



Green Energy
Markets

Small-scale Technology Certificates Data modelling 2020 - 2022

Report to the Clean Energy Regulator

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Executive Summary

The Clean Energy Regulator (CER) has engaged Green Energy Markets Pty Ltd (GEM) to provide an estimate of the Small-scale technology certificates (STCs) likely to be created during the 2020 calendar year, and for 2021 and 2022 calendar years.

In developing our projections for small generating units (SGUs) and solar water heater (SWH) we have updated and expanded our models and databases used in developing our STC forecasts previously undertaken for the CER. We have also made extensive use of the registry data provided by the CER and interviewed a range of solar industry participants.

We have segmented the solar market into the following sub-markets to more accurately forecast the level of installations:

- SGU PV – New Residential market
- SGU PV – Upgrade Residential market
- SGU PV – Non-residential (commercial market)
- SGU PV – Upgrade Non-residential market
- SWH – New building market
- SWH - Replacement or existing dwelling market

In making projections for installations of solar PV and SWH we have aimed to isolate the key factors that have influenced the historical uptake of systems. In the case of solar PV the predominant factor influencing uptake is financial attractiveness. We have developed a state-based payback model as a proxy for financial attractiveness, for the residential and commercial sectors and then incorporate the expected impact of market saturation in each state. To incorporate non-financial factors we also account for changes in customer awareness and solar industry competitiveness and marketing which are informed by industry interviews.

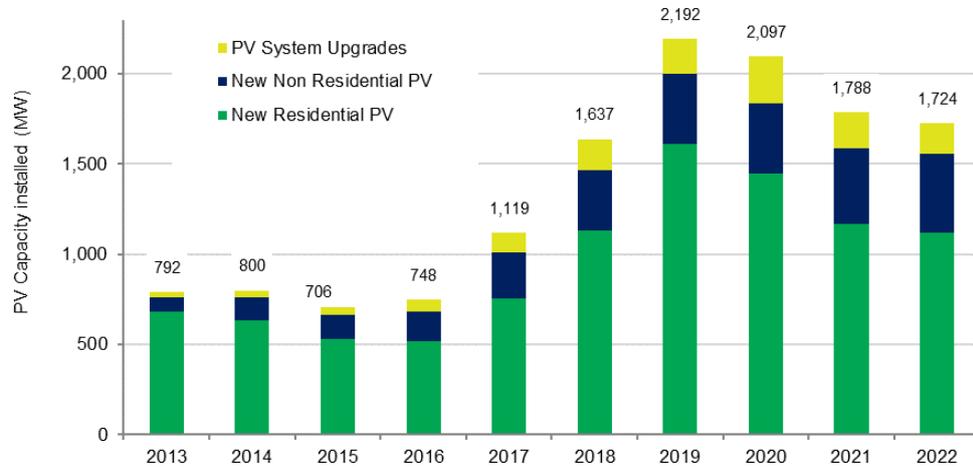
The following factors have been influential in the development of our estimates of the level of future solar installations:

- Wholesale power prices are expected to remain higher in 2020 than expected and are not projected to materially decline until after 2020. We have assumed that the level of daytime wholesale power prices progressively reduces to reach \$55 per MWh in real terms after 2023. This means that the attractiveness of solar PV starts to decline considerably after 2020 with resultant declines in the number of installations (other than in Victoria).
- The Victorian Solar Program is expected to underpin increasing levels of installations in the state over the forecast period with parameters of the program assumed to be adjusted to deliver on the policy commitment of 650,000 PV systems over 10 years;
- The average system size for new residential installations is expected to continue to increase, but at a more modest rate as we begin approaching the typical network inverter connection constraint of 5 kW (6.6 kW panel capacity);
- The number of non-residential (commercial) PV system installations is expected to increase slightly through to 2022;
- The number of SWH systems installed in new homes is expected to decline over the forecast period in line with declines in the expected rate of new home commencements. We expect a progressive increase in the replacement market as increasing numbers of SWH systems installed in 2009 and 2010, where the market surged due to expanded government grants, start to be replaced.

STC Modelling 2020 to 2022

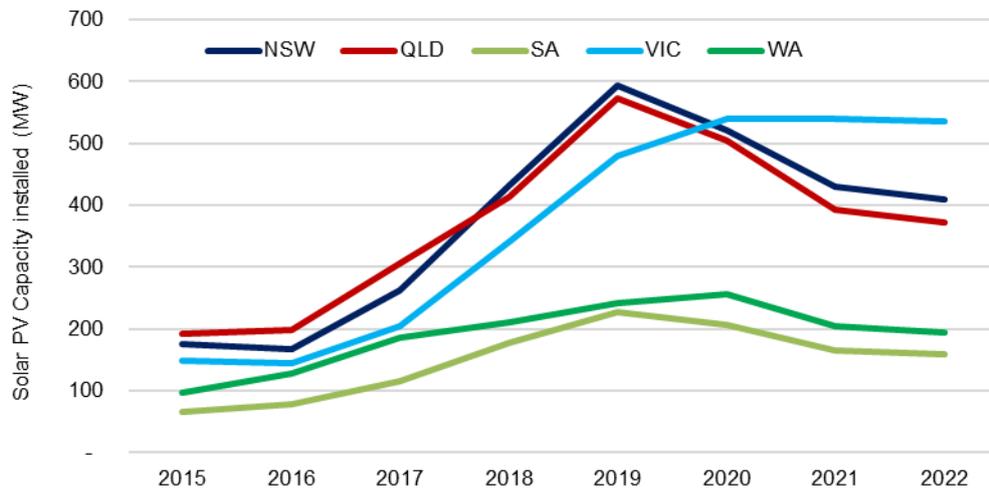
We estimate that 2192 MW of solar PV was installed in 2019 which is a 34% increase on 2018 levels. We expect that the capacity installed in 2020 will fall by 4% to 2097 MW and then continue to decline to reach 1724 MW by 2022.

PV Capacity installed by sector



The Victorian market underpinned by the government's solar program will underwrite Australia's PV capacity installations over the next three years. Victoria's share of capacity in 2022 is expected to be 32%, significantly higher than its 18% share in 2017.

PV Capacity installed by state



We expect that 36.4 million STCs will be submitted for registration in 2019 which is 6.7 million more than 2018 levels. The level of STCs expected to be submitted for creation over the forecast period drops dramatically to 22.6 million in 2022 with the reduction in PV capacity installed combined with the reduction in the number of years of deemed creation.

We estimate that the level of oversupply from 2019 to be carried into 2020 to be 5.9 million STCs.

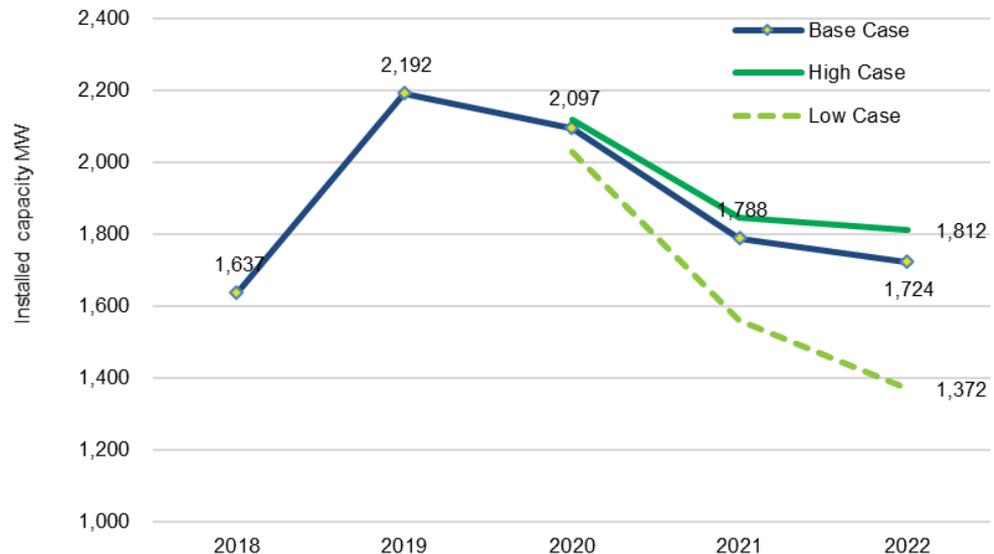
STC Modelling 2020 to 2022

Summary of results are as follows:

'000 STCs	Actual 2018	Estimate 2019	Forecast 2020	Forecast 2021	Forecast 2022
STCs for installations in year					
Solar PV	28,511	35,182	30,663	23,635	20,485
SWH	2,003	1,915	1,930	1,953	1,788
Total	30,513	37,097	32,592	25,588	22,272
Less					
STCs submitted following year (lag)	3,357	4,016	3,529	2,770	2,411
Add					
Previous year installs created this year	2,580	3,357	4,016	3,529	2,770
STCs submitted for creation	29,736	36,438	33,080	26,346	22,631
STCs pending audit at year end	1,125	1,566	1,422	1,132	973
STCs to be approved in year		35,997	33,224	26,635	22,791
Surplus from previous year			5,926	0	0
Estimated Target for year			39,150	26,635	22,791

The major uncertainty in developing the estimates revolves around the future level of daytime wholesale prices which has a material impact on the attractiveness of both residential and commercial PV. We have undertaken a sensitivity analysis and considered a "High" scenario where the drop in daytime wholesale price to \$55/MWh (real) is delayed by two years. We have also considered a "Low" scenario whereby daytime wholesale prices reduce to \$28/MWh (real) by 2024. The impact of the above sensitivities on installed PV capacity is shown in the following chart.

PV Capacity installed under different electricity price scenarios



The forecast level of STCs to be submitted for creation under the Base Case and the two other scenarios are summarised below.

