SOLAR REPORT

JANUARY 2022

Australian Energy Council

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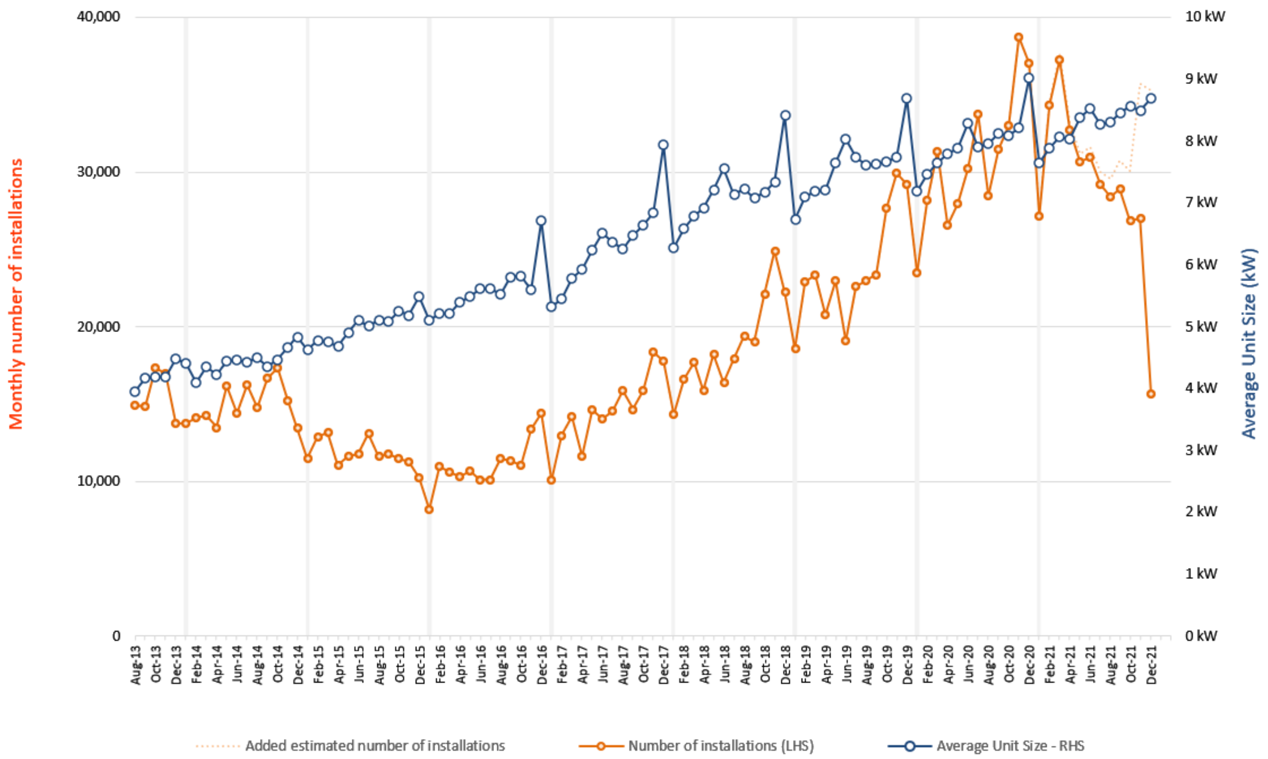
SECTION I: STATE OF SOLAR PV IN AUSTRALIA

Last year was another record-breaking year for rooftop solar in Australia. According to the latest data from the Clean Energy Regulator (CER) an estimated 3.04 million Australian homes and businesses had a rooftop PV system by the end of 2021.

Despite the global impacts of the COVID-19 pandemic, the nation's rooftop PV market was remarkably resilient with an additional 2.88 gigawatts (GW) and 349,122 installations added to the grid during 2021.

Figure 1 shows the number of monthly installations with the average monthly system size installed across Australia. New installed rooftop capacity is expected to be higher than currently reported[1], therefore it is anticipated that the final number of new installations will increase to around 386,798 small-scale solar PV systems, with a total capacity of 3,218MW. This is a 4.5 per cent increase in installations, and 8.6 per cent rise in total capacity compared to the same period last year.

Figure 1: Monthly installations and average system size July 2013 – December 2021



Source: Clean Energy Regulator, Australian Photovoltaic Institute, AEC analysis, January 2022

