland's solar-with-battery installation activity fell sharply (841 new installations in 2020 compared to 2711 installations in 2019, which is a 69 per cent drop). Western Australia recorded a more than doubling of battery-with-solar installations with 661 installations in 2020 compared to 316 installations in the previous year. Western Australia's latest buyback scheme Distributed Energy Buyback Scheme extends to exports from batteries and export-capable electrical vehicles with a rate of 10 cents per kWh between 3pm to 9pm or 3 c/kWh for other hours (increase from 7.135 c/kWh flat rate) from 6 November 2020.[ii]

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



Source: Clean Energy Regulator data, Australian Energy Council analysis, January 2021

Other state government schemes or rebates on battery storage installation with solar systems are:

- New South Wales: The Empowering Homes Program which will support installation for up to 300,000 households across the state with zero interest loans to purchase solar and battery systemsiii. At the end of February 2020, this program was extended to allow residents in the Hunter region.
- Victoria: The Solar Homes Program offers a rebate of up to $4,174 for a solar-battery system in 2020-21[iv].
- South Australia: As of September 2020, the Home Battery Scheme offers rebates of up to $3,000 for a home solar battery[v].

SECTION II: THE UNSUAL ELECTRICITY HABIT ON CHRISTMAS DAY

Christmas Day typically records the lowest electricity demand than almost any other day of the year. Low demand of electricity is mainly due to the fact that during the festive period schools, offices, shops and many factories are closed. Households are also less likely to be running appliances like washing machines or clothes dryers on Christmas day.

Last year's demand profile in the National Electricity Market (NEM) on Christmas Day was consistent with other years, recording the lowest daily total underlying demand of the year at 934GW. (Underlying demand includes all the electricity used by consumers, which can be sourced from the grid but also, increasingly, from other sources including consumers' rooftop PV and battery storage). At a state level, New South Wales and Victoria were the two states to record the lowest daily demand on Christmas Day. Victoria also set a new minimum demand record of 2,529MW at 1pm on 25 December 2020, 834MW lower than 2019's minimum. Other states' lowest daily electricity demand tends to fall in Autumn or Spring when the temperature is not extreme, and there are sunny days. Mild, clear sunny days is when solar output is high. Minimum demand also tends to occur on weekend days, so it not surprising to see the lowest demand days in the NEM in Queensland, South Australia and Tasmania occurred on a Sunday when there is less economic activity (6 September, 11 October, 22 March and 27 September).

Table 3: Lowest daily total underlying and operational demand across the NEM

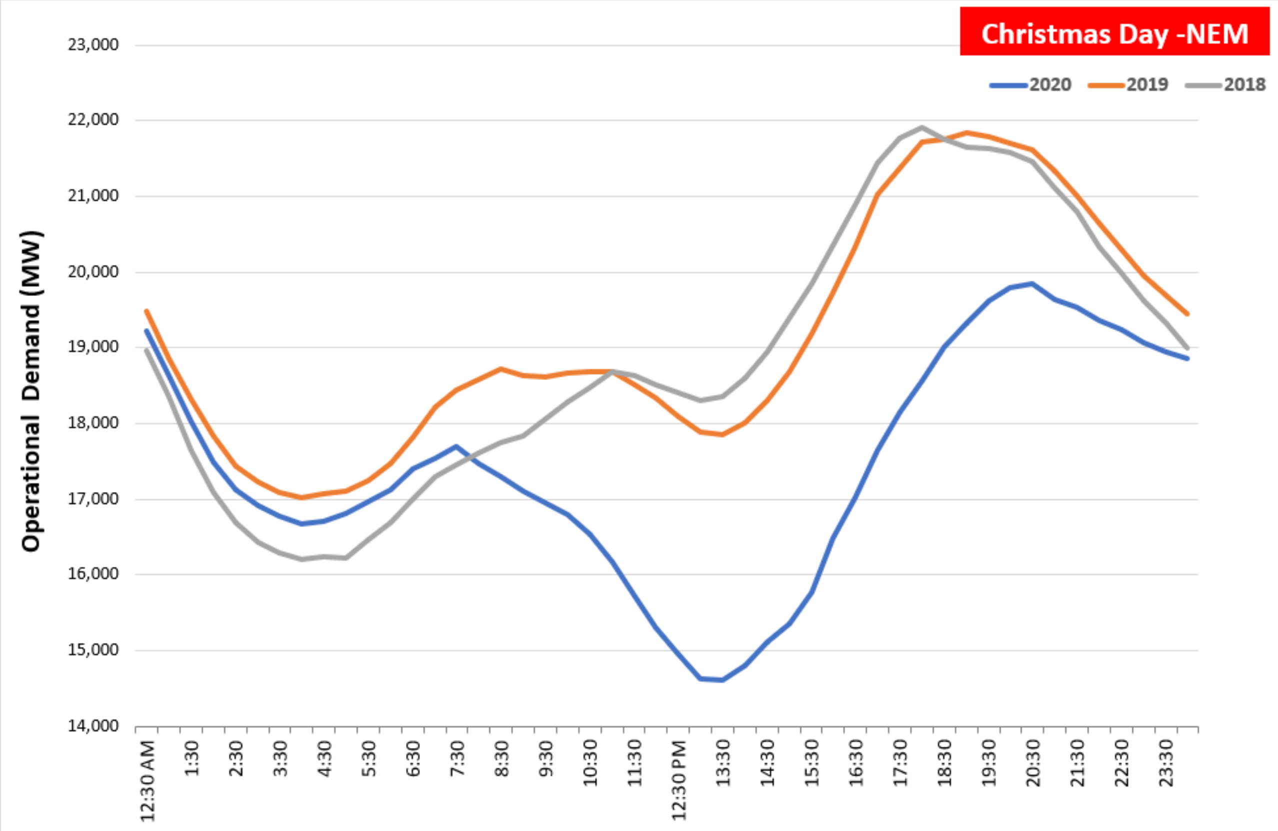
Year of 2020	NSW	QLD	SA	TAS	VIC	NEM
Underlying Demand (GW)	318	273	59	48	198	934
Lowest hit on (date)	25-Dec	6-Sep	11-Oct	22-Mar	25-Dec	25-Dec
Operational Demand (GW)	294	245	44	46	172	837
Lowest hit on (date)	25-Dec	27-Sep	11-Oct	22-Mar	25-Dec	25-Dec