'000 STCs Submitted for Creation	2018	2019	2020	2021	2022
Total Certificates - Base Case	29,736	36,438	33,080	26,346	22,631
Total Certificates - High Case			33,385	27,076	23,670
Total Certificates - Low Case			32,204	23,457	18,434

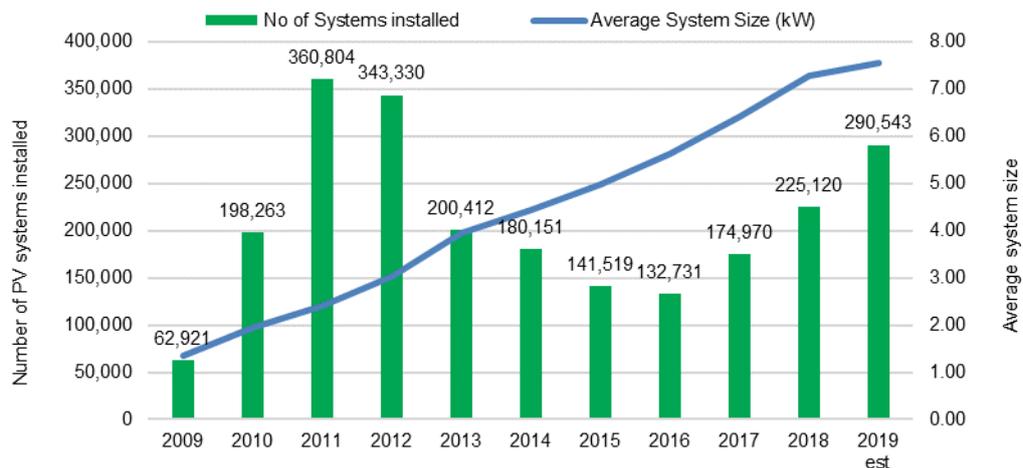
1. Introduction

The Clean Energy Regulator (CER) has engaged Green Energy Markets Pty Ltd (GEM) to provide an estimate of the Small-scale technology certificates (STCs) likely to be created during the 2020 calendar year, and for 2021 and 2022 calendar years.

The Small-scale Renewable Energy Scheme (SRES) creates financial incentives for investment in eligible small-scale renewable energy systems. Small-scale renewable energy systems are defined as solar PV systems with a capacity no more than 100kW and solar hot water installations. Solar PV dominates the creation of STCs accounting for 95% of STCs.

The growth in the number of solar PV installations has been primarily due to the surge in the demand from small and large businesses as power prices have increased and solar PV has become a more financially attractive proposition. The average system size has continued to increase which has resulted in a significant expansion in the capacity installed and subsequent STC creation.

Figure 1.1 Number of solar PV systems installed and average system size (kW)



This report is set out in 4 sections

Section 2. Methodology and approach – summarises the approach that GEM has taken in developing its STCs estimates for each solar market sub-sector.

Section 3. Assumptions – summarises the key assumptions that have been made in the models used to develop the estimates

Section 4. Updated STC forecasts for Solar PV – summarises the number of PV systems expected to be installed together with the expected capacity and resultant STCs created.

Section 5. Updated STC forecasts for SWH – summarises the number of SWH systems expected to be installed together with the resultant STCs created.

2. Methodology and Approach

We have segmented the solar market into the following sub-markets, which tend to have different characteristics and consumer drivers:

- SGU PV – New Residential market
- SGU PV – Upgrade Residential market
- SGU PV – Non-residential (commercial market)
- SGU PV – Upgrade Non-residential market
- SWH – New building market
- SWH - Replacement or existing dwelling market

Residential and commercial installations have been segmented based on the “property installation type” classification in the registry data provided by the CER. We have used the CER’s delineation from 2015 when a full years data was available. For systems installed prior to 2015 we have assumed that systems greater than 10 kW were commercial and those less than 10kW were residential.

1. Modelling new residential PV system installations

Our projections for new residential PV systems are based on isolating the factors that have influenced the historical uptake of PV. The predominant influencing uptake is financial attractiveness. We use a simple payback calculation as the proxy for financial attractiveness.

Forecasting PV payback periods

Payback period is modelled using Green Energy Markets payback model. The payback (in years) in the year of installation is determined by dividing the expected savings in the year of installation into the installed system cost (refer to Attachment 2).

- The expected savings in the year of installation is determined by the sum of (i) the value of avoided electricity purchases in the year of installation and (ii) the value of electricity exports in the year of installation.
- The installed system cost is derived by the total cost of the system less the value of STCs and any other rebates available.

The assumptions used in the model are summarised in Section 3.

PV Demand

We forecast the level of demand for each state with reference to the following four factors:

- Relative financial attractiveness - as represented by simple payback index for each year with 2015 as the base;
- Relative level of saturation – represented by scaling factor that reduces as saturation increases, we have calibrated this as being 1.0 (no discount) at saturation levels of 20% or less and then reduces to 0.5 (50% discount) at saturation levels of 80%. This is then also converted into an index with 2015 as the base;
- Relative customer awareness – heightened media concerns over high power prices has been demonstrated (through market interviews) to be a major contributing factor to customer preparedness to consider solar. We have developed a scaling factor that considers the impact in each year and then convert this into an index with 2015 as the base; and

- Relative solar industry competitiveness and marketing – the level of new market entrants (and exit), general industry competitive environment together with the level of marketing and promotion will also have an impact on solar PV uptake. We have developed a scaling factor that considers the impact in each year and then convert this into an index with 2015 as the base.

The last two factors (customer awareness and industry competitiveness and marketing) are extremely subjective but have clearly impacted on the level of demand particularly since 2017 (refer to Figure 4.1).

The five years from 2015 to 2019 provide a reasonable timeframe and cover new residential installations rising from 124,000 systems in 2015 to 245,000 systems in 2019. This now represents 5 years of reasonable data that is not complicated by solar credits multipliers or extremely attractive feed-in tariffs. The residential market sector can be seen to be mature and enables us to have confidence in this approach, albeit with some subjective factors. Interviews with industry participants have been a key component in gauging factors and issues that are actually working on the ground influencing customer purchasing decisions, beyond just financial attractiveness.

We have used systems installed in 2015 as the base level of demand for 2015 which is our base year. We have used 2016 level installations as base data in the case of WA, SA and NT as this was seen to be more representative.

Our approach can be represented by the following formula:

$$\text{Demand (year)} = \text{Base year installations} \times \text{Relative Financial Attractiveness Index (year)} \times \text{Relative Level of Saturation (year)} \times \text{Relative Customer Awareness Index (year)} \times \text{Relative Solar Industry Competitive Index (year)}$$

2. Modelling new non-residential (commercial) PV systems

The commercial or non-residential sector continues to be seen as an attractive market by the solar industry, now representing over 20% of installed capacity.

This market sector is not as mature as the residential market and we use 2019 installations as our base level of demand. Forecast installations are based on relative financial attractiveness (relative to the 2019 base year) we have also incorporated a scaling factor to reflect improved industry attractiveness as more solar businesses target this sector.

We have also analysed capacity sub-segments as follows:

- Up to 30kW
- 30.1kW to 50kW
- 50.1kW to 100 kW

3. Modelling upgrades and replacements of residential and commercial systems

This market sector is increasing albeit from a very low base. Many small systems (less than 1.6 kW) were installed over the 2010 to 2013 period and a number of the customers are expanding their systems in response to higher power prices and lower panel prices. While this market sector is still very small we expect it to continue to grow and become a much more important feature of the industry in future years as saturation increases. The commercial upgrade market at an estimated 48 MW (780,000 STCs) is probably not that material, however we believe it is worth separating as it has scope to grow in future and it is also important to exclude these systems when considering saturation levels.

4. Modelling solar water heating certificates

Water heater systems are essential appliances and subject to state regulations increasingly limiting choice in some applications. As such, water heater system choices are based on different factors which include: the existing system type (if being replaced); the relevant state regulations; the type of premises; access to reticulated gas, and also net system up-front costs (after taking incentives into account). Operational costs, such as future electricity and gas prices (particularly in the case of LPG) are also factors that may be considered.

The solar water heater (SWH) market (including heat pump water heaters) has two key sub-markets which are each subject to different incentives and regulations – these are the new building market (residential) and the replacement market (for existing water heaters in residences).

SWH systems in each state and each sub-market are separately modelled. Major inputs into this analysis include building forecasts (new houses), system replacement rates and market shares for each water heater technology by year.

The model will consider relative market shares together with the following key factors largely impacting future installations:

- State regulations for new/replacement systems
- Relative financial and market attractiveness
- Other state and federal government incentives (if any)

SWH system installation forecasts will be combined with average system certificate creation (based on recent data) to estimate total certificate creation in each state and each submarket.

The commercial market which had been important prior to 2011 is not significant and will not be separately analysed. Air sourced heat pumps over 425 litres have been ineligible to create certificates since June 2010 and as a result very few commercial sized SWH systems (non heat pumps) have been installed.

5. Modelling other small generation unit certificates

Certificate creation for small wind and hydro power systems are presently not material and are not included.