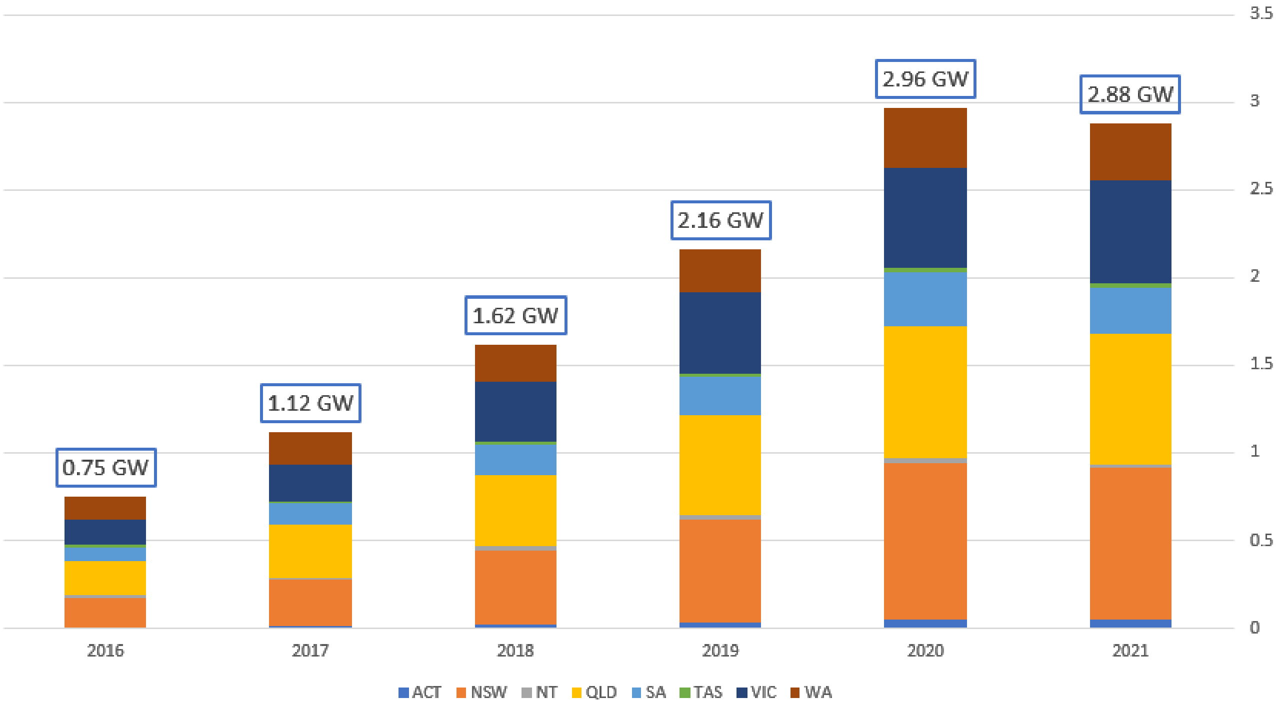
[1] Solar PV system owners have up to 12 months to report their data to the Clean Energy Regulator.

Increasing consumer demand for greater energy independence during daylight hours is a key factor behind this growth of rooftop PV, and that has been reinforced over the past two years with more people working from home and seeking to reduce their energy costs.

State capacity and installations

Shown in Figure 2, New South Wales, Queensland, and Victoria continue to be the dominant states for annual grid-connected capacity, accounting for three-quarters of newly installed capacity for three consecutive years since 2019.

Figure 2: Annual grid-connected capacity (GW) of installed capacity by states since 2016 in Australia



Source: Clean Energy Regulator data, Australian Energy Council analysis, January 2022. Note: Due to the 12-month creation period, the figures will continue to change (increase)

Table 1: Total installed capacity by states in 2020 and 2021 and percentage change

YEAR	ACT	NSW	NT	QLD	SA	TAS	VIC	WA
2020	46.51	895.43	27.74	753.27	303.68	26.78	574.31	336.01
2021	50.24	869.25	14.77	744.17	261.24	29.60	587.56	323.09
% Change	8%	-3%	-47%	-1%	-14%	11%	2%	-4%

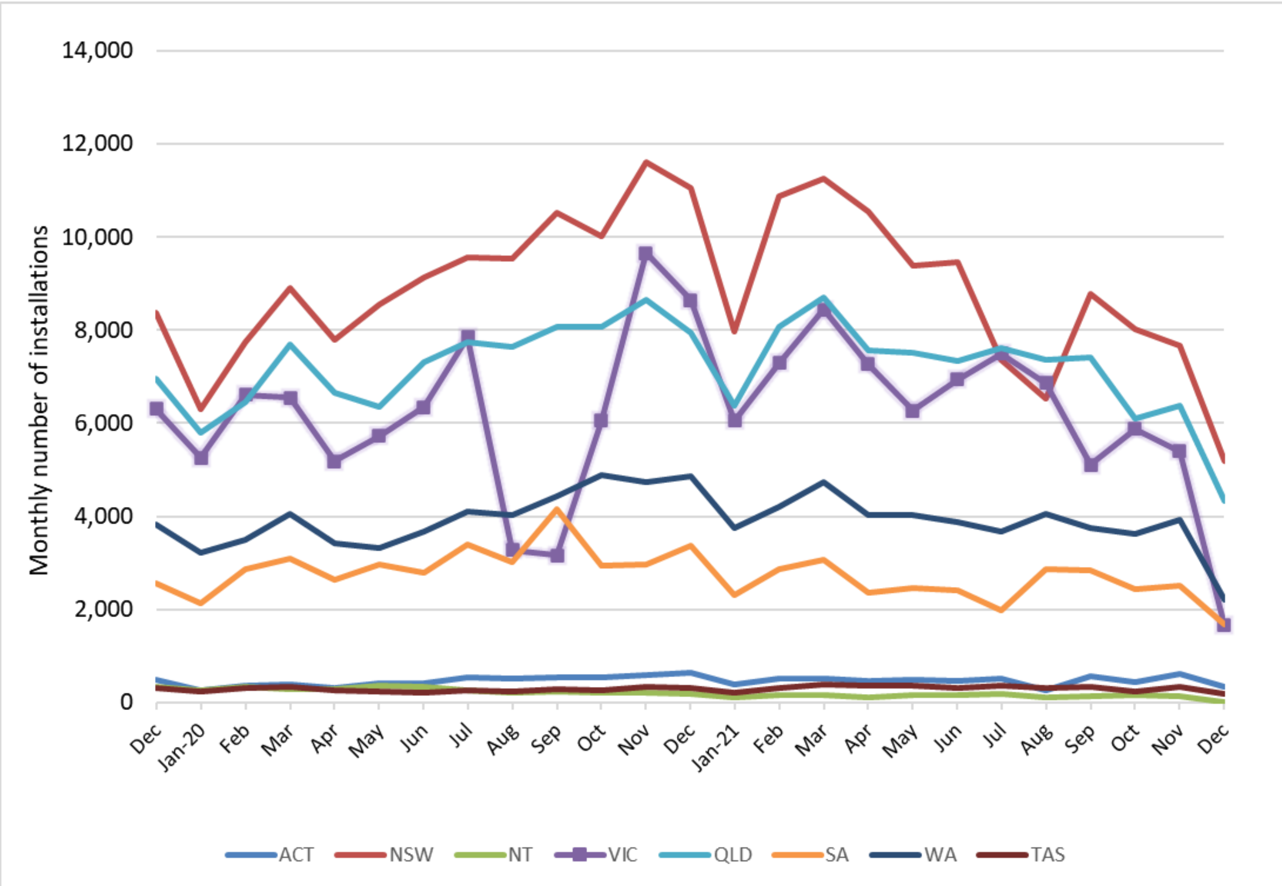
Source: Clean Energy Regulator data, Australian Energy Council analysis, January 2022. Note: Due to the 12-month creation period, the figures will continue to change (increase)