Source: NEO Express, Australian Energy Council analysis, January 2021

Figures 5 and 6 show the operational and underlying demand profiles for the NEM on Christmas Day in the past three years. In these two charts, we focus on the trends.

The demand profile on Christmas Day 2020 is dramatically different to the previous two years. Figure 5 shows grid demand ramps up as usual in the early morning but is followed by a distinct drop from a much earlier hour (7:30am), touching the minimum operational demand of 14,617 MW between 1pm and 1:30 pm. The peak also happened much later in the evening at 8:30 pm. This reflects the impact of increased amounts of rooftop PV and favourable weather conditions across the states.

Figure 5: Operational demand profile in the NEM

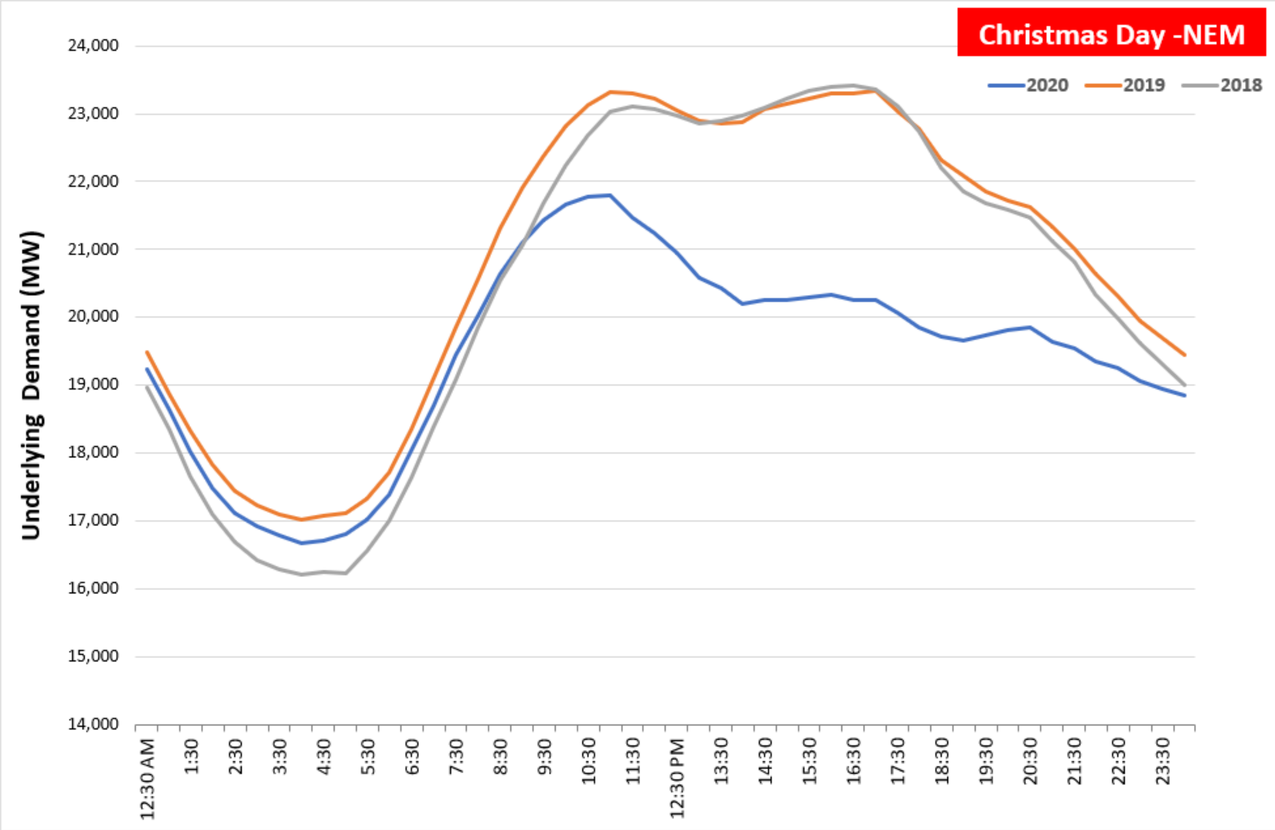


Source: NEO Express, Australian Energy Council analysis, January 2021

When we add residential rooftop generation to the grid demand, the underlying demand profile for 2020 does not have the double peaks seen on the previous two Christmas days (see figure 6). Usually, a peak occurs leading up to lunchtime as the main meal is prepared on the day. The second peak reflects increasing demand generally as households turn to air conditioners (given the usually hotter weather) as well as TVs later in the day. This year Sydney, Melbourne and Adelaide all had a cooler than average December and reported cooler temperatures on Christmas Day compared to the previous two years, according to Bureau of Meteorology data, which would likely impact the later peak demand.

The Australian Energy Market Operator has reported that mild weather reduced underlying demand, particularly in December. In NSW, Victoria and SA, day-to-day variation in summer temperatures can cause very large changes in daily electricity consumption and variations in daily peaks.

Figure 6: Underlying demand profile in the NEM



Source: NEO Express, Australian Energy Council analysis, January 2021