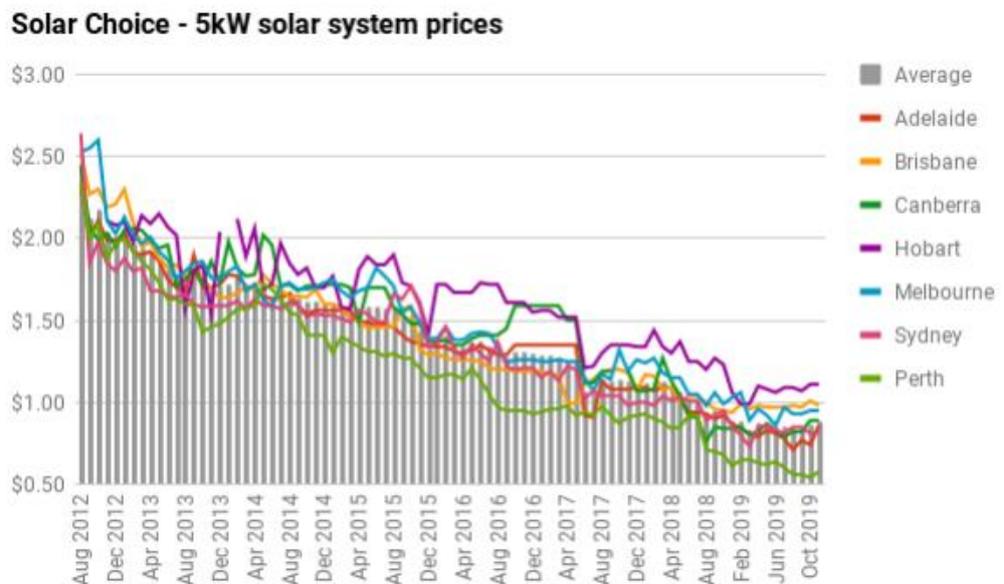
3. Assumptions

Key assumptions used in our modelling are outlined in this section.

3.1 Forecasting Installed PV costs

Installed system costs have drifted lower during 2019. The most recent Solar Choice analysis shows that net system prices have levelled out over the last nine months (Figure 3.1)

Figure 3.1 Installed system Costs (after STCs) for 5kW system (\$/Watt) (Solar Choice, Dec 2019)



<https://www.solarchoice.net.au/blog/solar-power-system-prices>

We estimate that the average installed system cost (pre STCs) in 2019 will average \$1.60 per Watt which is slightly lower than the \$1.65 per Watt used in our previous analysis.

Cost reductions to date have been due to a combination of factors including; declines in module prices, lower labour and balance of system equipment costs per watt installed through gains in solar module conversion efficiency and increasing system size. In addition, the increasing number of systems installed has meant fixed administration and sales and marketing costs have been easier to cover.

Whilst we expect to see modest reductions in module prices and continued gains in conversion efficiency, we expect to see constraints on continued increases in system size and we expect that lead generation and sales and marketing costs will increase as saturation increases and financial attractiveness reduces. Our projections assume a AUD/USD exchange rate of 0.69 over the forecast period.

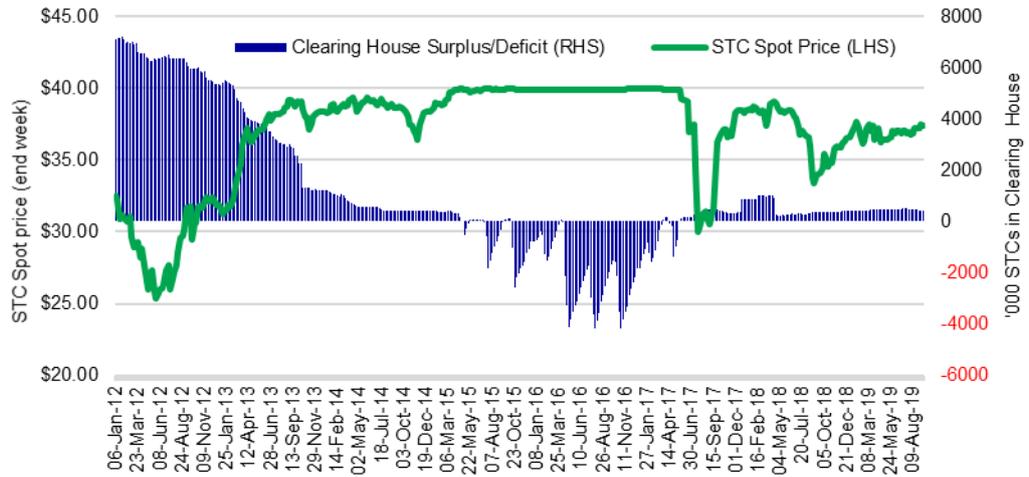
As a result, we expect to see only modest real cost reductions over the next three years and as result we assume that the current gross installed cost (prior to STCs) of \$1.60 per Watt will be maintained in nominal terms over the forecast period.

3.2 Forecasting STC prices

Spot STC prices in 2019 have averaged \$37.04 (to mid October). Spot prices averaged \$37.00 for 2018. Since mid-2017 the Clearing House has been in surplus with more

STCs created than required by Liable Parties to meet their STC surrender needs. The resulting surplus of STCs in the market has meant that STCs have traded at a considerable discount to the \$40 Clearing House Price (Figure 3.2).

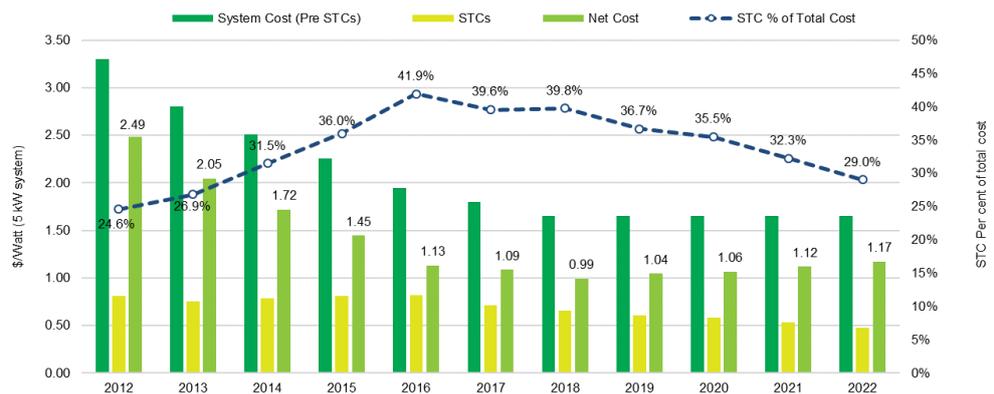
Figure 3.2 Spot STC prices and Clearing House Surplus/ Deficit



We are assuming that over the forecast period the STC market comes in to better balance and that the Clearing House does not go into deficit. We are forecasting an underlying STC spot price of \$39 from 2020 to 2022 and after allowing for 47 cents registration cost we have used \$38.53 per STC to incorporate into our payback model.

STCs accounted for nearly 37% of the total cost of the system in 2019 and this is expected to drop considerably to 29% by 2022 as the number of years deeming reduces (Figure 3.3).

Figure 3.3 Forecast Installed system costs for 5 kW system (\$/Watt)



3.3 Forecasting Electricity prices

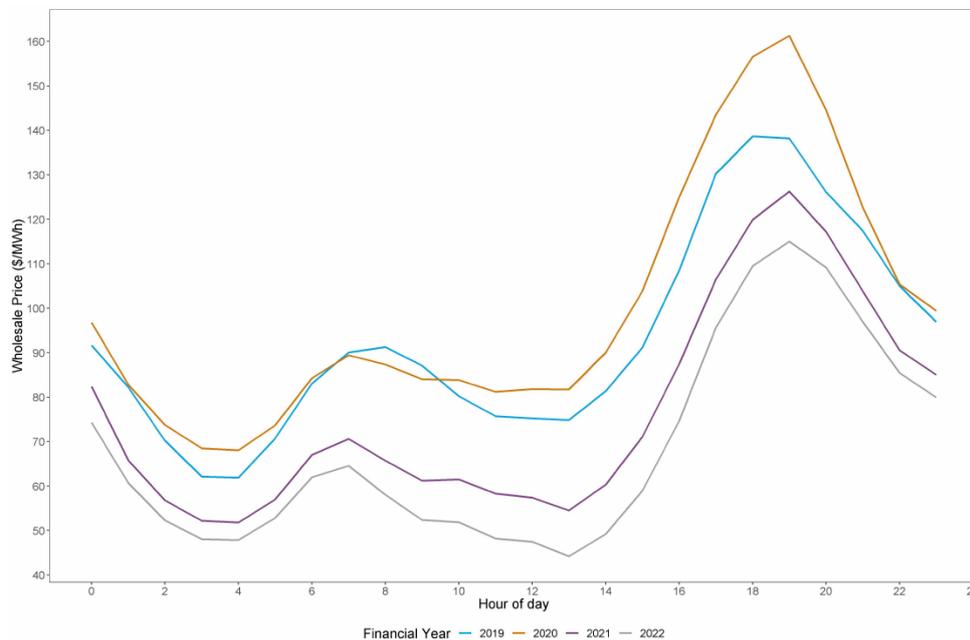
There are two components to electricity prices that we incorporate into our payback model:

- Import replacement price: this is the variable electricity price that can be avoided by that level of solar generation that is consumed by the household or business; and
- Export price: this is the variable electricity price that is received through the export of electricity to the grid.

Our payback model time series generally incorporates the Australian Energy Market Commission’s (AEMC) latest projections (December 2019 Report) and are adjusted for standing charges utilising AEMC typical demand estimates. We have then progressively reduced the wholesale price component to reflect the expected significant decline during daylight hours.

A significant amount of large-scale solar generation capacity (6000 MW) will be added over the 2018 to 2021 period. This is on top of a similar level of roof-top solar PV and a further 6,000 MW of wind generation. As a result, we expect that wholesale market prices (during sunlight hours) will drop considerably over the period to 2023. The AEMC in their December report also recognised the expected drop in the wholesale price during daylight hours from 2021 financial year (refer to Figure 3.4). The AEMC analysis also indicated that wholesale prices in NSW during 2020/21 would be higher than 2019/20 and for other key states prices in 2020/21 would be similar to or slightly lower than 2019/20 levels.

Figure 3.4 Average wholesale electricity prices by hour of day in NSW
Source: AEMC, Residential Electricity Price Trends 2019



We have assumed that wholesale the price (for daylight hours) during 2020 remains fairly high and only starts to fall from 2021 onwards. We have assumed that the price in the NEM progressively drops to \$55/MWh in real terms and that this represents the average marginal cost of gas and NSW black coal generation each setting the price 50% of the time during daylight hours. For WA we have assumed that the equivalent price during daylight hours is \$50/MWh by 2023 in real terms.