Despite Victoria accounting for more than 20 per cent of installed capacity nationally in 2021, it grew just over 2.3 per cent in 2021 compared to 2020 - with new installed capacity increasing from 574MW to 587MW (Table 1). Only the ACT and Tasmania saw a significant increase in installations, while New South Wales, Victoria and Queensland remained relatively steady (+/-3 per cent) compared to 2020.

South Australia and Western Australia experienced declines compared to 2020, while the Northern Territory was the only region to record a strong decline in solar PV installations - down 47 per cent (14.8MW compared to 27.7MW in 2020). The Northern Territory's installed capacity is relatively small, therefore any change can have a substantial impact while its installed capacity does not have a significant impact on Australia's total overall installed capacity.

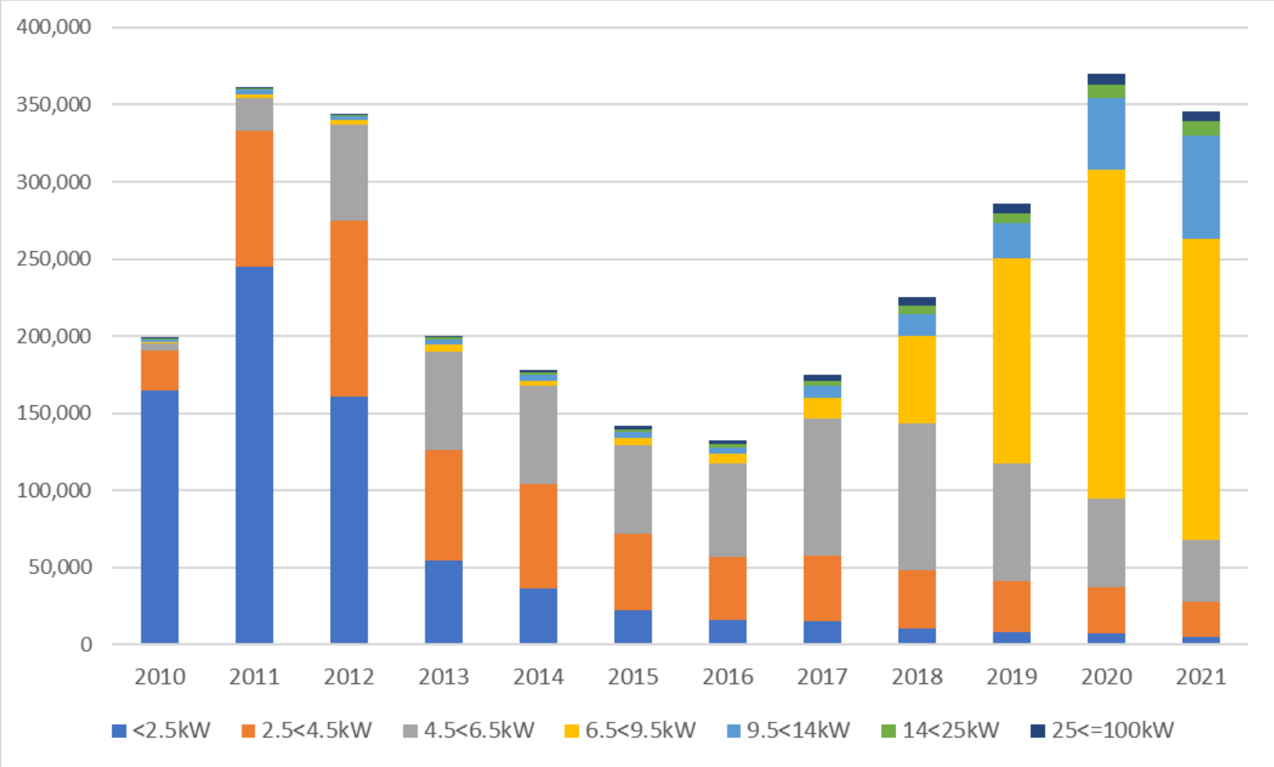
While the data is incomplete for 2021 due to the reporting time lag, the most common installation size for household PV systems was between 6.5kW and 9.5kW, accounting for slightly more than half of total installations. Larger system sizes of 9.5kW to 14kW also accounted for a higher proportion of installations than reported in 2020, this rise may have been aided by incentives for larger system sizes such as the Victorian Government's Solar For Business program.