Electricity consumption on Christmas Day remains such a high proportion of annual average working day consumption in Queensland (92 per cent) and almost the same as daily average consumption of weekends (98 per cent). Victoria and South Australia were approximately 70 per cent and 68 per cent of average working day consumption during the year in respectively, while consumption on Christmas Day were 78 per cent and 76 per cent respectively of daily average consumption of weekends.

Table 4: Consumption on Christmas Day and its proportion to a workday average and a weekend average in 2020

	NSW	QLD	SA	TAS	VIC
Total grid consumption on Christmas Day (GWh)	149	141	23	25	86
Christmas Day / Workday average consumption (%)	78%	92%	68%	85%	70%
Christmas Day / Weekend average consumption (%)	83%	98%	76%	89%	78%

Source: NEO Express, Australian Energy Council analysis, January 2021

SECTION III: LEVELISED COST OF ENERGY

The Levelised Cost of Energy (LCOE) is the cost of energy per kilowatt hour (kWh) produced. When this is equal to or below the cost consumers pay directly to suppliers for electricity, this is called grid parity. Table 4 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 2020. 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 5, 6 and 7 show the LCOE across major cities at different discount rates.

Table 5: Central estimate: 5.62 per cent discount rate (ten-year average mortgage rate)

All figures in $/KWh	System Size						Retail prices	FIT
	3 kW	4 kW	5 kW	6 kW	7 kW	10 kW		
Adelaide	$0.12	$0.11	$0.10	$0.09	$0.10	$0.09	$0.33	$0.12
Brisbane	$0.12	$0.11	$0.10	$0.09	$0.10	$0.10	$0.22	$0.10
Canberra	$0.12	$0.11	$0.10	$0.10	$0.10	$0.10	$0.22	$0.10
Darwin	$0.16	$0.15	$0.14	$0.13	$0.13	$0.11	$0.26	$0.24
Hobart	$0.18	$0.16	$0.14	$0.14	$0.13	$0.14	$0.27	$0.09
Melbourne	$0.15	$0.14	$0.13	$0.12	$0.13	$0.12	$0.24	$0.12
Sydney	$0.12	$0.11	$0.10	$0.10	$0.10	$0.10	$0.27	$0.12
Perth	$0.10	$0.09	$0.08	$0.08	$0.09	$0.10	$0.29	$0.07