Figure 3.5 Value of exported electricity for key states (cents per kWh nominal)

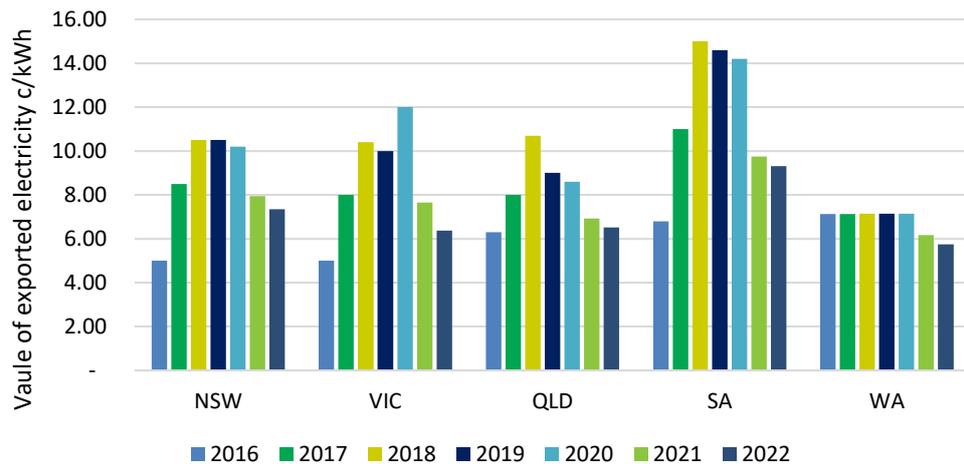
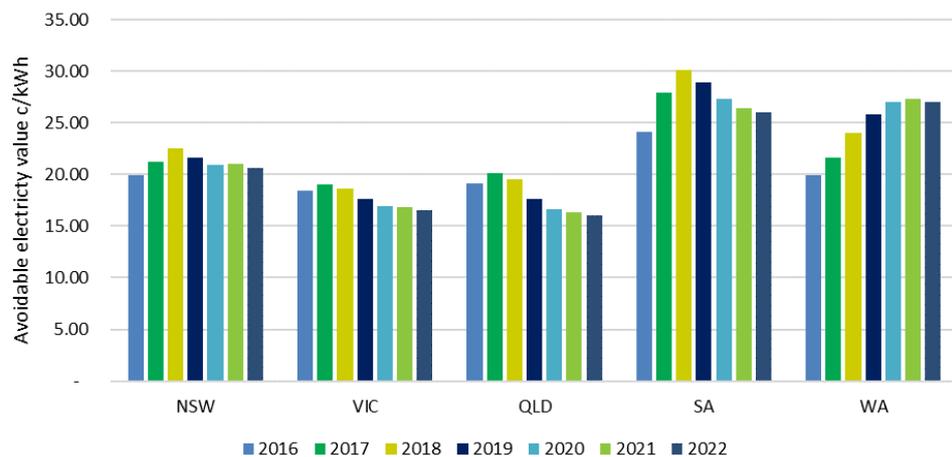


Figure 3.6 Avoidable electricity price (variable cents per kWh nominal)



3.4 Forecasting new residential and commercial PV payback periods

We adopt a simple payback approach to represent the relative financial attractiveness of PV to consumers in each state. The system payback is derived by dividing the installed cost of the system (less the value of STCs) by the value of electricity produced in the year of installation. In addition to the installed system cost, STC price and electricity price assumptions covered above we have also incorporated the following assumptions:

For residential systems:

- For payback modelling purposes we use a generic average system size for each state and is assumed to be generally 6.0 kW; and
- Electricity exports are determined by state and are linked to the average system size and the average consumption levels in each state. Export levels range from 60% in the NT to 70% in NSW and Victoria.

For commercial systems:

- Most business sites consume less than 160 MWh of electricity per annum and pay electricity tariffs that are broadly similar to residential customers. The average system size is assumed to be 20 kW which is consistent with the average system size installed over the last few years; and

STC Modelling 2020 to 2022

- We assume that most of the power generated is consumed on site and that only 20% of the electricity generated by solar PV is exported at an assumed zero value (other than in Victoria where systems less than 100kW are eligible for a feed-in tariff).

Average system paybacks dropped dramatically in most NEM states during 2018 and 2019 due to high wholesale prices. With the expected reduction in the value of exported electricity and lower avoided import prices combined with reducing STC value, paybacks across all states are expected to increase over the forward period.

Figure 3.7 Simple Payback for typical residential PV system

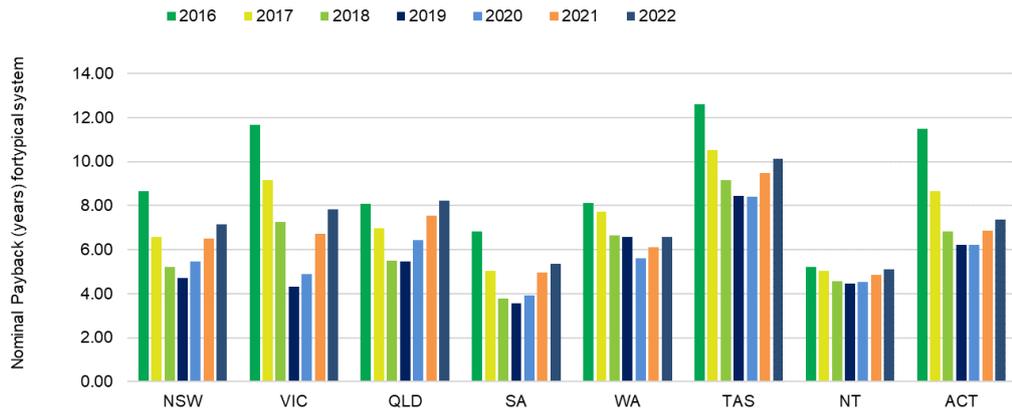
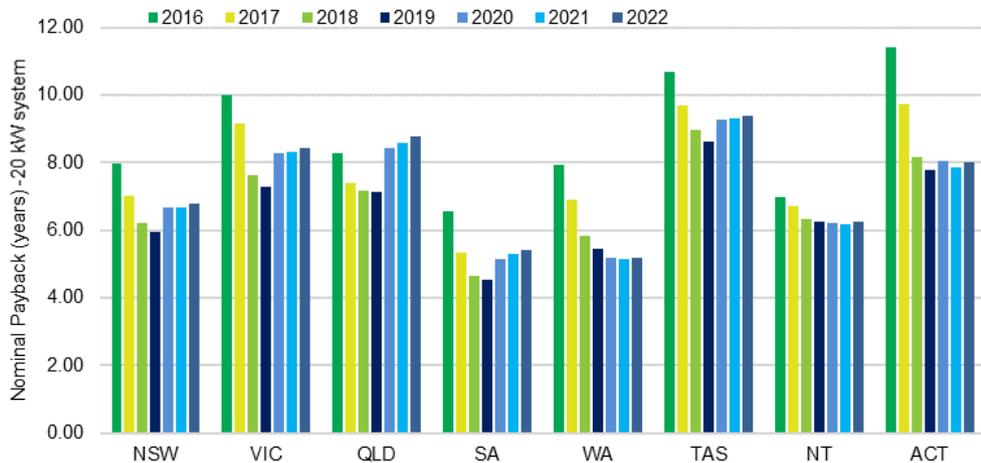


Figure 3.8 Simple Payback for typical Commercial PV system



4. STC Forecasts for solar PV

4.1 Solar industry participant interviews

We have undertaken a series of informal interviews with a cross section of solar market participants to obtain their views on the current market for solar installations and expected activity over the coming years. This has informed our judgements on the non-financial factors that impact on consumers purchasing decision.

Some key observations that have informed our assumptions used in the modelling are set out below:

- Lead generation is becoming more expensive;
- Financing PV systems still appears relatively modest (Victoria an exception with Government interest free loans for 4 year);
- Commercial sector still offering considerable potential, though uncertain economic outlook means sales take longer to close;
- While considerable customer interest in batteries, the level of uptake remains low;
- Not much room for Panel prices to fall further and expectation that installed system costs to remain stable; and
- System sizes continue to increase though seem to have levelled out.

4.2 Estimated STCs to be created for 2019 Installations

We have analysed the level of STCs that have been submitted for creation on a weekly basis by year of installation for the key market sectors. We have assumed that the average lag in 2019 creation will be an average of the lag experienced for the 2017 and 2018 years. The lag in creation for all market sectors is summarised in Attachment 9. For the level of Victorian installations, we have based our projections on an estimated 68,000 residential systems installed in 2019.

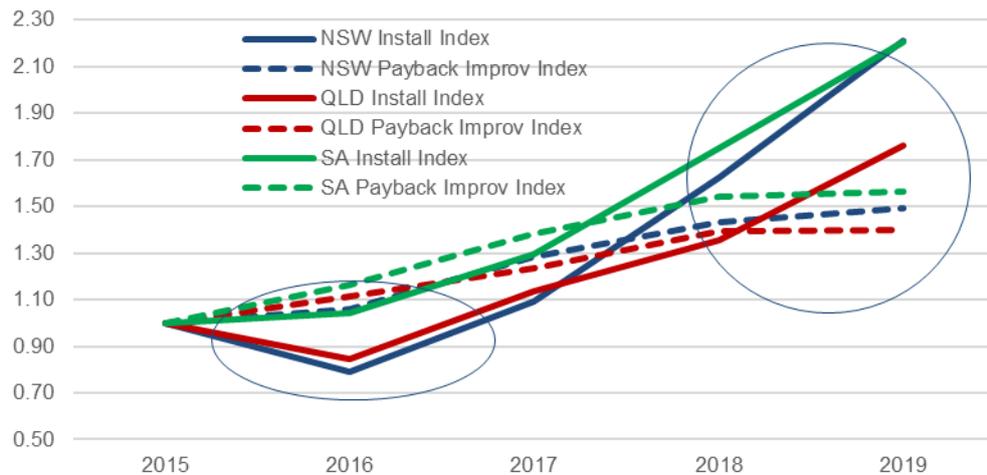
4.3 Forecasting new residential PV installations and STCs created

We have adopted the same approach as we have in our previous modelling exercise in developing demand for new residential solar PV systems (refer to Section 3).