Figure 3: Monthly installations by states



Source: Clean Energy Regulator data, Australian Energy Council analysis, January 2022

Figure 4: Total small-scale solar installations by size in kW



Source: APVI data, Australian Energy Council analysis. Note: Due to the 12-month creation period, the 2021 figures will continue to change (increase)

Battery installations with rooftop solar

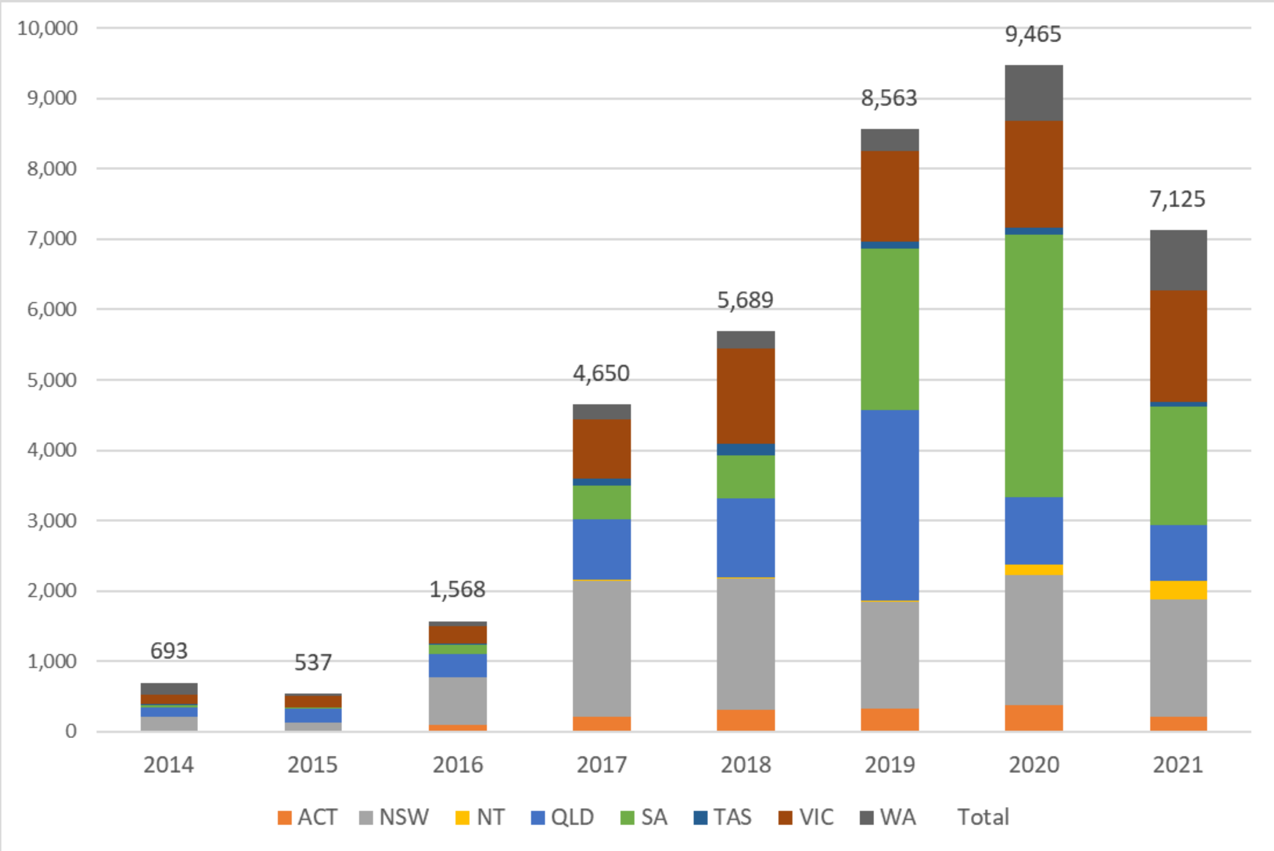
Last year also marked a strong period for residential battery-with-solar installations, with uptake helped by state-based schemes (Figure 5).

Current data shows South Australia's solar-with-battery installation activity experienced a 55 per cent drop during 2021 compared to 2020 (1,676 new installations in 2021 versus 3,728 installations in 2020). 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 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 of January 2022, the Home Battery Scheme offers rebates of up to $2,000 for a home solar battery[i].

The Northern Territory nearly doubled battery-with-solar installations with 264 installations in 2021 compared to 148 installations in the previous year. In the Northern Territory, eligible homeowners and businesses can access a grant of $450 per kilowatt hour of useable battery system capacity, up to a maximum grant of $6,000[ii].

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[iii]. Queensland currently has no incentive rebate scheme for battery-with-solar installations.

Figure 5: Number of solar with concurrent battery installations per state since 2014



Source: Clean Energy Regulator data, Australian Energy Council analysis, January 2022. Note: Due to the 12-month creation period, the 2021 figures will continue to change (increase)

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

- New South Wales: The Empowering Homes solar battery loan offer is a state government initiative designed to help eligible homeowners cut their power bills by transitioning to clean, renewable energy. There are two interest-free loans available:
    - up to $14,000 towards a solar PV and battery system (repayable over a range of terms up to 8 years)
    - up to $9000 towards retrofitting a battery system to an existing solar PV system (repayable over a range of terms up to 10 years)[iii]
- Victoria: The Solar battery rebate offers a rebate of up to $3,500 for a solar-battery system in 2020-21[iv].