Source: Australian Energy Council analysis, January 2021

Table 6: Low cost of capital sensitivity: 3.7 per cent discount rate (low current standard variable rate)

All figures in $/KWh	System Size						Retail prices	FIT
	3 kW	4 kW	5 kW	6 kW	7 kW	10 kW		
Adelaide	$0.11	$0.10	$0.09	$0.09	$0.09	$0.09	$0.33	$0.12
Brisbane	$0.11	$0.10	$0.09	$0.09	$0.09	$0.10	$0.22	$0.10
Canberra	$0.11	$0.10	$0.09	$0.09	$0.09	$0.09	$0.22	$0.10
Darwin	$0.14	$0.14	$0.13	$0.12	$0.12	$0.11	$0.26	$0.24
Hobart	$0.16	$0.14	$0.13	$0.13	$0.12	$0.13	$0.27	$0.09
Melbourne	$0.14	$0.12	$0.12	$0.11	$0.12	$0.11	$0.24	$0.12
Sydney	$0.11	$0.10	$0.10	$0.09	$0.10	$0.09	$0.27	$0.12
Perth	$0.09	$0.08	$0.08	$0.08	$0.08	$0.09	$0.29	$0.07

Source: Australian Energy Council analysis, January 2021

Table 7: High cost of capital sensitivity: 13.15 per cent discount rate (indicative personal loan rate)

All figures in $/KWh	System Size						Retail prices	FIT
	3 kW	4 kW	5 kW	6 kW	7 kW	10 kW		
Adelaide	$0.17	$0.15	$0.13	$0.12	$0.13	$0.12	$0.33	$0.12
Brisbane	$0.16	$0.15	$0.14	$0.12	$0.13	$0.14	$0.22	$0.10
Canberra	$0.16	$0.15	$0.13	$0.13	$0.13	$0.13	$0.22	$0.10
Darwin	$0.23	$0.21	$0.19	$0.19	$0.18	$0.16	$0.26	$0.24
Hobart	$0.25	$0.22	$0.19	$0.19	$0.18	$0.18	$0.27	$0.09
Melbourne	$0.21	$0.18	$0.17	$0.16	$0.17	$0.17	$0.24	$0.12
Sydney	$0.16	$0.15	$0.14	$0.13	$0.13	$0.13	$0.27	$0.12
Perth	$0.13	$0.12	$0.11	$0.10	$0.11	$0.13	$0.29	$0.07

Source: Australian Energy Council analysis, January 2021

Small and Large business - Levelised Cost of Electricity

Tables 8 and 9 show the estimated cost of electricity production for commercial-sized solar systems. As businesses look to reduce overhead costs, installation of larger-scale solar systems 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 8 and 9 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[vi].

Table 8: Central estimate: 5.51 per cent discount rate, ten-year average small business interest rate

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

Source: Australian Energy Council analysis, January 2021

Table 9: Central estimate: 4.78 per cent discount rate, ten-year average large business interest rate