The results from our system payback model are summarised in Attachment 2 and shown in graphical form in Figure 3.6. Paybacks have been converted to an index with 2015 as a base and compared to the level of installations as an index also with 2015 as base (Figure 4.1). This is showing system payback and level of installations as a linear relationship, with the exception of two time periods.

- In 2016 paybacks were increasing however the level of installations in NSW and QLD fell by more than 10%; and
- In 2019 paybacks for systems in NSW, QLD and SA were similar to 2018 levels, however the number of systems installed increased significantly.

Figure 4.1 Payback Index cf: Installation levels for NSW, QLD and SA



The above apparent anomalies can be explained by:

- Reduced solar industry competitiveness and marketing in 2016 and 2017 as the industry was consolidating with a number of businesses exiting from the market. This situation has been reversed in 2018 and 2019 with many new entrants in the market with expanded marketing and promotion. Some new entrants have adopted different business models and market focus.
- Heightened customer awareness was apparent in 2018 and 2019 with increases in wholesale power prices and considerable media focus and attention on energy reliability and cost; and
- There will also be lags between the time parameters change, customers make purchasing decisions and when the system is finally installed.

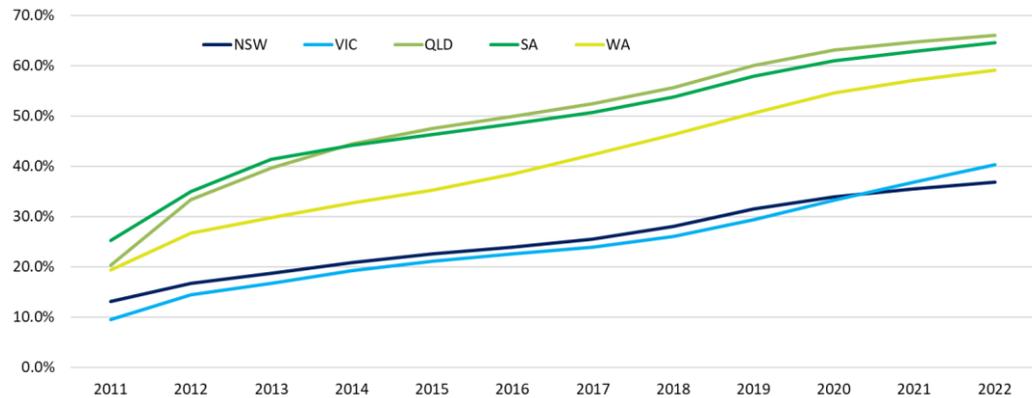
In our modelling we have assumed that the enhanced industry competitiveness and customer awareness remains in place for 2020 but at a lower level compared to 2019 and then proceeds to get back to more normal levels by 2021.

We have assumed that the level of new residential installations in Victoria will be governed by the Victorian Solar Program with the desire to support 650,000 residential PV systems over 10 years. The level of rebates each year is expected to be back-ended. Other than for the 2019/20 financial year few details are available as to the specific level of rebates to be supported in each year. We have incorporated the Victorian Government's commitment to fund an additional 23,000 rebates for the 2019/20 financial year. We have assumed that the program parameters will be adjusted to ensure that the policy commitment of 650,000 solar PV systems will be achieved. We have assumed that new residential installations (including new residential systems that are not eligible for the rebate) in 2019 will be 68,000, 68,200 in 2020, 67,000 in 2021 and 66,063 in 2022.

We expect that the NSW government solar program which currently focusses on low income families will support only a modest level of demand for systems from 2020 onwards.

The level of projected system installations by state is outlined in detail in Attachment 3 together with expected penetration levels. Penetration level by state is summarized in the following chart.

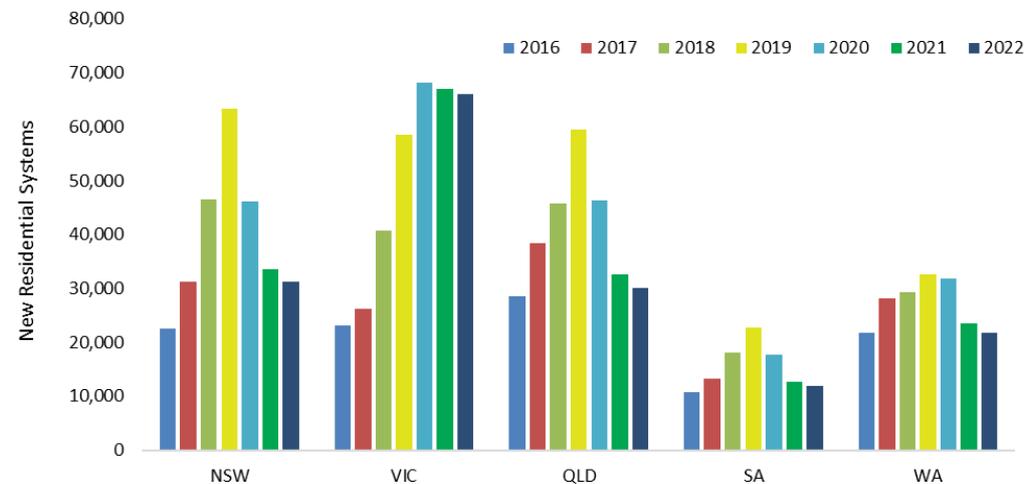
Figure 4.2 Penetration level by key state



Note: Penetration rate represents the cumulative proportion of residential systems installed as a proportion of owner occupied houses (separate and semi-detached)

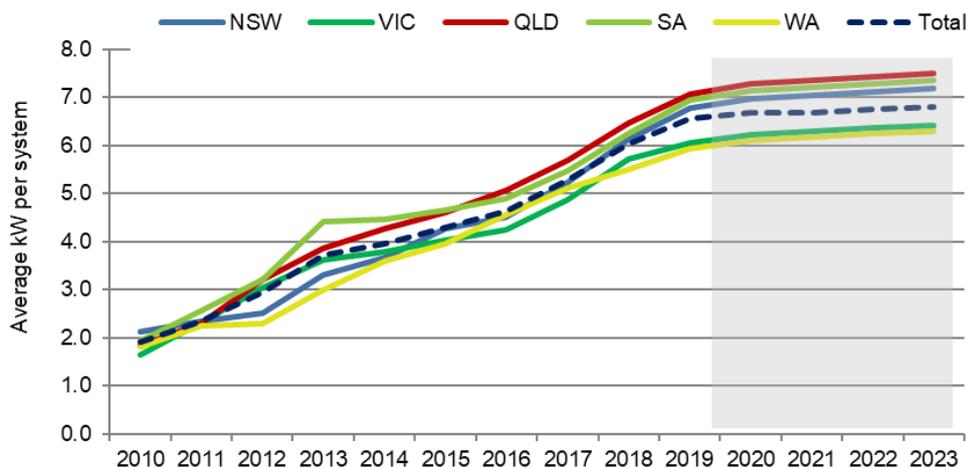
New residential system installations are expected to decline markedly over the next four years as financial attractiveness deteriorates. The only exception is Victoria where installations are supported under the solar program (Figure 4.3)

Figure 4.3 New residential installations by key state



We are expecting a slowdown in the increase in the average system size that has been experienced over the last few years. As the level of STC deeming reduces and the value of exported electricity falls, there will be less of an incentive to opt for larger systems. In addition there has to date been a soft electricity network constraint whereby it is a much easier process to connect systems where the inverter capacity is 5kW or less (with 30% oversizing is equivalent to between 6.5 and 7 kW of panels).

Figure 4.4 Average system size installed for NSW, Qld, SA, Vic and WA



The capacity installed and resultant STCs created by state are included in Attachment 4. A summary of results is outlined in Figure 4.3 below:

Figure 4.4 New residential solar installations and STC creation

Year of installation	Actual 2018	Estimate 2019	Forecast 2020	Forecast 2021	Forecast 2022
Number of Systems Installed	187,703	245,481	216,867	174,407	165,765
Avge kW/system	6.03	6.57	6.67	6.68	6.74
Avge Certificates/kW	17.4	16.0	14.5	13.1	11.7
MW Installed	1,131.5	1,613.0	1,446.2	1,165.8	1,117.5
Eligible Certificates ('000)	19,682	25,846	21,003	15,243	13,124

4.4 Forecasting new commercial PV installations and STCs created

We identified in Section 2 of this report, the CER has been collecting data on the type of premises that the system was installed since mid-2014. We have used the CER’s delineation from 2015 when a full years data was available. For systems installed prior to 2015 we have continued to use systems greater than 10 kW as a proxy for non-residential systems.

We have adopted the same approach as previous modelling exercises in developing our estimates for new commercial PV installations. As opposed to residential installations demand is not significantly constrained by high levels of saturation. The commercial sector therefore is expected to be an attractive market for the solar industry as the residential market declines.

Assumptions used and methodology are summarised in Sections 2 and 3. The expected reduction in wholesale prices combined with a reduction in the contribution of STCs will see a modest increase in payback periods from 2020 (Figure 3.7).

For the forecast period, we have assumed that the average system size in each state for 2019 period applies.

The total number of systems installed, and associated certificates created for the non-residential PV market is detailed in Attachment 5 and summarised in Figure 4.5.