SECTION II: MINIMUM DEMAND

While COVID-19 had little impact on the uptake of residential solar PV, the pandemic coupled with milder weather and increased rooftop PV supply impacted electricity demand with decreases shown across the National Electricity Market (NEM) in the second half of 2021.

All states, except Tasmania, recorded the lowest daily demand during the fourth quarter 2021, largely due to increased distributed PV output, according to the Australian Energy Market Operator (AEMO). AEMO also reported new minimum operational demand records were set in New South Wales, Victoria, and South Australia. Operational demand is met from the grid, while underlying demand refers to all electricity consumed so can be sourced from behind-the-meter solar, battery storage, embedded networks as well as the grid.

Across the NEM a new low of 12,936MW was recorded on Sunday 17 October. This was 1257MW below the previous low mark (14,193MW in Q3 2021) while the NEM-wide minimum demand record was reduced on three separate days in the fourth quarter 2021, and rooftop solar contributed 40 per cent of underlying demand when the new record was set[iv].

NSW operational demand was down 211MW on the previous minimum set in 1999, while Victoria was down 196 MW on the previous record set in Q4 2020, and South Australia was down 132 MW on its previous record from Q3 2021.

New South Wales' new minimum demand record of 4,425 MW was set on the same day as the NEM record. Victoria's new minimum demand record of 2,333MW occurred at 1pm on Sunday 28 November 2021. On Sunday 21 November, SA set its new minimum demand record of 104 MW also at 1pm - distributed PV provided 1,220MW or 92 per cent of the underlying demand.

Increased solar as well as mild sunny days and weekend demand are key factors. Distributed PV (along with less large loads) also helped produce a record minimum operational demand in Western Australia's Wholesale Electricity Market of 761MW reported on Sunday 14 November 2021, 12 per cent lower than the previous quarterly record set in September last year – rooftop solar was estimated to meet 67 per cent of underlying demand when the record was set.

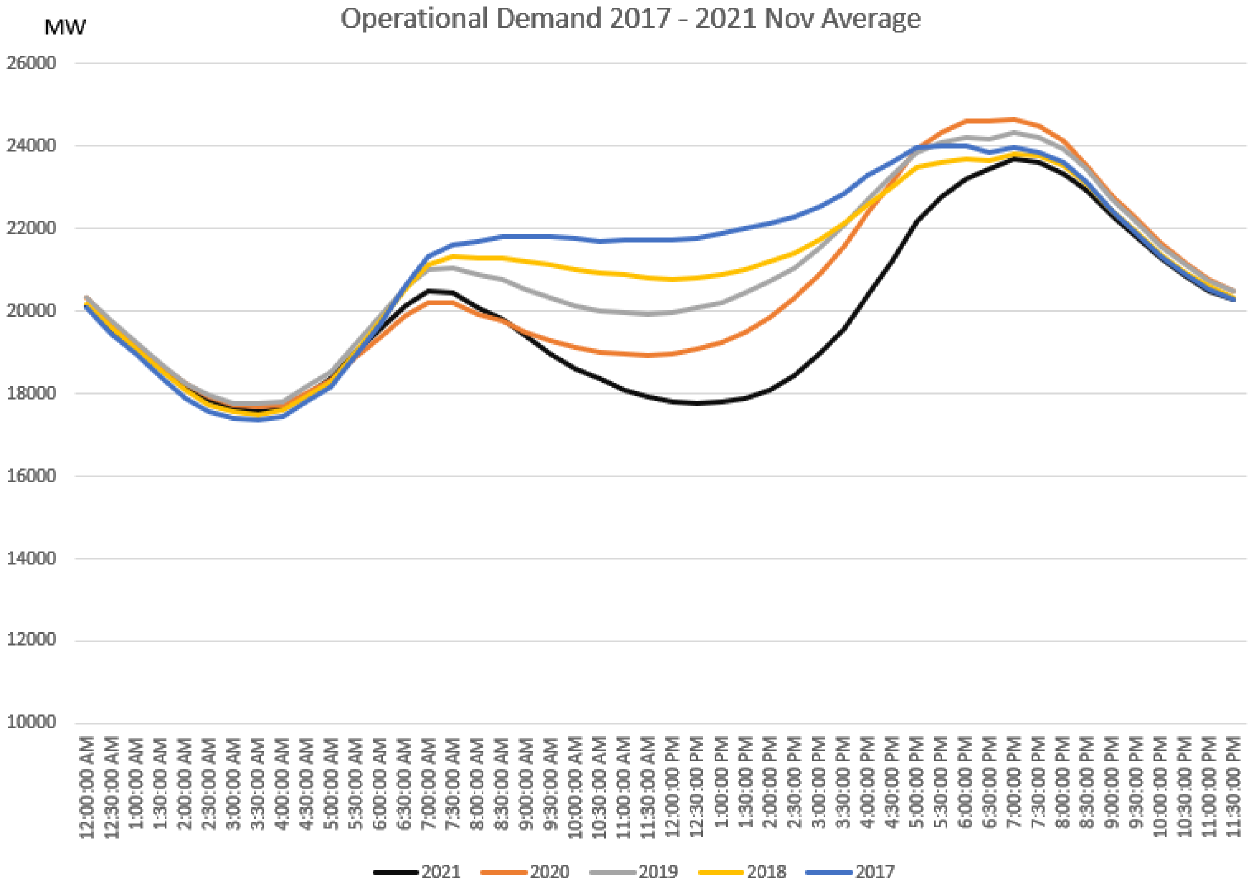
Table 2: Lowest daily total underlying and operational demand across the NEM