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

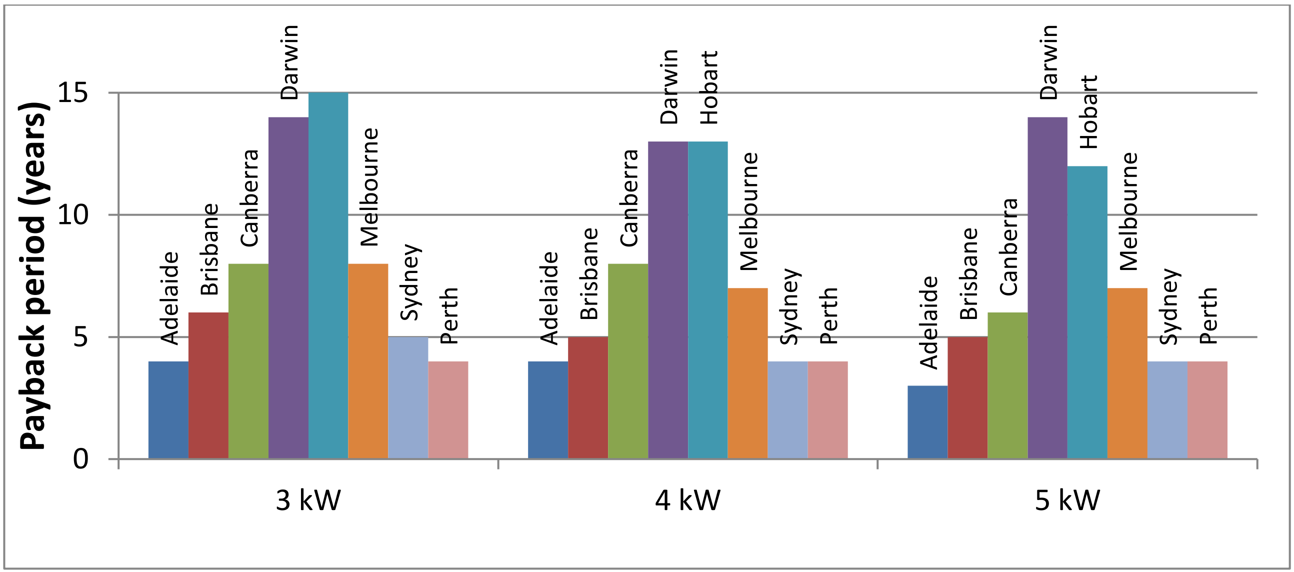
Source: Australian Energy Council analysis, January 2021

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 7 highlights the payback period for different system sizes across Australia. Note that electricity prices are subject to change with Consumer Price Index (CPI) levels (currently 0.9 per cent, last updated December 2020) and thus will affect the payback period. Low payback periods across many cities (Adelaide, Brisbane, Sydney and Perth) further highlights there is a greater incentive for customers to install solar PV in these cities.

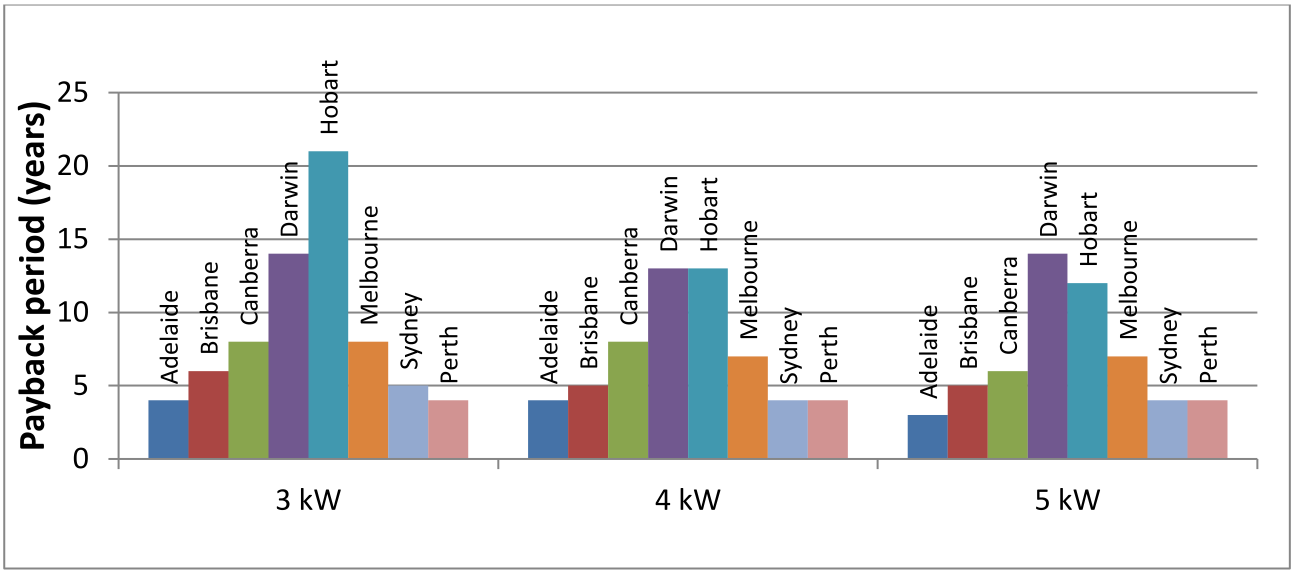
Figure 7: Payback period for solar PV (3.7 per cent discount rate)



Source: Australian Energy Council analysis, January 2021

Figure 8 shows the expected payback period for systems with a 5.62 per cent discount rate (10-year average home loan rate). Higher interest rates increase the payback periods, especially in Darwin and Hobart cities when their installation costs alone are also the two most expensive.