Figure 4.5 New non-residential solar installations and STC creation

Year of installation	Actual 2018	Estimate 2019	Forecast 2020	Forecast 2021	Forecast 2022
Number of Systems Installed	14,619	18,084	18,479	20,190	20,848
Avg kW/system	22.92	21.44	20.96	20.96	20.96
Avg Certificates/kW	17.4	16.0	14.8	13.4	12.1
MW Installed	335.0	387.8	387.4	423.1	437.0
Eligible Certificates ('000)	5,826	6,214	5,728	5,688	5,287

3.7 Forecasting upgrade residential and commercial PV installations and STCs created

We have separately analysed the solar PV systems that have created certificates at an address that already had a system installed. These installations will either represent instances where a solar system has been upgraded (ie. the capacity has been increased) or where the previous system has been replaced. We have segmented these installations into residential and non-residential.

With rising penetration in the new residential market segment solar resellers and installers are increasingly targeting their existing customers to upgrade their systems. More than 600,000 solar PV systems were installed before 2012, the vast majority of which were less than 1.6 kW. With the average size of new residential system installed in recent years being above 6.0 kW there is enormous potential for the progressive upgrading of these systems. There is however a disincentive to upgrade systems where attractive feed-in tariffs are in place.

We have modelled upgrade systems using 2019 as a base and then applying recently observed growth rates moderated by changes in relative payback rates.

The total number of systems installed, and associated certificates created for the upgrade PV market is detailed in Attachment 6 and summarised in Figures 4.6 and 4.7.

Figure 4.6 Upgrade residential solar installations and STC creation

Year of installation	Actual 2018	Estimate 2019	Forecast 2020	Forecast 2021	Forecast 2022
Number of Systems Installed	20,442	24,706	34,995	24,197	22,048
Avg kW/system	5.77	5.81	5.79	5.76	5.76
Avg Certificates/kW	17.6	16.3	15.0	13.6	12.2
MW Installed	118.0	143.5	202.6	139.4	127.1
Eligible Certificates ('000)	2,082	2,343	3,032	1,894	1,555

Figure 4.7 Upgrade non-residential solar installations and STC creation

Year of installation	Actual 2018	Estimate 2019	Forecast 2020	Forecast 2021	Forecast 2022
Number of Systems Installed	2,356	2,271	2,878	2,854	2,032
Avg kW/system	22.31	21.11	21.03	21.01	21.01
Avg Certificates/kW	17.5	16.3	14.9	13.5	12.2
MW Installed	52.6	48.0	60.5	60.0	42.7
Eligible Certificates ('000)	920	780	899	810	519

5. STC Forecasts for SWH

Overview

We estimate that nearly 64,000 SWH systems will be installed and create certificates in 2019 which is a 5% decrease on 2018 levels. The most important drivers of uptake have been the level of new home building and policy support measures such as building regulations and energy efficiency schemes.

New building market

The number of systems installed by state in the new building market has been reasonably stable on a year to year basis (refer to Attachment 7). This is in sharp contrast to the replacement market.

The primary drivers behind purchase behaviour in the new home market segment is the number of new dwellings and building regulations.

SWH sales data, sourced from Industry, suggests that the number of SWH systems that create certificates is between 10 to 15% lower than the total number of systems sold. This is not a new trend, and we see no reason for this to change. The SWH systems that do not create certificates are generally thought to be the result of difficulties that home builders/renovators face when faced with the prospect of creating certificates. The difficulties arise from the confusion and uncertainty as to who has the right to create the certificates. Specifically, when the future owner of the home/building may not own the system at the time it was installed. This means that using SWH systems creating certificates will understate the real level of SWH installations in new homes by 20 to 25%.

Using the data provided by the CER we have isolated the SWH systems installed in new buildings and analysed historic trends. We use this analysis as the basis for forecasting SWH installations for the new-build submarket.

The level of new home starts is expected to fall in most states over the next few years (other than WA and NT) according to forecasts by the Master Builders Association (Figure 5.1)

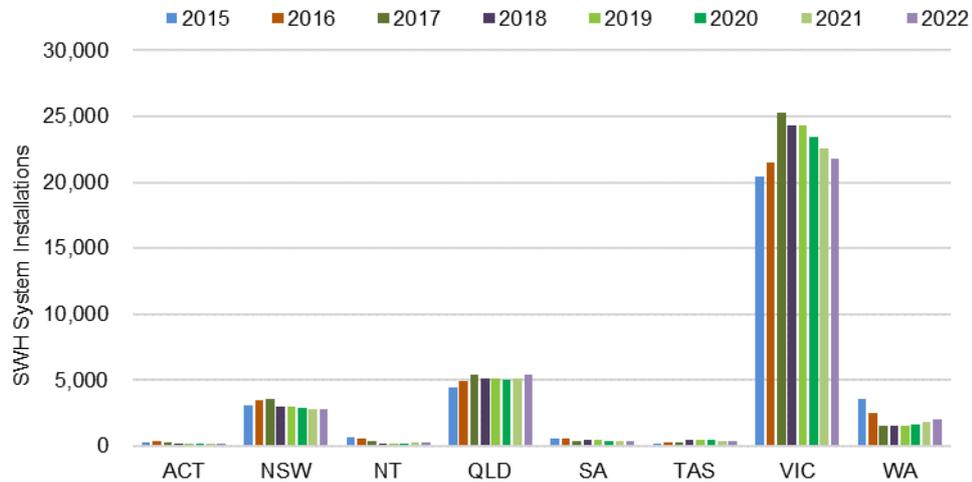
Figure 5.1 Master Builders Association (MBA) – New Home starts

	2019	2020	2021	2022	2023
ACT	2.00%	-2.85%	-2.31%	-4.69%	-2.22%
NSW	-7.76%	-5.64%	-4.95%	-3.90%	-1.73%
NT	6.36%	9.83%	8.47%	4.95%	2.00%
QLD	-4.57%	-2.96%	-0.63%	2.74%	2.15%
SA	-5.53%	-9.57%	-10.28%	-8.23%	-4.15%
TAS	-1.17%	-12.12%	-13.72%	-13.46%	-6.91%
VIC	-2.88%	-6.28%	-6.28%	-5.91%	-2.59%
WA	-4.50%	3.88%	7.37%	4.51%	1.31%
	-4.66%	-4.51%	-3.36%	-2.30%	-0.84%

We do not envisage any changes to new building regulations over the forecast period and have used the MBA forecast of new home starts as the basis for projections. We have also incorporated a market growth factor of 2.5% per annum which is the observed growth in the level of SWH installations over the last four years beyond what would have been suggested by the level of new home starts.

The level of SWH systems creating certificates is summarised in Figure 5.2. Victoria which has the most progressive new building regulations remains the leading state for this segment.

Figure 5.2 SWH Systems installed claiming certificates for New Homes by state



Replacement market

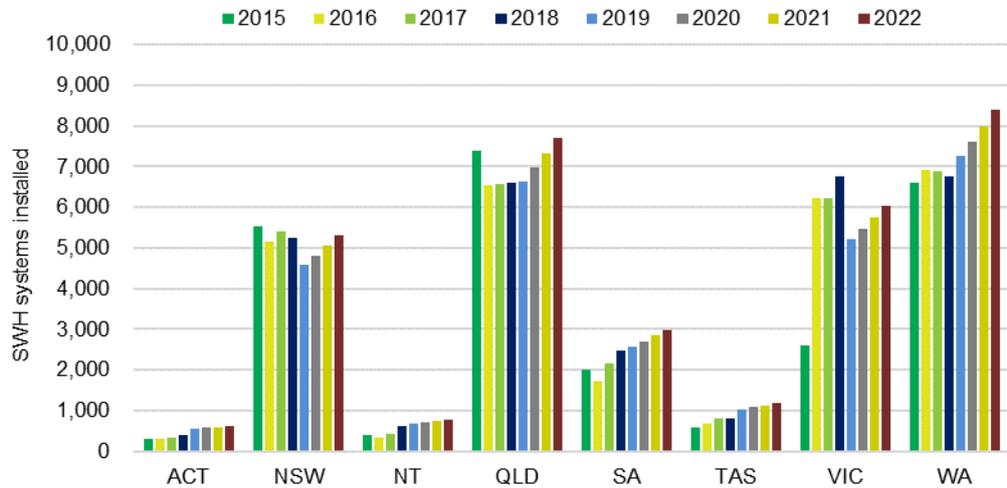
At the time of replacement, most hot water systems are replaced with the same or similar type of system. The dynamics of the replacement market, which are often dictated by a rush to replace a broken or failed water heater, mean there is little time and/or financial liquidity to make thoroughly researched decisions. Thus, historically, the majority of water heater replacements have been on a 'like-for-like' basis.

There have been a range of state-based schemes, incentives and/or regulations, particularly for the replacement of electric resistance water heaters (EWH).

The only material rebates that are currently available are in Victoria through the Victorian Energy Upgrade (VEU) which includes SWH as an eligible activity and the Government's new Solar Program. Under the VEU, an EWH system replaced by a SWH system can generate between 30 to 50 Victorian Energy Efficiency Certificates (VEECs). VEECs provide an added financial incentive of \$400 to \$1200 that helps drive extra SWH system installations in Victoria. Under the Solar Program a \$1000 rebate will be available on the installation of a SWH.

We forecast that the replacement market will grow over the forecast period as increasing numbers of SWH systems installed in 2009 and 2010, where the market surged due to expanded government grants, will start to be replaced. We have factored in average growth rates of 5% per annum to reflect this development.

Figure 5.3 Replacement SWH Systems installed claiming certificates by state



Certificates created from the installation of water heater systems

We have assumed that the average certificates per system (on a state basis) for the 2020 to 2022 forecast period will be similar to the average levels achieved over the 2018 to 2019 period.