Year of 2021	NSW	QLD	SA	TAS	VIC	NEM
Operational Demand (GW)	331	251	44	50	174	852
Lowest hit on date	17-Oct	03-Oct	27-Nov	07-Feb	27-Dec	28-Dec

Source: NEO Express, Australian Energy Council analysis, January 2022

In New South Wales, Victoria and South Australia, day-to-day variation in summer temperatures can cause large changes in daily electricity consumption and variations in daily peaks. November's average demand profile is illustrated in Figure 6, reflecting the impact of increased rooftop PV coupled with favourable weather conditions across the NEM states during 2021.

Figure 6: Operational demand profile in the NEM, November half-hourly average



Source: NEO Express, Australian Energy Council analysis, January 2022

The market operator notes the increased uptake of solar PV is also contributing to increases in the daily operational demand swings between the minimum and maximum demand levels. As renewable energy further grows and coal plants retire, grid demand in the middle of the day is expected to continue to shrink further, moving to later in the evening once the sun sets. This demand peak, and subsequent quick drop, requires careful planning to ensure supply risks are managed. The shifting demand requires firm generation to start up and shut down more often, and in a very short space of time to meet the population's energy needs.

Christmas holidays

When we add residential rooftop generation to the grid demand, the underlying demand profile for 2021 does not have the double peaks seen on the previous Christmas holidays (2018, 2019). Christmas day typically sees a peak leading up to lunchtime as the main meal is prepared. Later in the day, a second peak reflects increasing demand generally as households turn to air conditioners (given the usually hotter weather) as well as TVs.

While in previous years minimum demand occurred on Christmas day, in 2021, minimum demand occurred on 27 December in Victoria and 28 December NEM-wide. Last year Sydney, Melbourne, and Adelaide had a cooler than average December and reported cooler temperatures, which would likely impact the later peak demand. The Bureau of Meteorology declared a La Niña for eastern and northern Australia over summer, therefore the season is expected to have less extremely hot days.

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 2021. 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 3, 4 and 5 show the LCOE across major cities at different discount rates.

Table 3: Central estimate: 5.24 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	$0.10	$0.10	$0.09	$0.09	$0.09	$0.09	$0.31	$0.15
Brisbane	$0.11	$0.10	$0.09	$0.09	$0.09	$0.09	$0.22	$0.15
Canberra	$0.10	$0.09	$0.09	$0.08	$0.09	$0.08	$0.23	$0.11
Darwin	$0.14	$0.13	$0.12	$0.12	$0.11	$0.11	$0.26	$0.24
Hobart	$0.15	$0.14	$0.13	$0.12	$0.12	$0.12	$0.27	$0.09
Melbourne	$0.13	$0.11	$0.11	$0.10	$0.10	$0.10	$0.22	$0.10
Sydney	$0.12	$0.10	$0.10	$0.10	$0.09	$0.09	$0.21	$0.15
Perth	$0.09	$0.08	$0.08	$0.08	$0.08	$0.09	$0.29	$0.07

Source: Australian Energy Council analysis, January 2022

Table 4: Low cost of capital sensitivity: 3.45 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	$0.10	$0.09	$0.08	$0.08	$0.08	$0.08	$0.31	$0.15
Brisbane	$0.10	$0.09	$0.09	$0.08	$0.09	$0.08	$0.22	$0.15
Canberra	$0.09	$0.09	$0.08	$0.08	$0.08	$0.08	$0.23	$0.11
Darwin	$0.13	$0.12	$0.11	$0.11	$0.10	$0.10	$0.26	$0.24
Hobart	$0.14	$0.13	$0.12	$0.11	$0.11	$0.11	$0.27	$0.09
Melbourne	$0.12	$0.11	$0.10	$0.09	$0.09	$0.09	$0.22	$0.10
Sydney	$0.11	$0.10	$0.09	$0.09	$0.09	$0.08	$0.21	$0.15
Perth	$0.08	$0.08	$0.07	$0.07	$0.08	$0.08	$0.29	$0.07

Source: Australian Energy Council analysis, January 2022

Table 5: High cost of capital sensitivity: 9.88 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	$0.13	$0.12	$0.11	$0.10	$0.10	$0.10	$0.31	$0.15
Brisbane	$0.14	$0.12	$0.11	$0.10	$0.11	$0.11	$0.22	$0.15
Canberra	$0.12	$0.11	$0.10	$0.10	$0.10	$0.09	$0.23	$0.11
Darwin	$0.17	$0.16	$0.15	$0.14	$0.14	$0.13	$0.26	$0.24
Hobart	$0.19	$0.17	$0.16	$0.15	$0.14	$0.14	$0.27	$0.09
Melbourne	$0.16	$0.14	$0.13	$0.12	$0.12	$0.12	$0.22	$0.10
Sydney	$0.14	$0.13	$0.11	$0.11	$0.11	$0.11	$0.21	$0.15
Perth	$0.11	$0.10	$0.09	$0.09	$0.10	$0.10	$0.29	$0.07

Source: Australian Energy Council analysis, January 2022

Small and Large business - Levelised Cost of Electricity

Tables 6 and 7 show the estimated cost of electricity production for commercial-sized solar systems. As businesses look to reduce overhead costs, installation of 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[v].