Figure 8: Payback period for solar PV (5.62 per cent discount rate)



Source: Australian Energy Council analysis, January 2021

SECTION V: METHODOLOGY APPENDIX

1. Solar installations methodology

Analysis from the Clean Energy Regulator's (CER) monthly 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 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 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 (5.62 per cent). The low discount rate sensitivity is based on the minimum variable home loan mortgage rate offered by the Big Four banks (currently 3.7 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 (13.15 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 5.51 per cent and the small business discount rate is 4.78 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[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 per cent 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. The 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 $(1+ \text{CPI})^t$ x consumption / 100) + (Export x FiT)

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

t = years

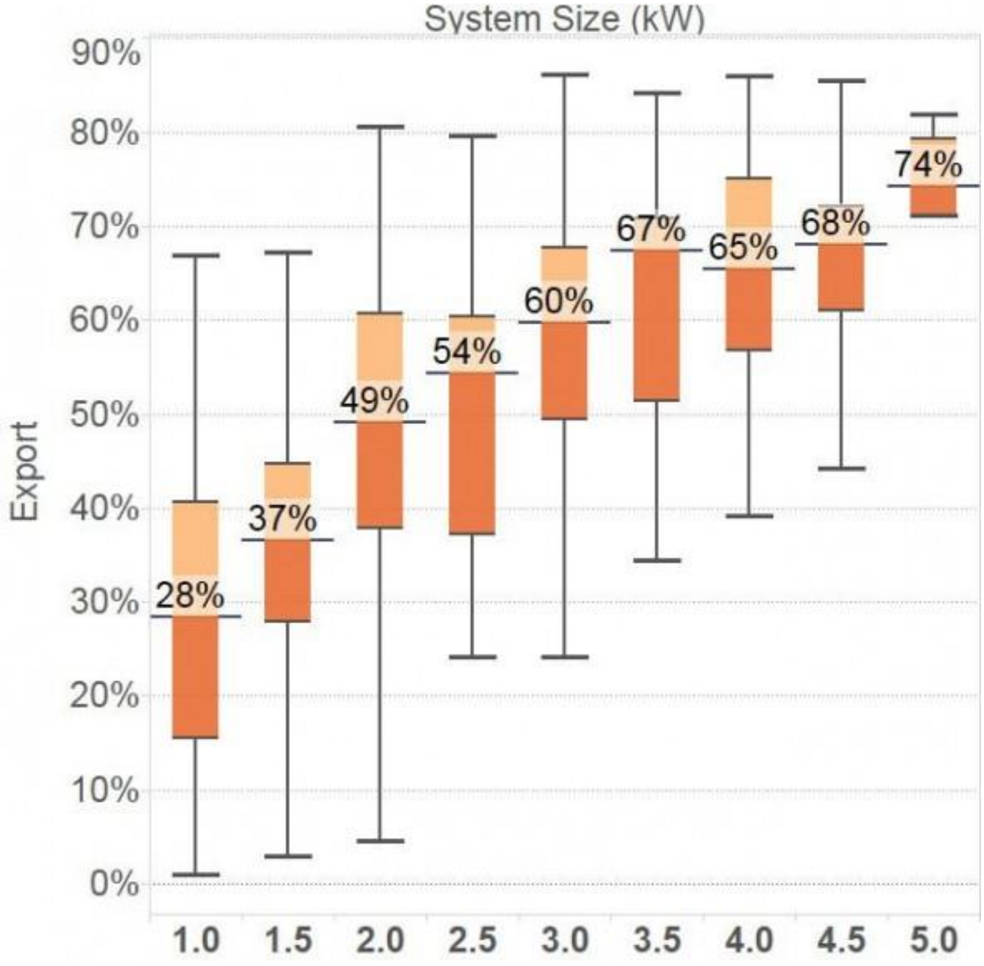
Avoided cost and FiT

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

[ii] https://www.wa.gov.au/organisation/energy-policy-wa/household-renewable-energy-overview

[iii] https://energy.nsw.gov.au/renewables/clean-energy-initiatives/empowering-homes

[iv] https://www.premier.vic.gov.au/helping-victorians-pay-their-power-bills

[v] https://homebatteryscheme.sa.gov.au/home-battery-scheme-subsidy-changes

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

[vii] estimate based on, RenewEconomy, 26 August 2013, http://reneweconomy.com.au/2013/hidden-cost-of-rooftop-solar-who-should-pay-for-maintenance-99200

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

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