Figure 5.4 Certificate creation from SWH

Year of installation	Actual 2018	Estimate 2019	Forecast 2020	Forecast 2021	Forecast 2022
New Buildings					
Number of Systems Installed	37,332	35,373	34,381	33,630	33,173
Avg Certificates/System	29.7	29.9	30.0	30.0	27.0
Eligible Certificates ('000)	1,110	1,059	1,030	1,008	895
Replacement					
Number of Systems Installed	29,646	28,513	29,939	31,436	33,008
Avg Certificates/System	30.1	30.0	30.1	30.1	27.1
Eligible Certificates ('000)	893	856	900	945	893
Total					
Number of Systems Installed	66,978	63,886	64,320	65,066	66,181
Avg Certificates/System	29.9	30.0	30.0	30.0	27.0
Eligible Certificates ('000)	2,003	1,915	1,930	1,953	1,788

Summary of Results

Year of installation	Actual 2016	Actual 2017	Actual 2018	Estimate 2019	Forecast 2020	Forecast 2021	Forecast 2022
1. SGUs (PV)							
1.1 New Residential							
Number of Systems Installed	111,461	143,054	187,703	245,481	216,867	174,407	165,765
Avg kW/system	4.64	5.29	6.03	6.57	6.67	6.68	6.74
Avg Certificates/kW	20.1	18.8	17.4	16.0	14.5	13.1	11.7
MW Installed	517.5	756.8	1,131.5	1,613.0	1,446.2	1,165.8	1,117.5
Eligible Certificates ('000)	10,401	14,245	19,682	25,846	21,003	15,243	13,124
1.2 Residential Upgrades							
Number of Systems Installed	11,984	18,960	20,442	24,706	34,995	24,197	22,048
Avg kW/system	3.69	4.24	5.77	5.81	5.79	5.76	5.76
Avg Certificates/kW	20.4	19.0	17.6	16.3	15.0	13.6	12.2
MW Installed	44.2	80.4	118.0	143.5	202.6	139.4	127.1
Eligible Certificates ('000)	901	1,530	2,082	2,343	3,032	1,894	1,555
1.3 New Non Residential							
Number of Systems Installed	8,338	11,581	14,619	18,084	18,479	20,190	20,848
Avg kW/system	20.13	22.02	22.92	21.44	20.96	20.96	20.96
Avg Certificates/kW	20.2	18.7	17.4	16.0	14.8	13.4	12.1
MW Installed	167.9	255.1	335.0	387.8	387.4	423.1	437.0
Eligible Certificates ('000)	3,388	4,782	5,826	6,214	5,728	5,688	5,287
1.4 Non Residential Upgrades							
Number of Systems Installed	948	1,375	2,356	2,271	2,878	2,854	2,032
Avg kW/system	19.44	19.66	22.31	21.11	21.03	21.01	21.01
Avg Certificates/kW	20.5	18.9	17.5	16.3	14.9	13.5	12.2
MW Installed	18.4	27.0	52.6	48.0	60.5	60.0	42.7
Eligible Certificates ('000)	377	511	920	780	899	810	519
Total PV Systems							
Number of Systems Installed	132,731	174,970	225,120	290,543	273,219	221,648	210,693
Avg kW/system	5.64	6.40	7.27	7.55	7.67	8.07	8.18
Avg Certificates/kW	20.1	18.8	17.4	16.0	14.6	13.2	11.9
MW Installed	748.1	1,119.3	1,637.2	2,192.3	2,096.7	1,788.2	1,724.2
Eligible Certificates ('000)	15,067	21,068	28,511	35,182	30,663	23,635	20,485
2. SWH Systems							
2.1 SWH System (New Homes)							
Number of Systems Installed	34,182	35,366	37,332	35,373	34,381	33,630	33,173
Avg Certificates/System	30.3	30.0	29.7	29.9	30.0	30.0	27.0
Eligible Certificates ('000)	1,035	1,061	1,110	1,059	1,030	1,008	895
2.2 SWH System (Replacement)							
Number of Systems Installed	27,836	28,778	29,646	28,513	29,939	31,436	33,008
Avg Certificates/System	30.4	30.2	30.1	30.0	30.1	30.1	27.1
Eligible Certificates ('000)	845	870	893	856	900	945	893

Summary of Results

Year of installation	Actual 2016	Actual 2017	Actual 2018	Estimate 2019	Forecast 2020	Forecast 2021	Forecast 2022
Total SWH Systems							
Number of Systems Installed	62,018	64,144	66,978	63,886	64,320	65,066	66,181
Avg Certificate/System	30.3	30.1	29.9	30.0	30.0	30.0	27.0
Eligible Certificates ('000)	1,880	1,931	2,003	1,915	1,930	1,953	1,788
3. Small Wind/Hydro Systems							
Number of Systems	10	10	2	2	2	2	2
Avg Certificate/System	26.8	20.4	20.4	20.4	20.4	20.4	20.4
Eligible Certificates ('000)	0	0	0	0	0	0	0
TOTAL Certificates ('000)	16,947	22,999	30,514	37,097	32,592	25,588	22,273
'000 STCs	Actual 2016	Actual 2017	Actual 2018	Estimate 2019	Forecast 2020	Forecast 2021	Forecast 2022
STCs for installations in year							
Solar PV	15,067	21,068	28,511	35,182	30,663	23,635	20,485
SWH	1,880	1,931	2,003	1,915	1,930	1,953	1,788
Total	16,947	22,999	30,513	37,097	32,592	25,588	22,272
Less							
STCs submitted following year (lag)	1,897	2,580	3,357	4,016	3,529	2,770	2,411
Add							
Previous year installs created this year	3,357	1,897	2,580	3,357	4,016	3,529	2,770
STCs submitted for creation	18,407	22,316	29,736	36,438	33,080	26,346	22,631
STCs pending audit at year end							
STCs to be approved in year			1,125	1,566	1,422	1,132	973
Surplus from previous year				35,997	33,224	26,635	22,791
Estimated Target for year					5,926	0	0
					39,150	26,635	22,791

Attachment 2

New Residential PV Systems

PV Financial Attractiveness

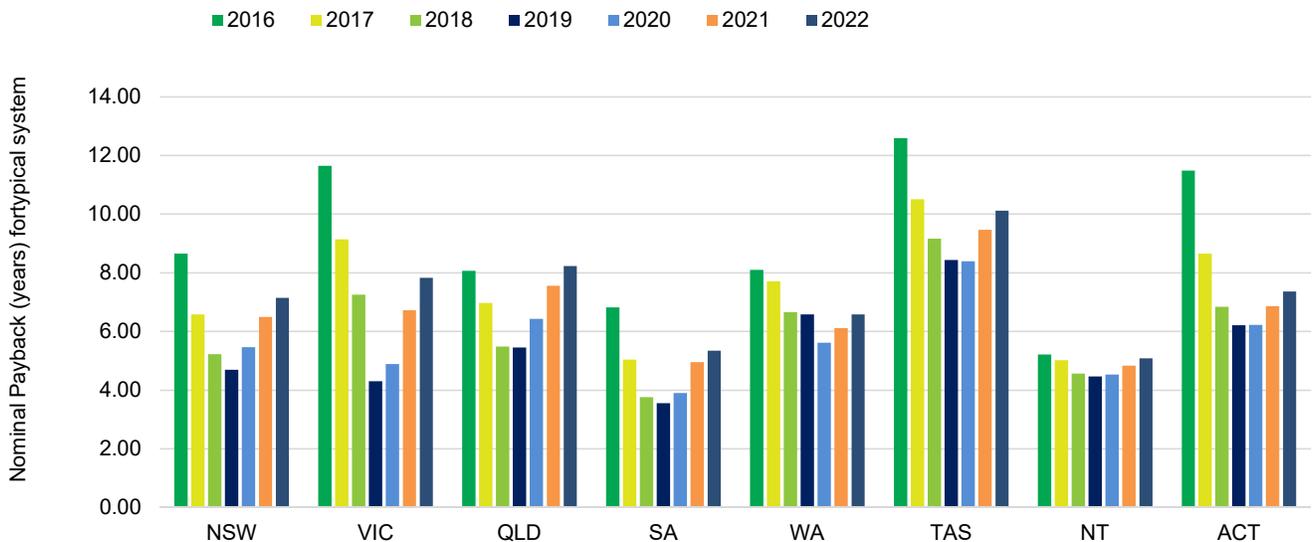
Typical projected Installed cost of solar PV in NSW (nominal terms)

	2016	2017	2018	2019	2020	2021	2022
\$ per Watt							
System Cost (Pre STCs)	1.95	1.80	1.65	1.65	1.65	1.65	1.65
STCs	0.82	0.71	0.66	0.61	0.59	0.53	0.48
Net Cost	1.13	1.09	0.99	1.04	1.06	1.12	1.17
STC % of Total Cost	41.9%	39.6%	39.8%	36.7%	35.5%	32.3%	29.0%
STC Price	\$39.44	\$36.81	\$36.53	\$36.53	\$38.53	\$38.53	\$38.53
STCs/kWatt	20.73	19.35	17.97	16.58	15.20	13.82	12.44
STC \$/Watt value	0.82	0.71	0.66	0.61	0.59	0.53	0.48

Average Nominal Payback (assuming 5 kW system)

	NSW	VIC	QLD	SA	WA	TAS	NT	ACT
2016	8.66	11.65	8.08	6.83	8.11	12.59	5.22	11.49
2017	6.59	9.15	6.98	5.05	7.71	10.51	5.02	8.66
2018	5.23	7.27	5.49	3.77	6.66	9.16	4.57	6.85
2019	4.70	4.31	5.47	3.57	6.59	8.45	4.48	6.22
2020	5.47	4.90	6.44	3.91	5.62	8.40	4.54	6.23
2021	6.50	6.73	7.56	4.96	6.12	9.47	4.85	6.87
2022	7.15	7.84	8.24	5.35	6.59	10.12	5.10	7.37