Table 6: Central estimate: 4.85 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	$0.10	$0.10	$0.10	$0.10
Brisbane	$0.11	$0.10	$0.10	$0.10	$0.09
Canberra	$0.10	$0.10	$0.10	$0.10	$0.10
Hobart	$0.14	$0.13	$0.13	$0.12	$0.11
Melbourne	$0.13	$0.12	$0.12	$0.12	$0.11
Sydney	$0.12	$0.10	$0.11	$0.11	$0.10
Perth	$0.11	$0.10	$0.11	$0.10	$0.09

Source: Australian Energy Council analysis, January 2022

Table 7: Central estimate: 4.77 per cent discount rate, ten-year average large business interest rate

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

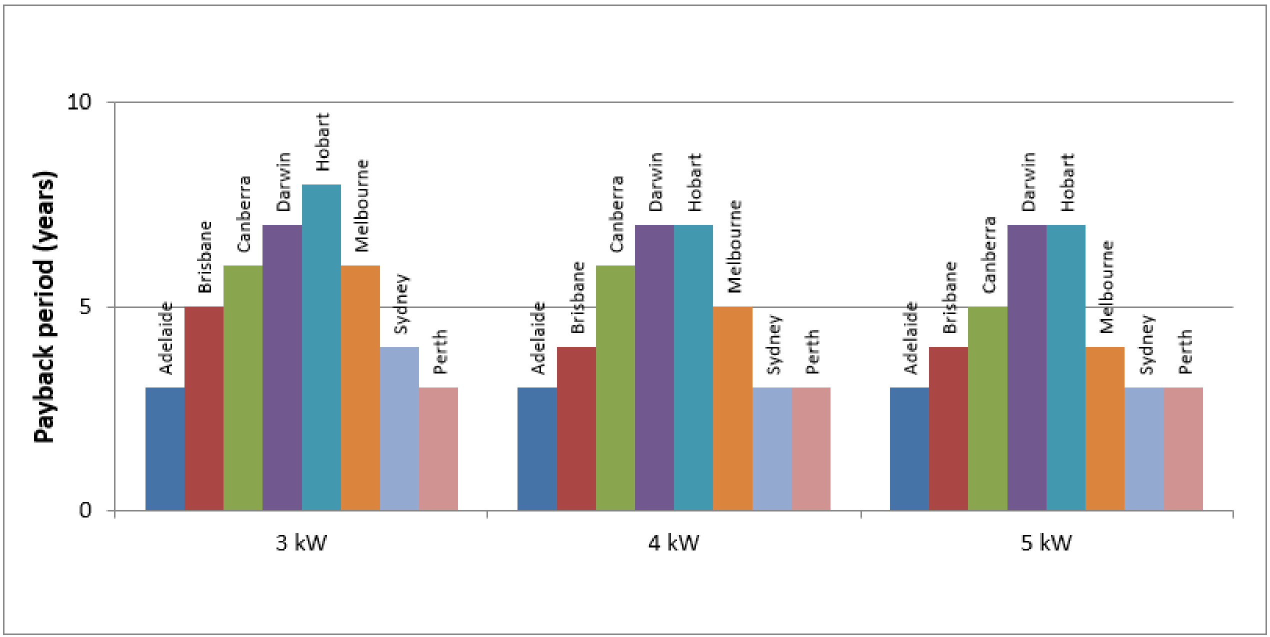
Source: Australian Energy Council analysis, January 2022

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 and therefore 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 7: Payback period for solar PV (3.45 per cent discount rate)

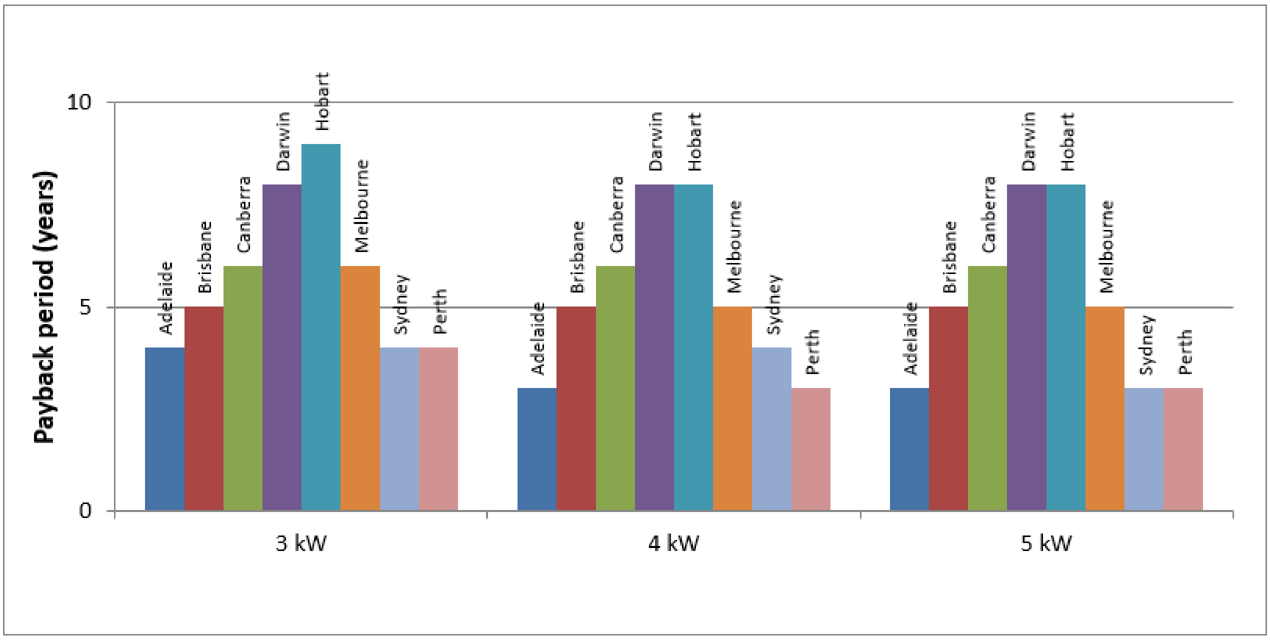


Source: Australian Energy Council analysis, January 2022

In NSW, the system price has increased $370 for a 3kW PV system, $210 for a 4kW system, $170 for a 5kW system compares to a quarter ago. Other states see relatively stable system prices. Melbourne sees a strong encouragement to install a 5kW system rather than a 3kW or 4kW unit size. This can reduce the payback time by two years for a 5kW system compares to a 3kW system.

Figure 8 shows the expected payback period for systems with a 5.28 per cent discount rate (10-year average home loan rate). Adelaide, Brisbane, Sydney and Perth see no changes in payback periods with a higher interest rate.

Figure 8: Payback period for solar PV (5.28 per cent discount rate)



Source: Australian Energy Council analysis, January 2022

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[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 (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[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 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 ∑ 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

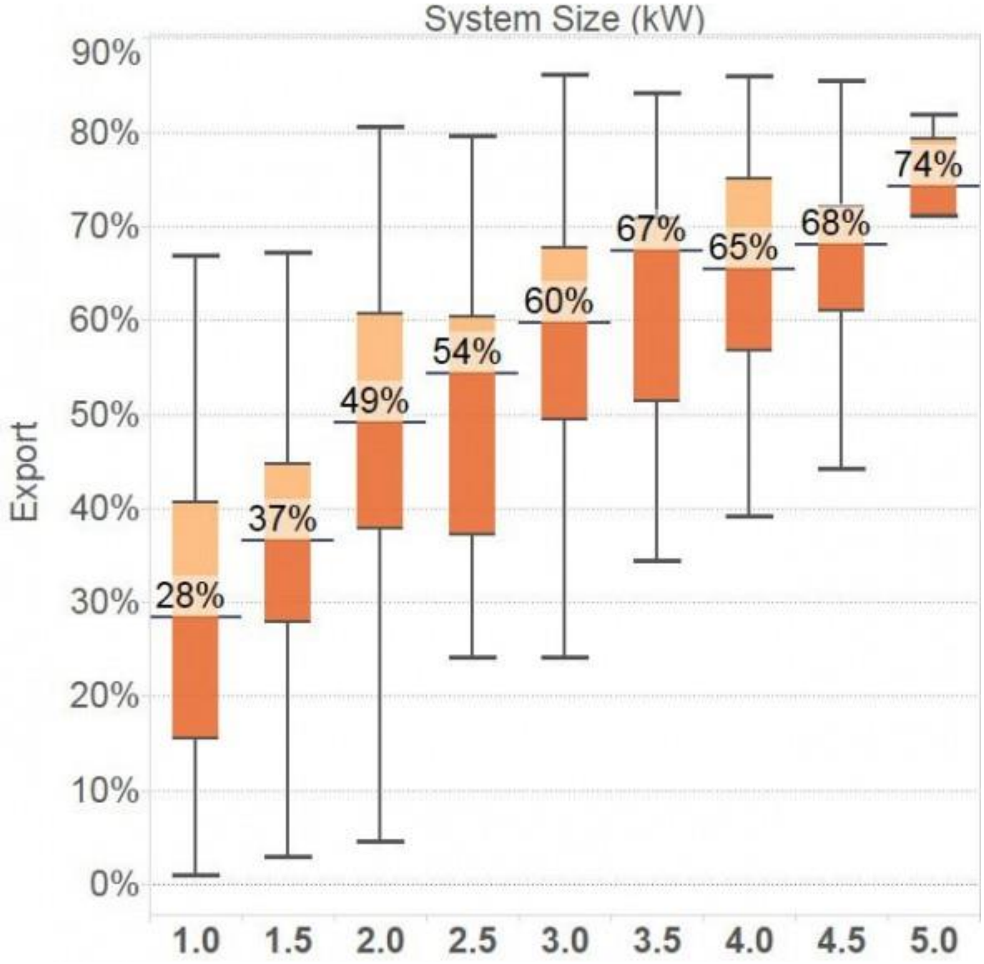
Avoided cost and FiT

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[viii]. See Figure 9 below.

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



Source: Sunwiz analysis, 2015

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i https://www.solar.vic.gov.au/solar-battery-rebate
ii https://nt.gov.au/industry/business-grants-funding/home-and-business-battery-scheme
iii https://www.qld.gov.au/community/cost-of-living-support/concessions/energy-concessions/solar-battery-rebate/about-the-program
iv Quarterly Energy Dynamics, Q4 2021, AEMO
v https://www.solar.vic.gov.au/solar-battery-rebate
vi https://www.homebatteryscheme.sa.gov.au/about-the-scheme
vii Clean Energy Council, http://www.solaraccreditation.com.au/dam/cec-solar-accreditation-shared/guides/Guide-to-installing-solar-PV-for-households.pdf
viii Sunwiz, Solar Pays Its Way on Networks. Last accessed 17 June 2015.