Average simple paybacks on an annual basis

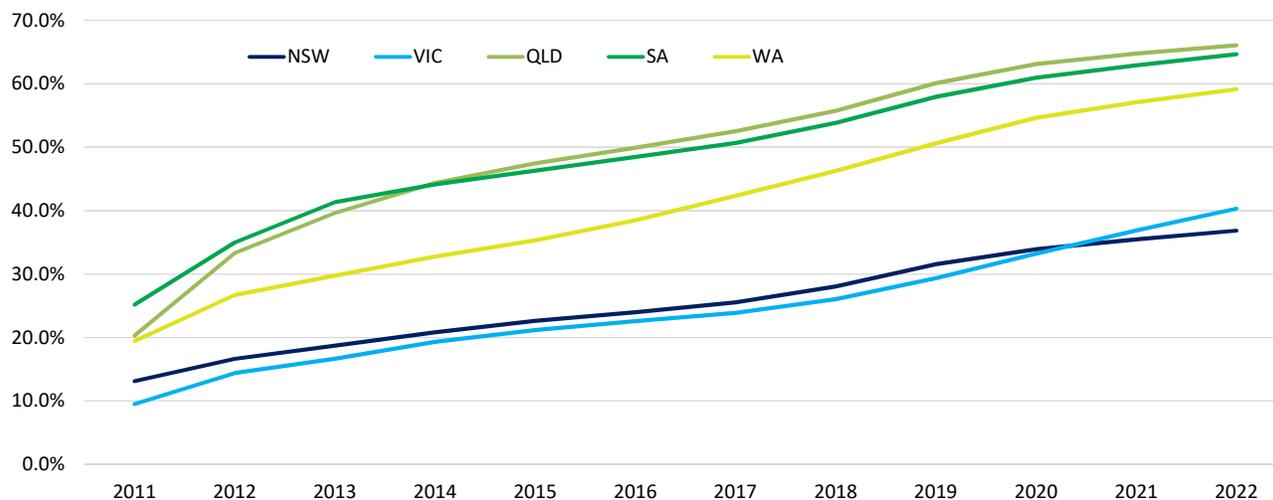


Solar PV Residential Systems by State

	2	3	4	5	6	7	8	9	
	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	Total
Systems installed									
2009	13,990	8,429	18,260	8,594	11,142	1,452	206	802	62,875
2010	69,667	35,658	48,548	16,666	22,209	1,883	620	2,311	197,562
2011	79,158	58,950	92,968	62,212	50,235	2,402	368	6,766	353,059
2012	52,937	64,769	123,257	41,022	40,734	6,000	475	1,472	330,666
2013	31,518	31,598	62,220	27,579	19,787	6,878	976	2,267	182,823
2014	33,022	37,545	49,146	13,194	21,158	3,804	954	1,177	160,000
2015	28,677	28,293	33,800	10,291	18,733	1,830	1,084	976	123,684
2016	22,616	23,140	28,520	10,715	21,818	2,272	1,530	850	111,461
2017	31,260	26,230	38,473	13,346	28,213	2,106	1,709	1,717	143,054
2018	46,603	40,773	45,832	17,998	29,385	2,178	2,049	2,885	187,703
2019	63,376	58,512	59,477	22,667	32,673	2,462	2,899	3,415	245,481
2020	46,045	68,200	46,308	17,754	31,791	3,196	1,831	1,743	216,867
2021	33,589	67,000	32,538	12,646	23,536	2,418	1,341	1,338	174,407
2022	31,160	66,000	30,044	11,895	21,803	2,324	1,248	1,291	165,765
Cumulative Installations									
2011	191,919	121,168	187,680	103,431	100,664	7,112	2,217	12,043	726,234
2012	244,856	185,937	310,937	144,453	141,398	13,112	2,692	13,515	1,056,900
2013	276,374	217,535	373,157	172,032	161,185	19,990	3,668	15,782	1,239,723
2014	309,396	255,080	422,303	185,226	182,343	23,794	4,622	16,959	1,399,723
2015	338,073	283,373	456,103	195,517	201,076	25,624	5,706	17,935	1,523,407
2016	360,689	306,513	484,623	206,232	222,894	27,896	7,236	18,785	1,634,868
2017	391,949	332,743	523,096	219,578	251,107	30,002	8,945	20,502	1,777,922
2018	438,552	373,516	568,928	237,576	280,492	32,180	10,994	23,387	1,965,625
2019	501,928	432,028	628,405	260,243	313,165	34,642	13,893	26,802	2,211,106
2020	547,973	500,228	674,713	277,997	344,956	37,839	15,724	28,545	2,427,973
2021	581,562	567,228	707,251	290,643	368,492	40,257	17,064	29,883	2,602,380
2022	612,722	633,228	737,295	302,538	390,295	42,581	18,312	31,174	2,768,145
Penetration rates									
2011	13.1%	9.5%	20.3%	25.2%	19.4%	5.4%	9.0%	14.5%	15.0%
2012	16.6%	14.4%	33.3%	34.9%	26.7%	9.9%	10.6%	15.7%	21.6%
2013	18.7%	16.6%	39.6%	41.3%	29.7%	15.0%	14.0%	17.6%	25.1%
2014	20.8%	19.3%	44.4%	44.2%	32.8%	17.8%	17.2%	18.4%	28.1%
2015	22.6%	21.1%	47.5%	46.3%	35.3%	19.1%	20.6%	19.0%	30.2%
2016	24.0%	22.6%	49.9%	48.5%	38.5%	20.7%	25.4%	19.5%	32.1%
2017	25.5%	23.8%	52.5%	50.7%	42.3%	21.9%	30.7%	21.0%	34.1%
2018	28.0%	26.0%	55.7%	53.8%	46.3%	23.1%	36.9%	23.6%	36.8%
2019	31.5%	29.4%	60.1%	57.9%	50.6%	24.4%	45.7%	26.8%	40.6%
2020	33.9%	33.2%	63.1%	61.0%	54.6%	26.3%	50.5%	28.2%	43.7%
2021	35.5%	36.8%	64.8%	62.9%	57.1%	27.6%	53.4%	29.1%	46.0%
2022	36.8%	40.3%	66.1%	64.7%	59.1%	28.9%	55.9%	30.1%	48.1%

Penetration Rate - Larger States

As proportion of Owner Occupied detached and semi-detached homes



Attachment 4

Certificate Creation - Solar PV Residential

	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	Total
Residential Systems installed (No.)									
2014	33,022	37,545	49,146	13,194	21,158	3,804	954	1,177	160,000
2015	28,677	28,293	33,800	10,291	18,733	1,830	1,084	976	123,684
2016	22,616	23,140	28,520	10,715	21,818	2,272	1,530	850	111,461
2017	31,260	26,230	38,473	13,346	28,213	2,106	1,709	1,717	143,054
2018	46,603	40,773	45,832	17,998	29,385	2,178	2,049	2,885	187,703
2019	63,376	58,512	59,477	22,667	32,673	2,462	2,899	3,415	245,481
2020	46,045	68,200	46,308	17,754	31,791	3,196	1,831	1,743	216,867
2021	33,589	67,000	32,538	12,646	23,536	2,418	1,341	1,338	174,407
2022	31,160	66,000	30,044	11,895	21,803	2,324	1,248	1,291	165,765
Average system size (kW/system)									
2014	3.67	3.79	4.26	4.47	3.61	4.30	4.61	3.80	3.96
2015	4.27	4.03	4.61	4.66	3.96	4.02	4.73	4.46	4.30
2016	4.52	4.24	5.06	4.90	4.56	3.94	4.84	5.20	4.64
2017	5.24	4.87	5.68	5.48	5.11	4.83	5.81	5.45	5.29
2018	6.12	5.71	6.45	6.26	5.51	5.42	6.74	5.99	6.03
2019	6.77	6.05	7.06	6.94	5.94	5.76	6.97	7.01	6.57
2020	6.97	6.23	7.28	7.15	6.11	5.00	7.18	7.22	6.67
2021	7.04	6.30	7.35	7.22	6.17	5.00	7.25	7.29	6.68
2022	7.11	6.36	7.42	7.29	6.24	5.05	7.32	7.36	6.74
Installed Capacity (MW)									
2014	121.3	142.2	209.5	59.0	76.4	16.3	4.4	4.5	633.5
2015	122.6	114.0	155.8	48.0	74.2	7.4	5.1	4.4	531.3
2016	102.3	98.1	144.4	52.5	99.5	9.0	7.4	4.4	517.5
2017	163.7	127.7	218.7	73.2	144.1	10.2	9.9	9.4	756.8
2018	285.4	233.0	295.8	112.6	161.8	11.8	13.8	17.3	1131.5
2019	429.2	354.1	420.1	157.3	193.9	14.2	20.2	23.9	1613.0
2020	321.2	425.1	336.9	126.9	194.4	16.0	13.1	12.6	1446.2
2021	236.6	421.8	239.1	91.3	145.3	12.1	9.7	9.8	1165.8
2022	221.7	419.7	223.0	86.8	136.0	11.7	9.1	9.5	1117.5
2019 Avge Zone Rating	1.377	1.188	1.377	1.371	1.377	1.177	1.535	1.376	1.335
Average Certificates/kW installed									
2014	20.6	17.8	20.7	20.5	20.6	17.6	23.3	20.6	19.9
2015	20.7	17.8	20.6	20.6	20.6	17.6	23.2	20.6	20.0
2016	20.7	17.9	20.7	20.6	20.6	17.6	23.1	20.6	20.1
2017	19.3	16.7	19.3	19.2	19.3	16.5	21.6	19.3	18.8
2018	17.9	15.5	17.9	17.8	17.9	15.3	20.0	17.9	17.4
2019	16.5	14.3	16.5	16.5	16.5	14.1	18.4	16.5	16.0
2020	15.1	13.1	15.1	15.1	15.2	12.9	16.9	15.1	14.7
2021	13.8	11.9	13.8	13.7	13.8	11.8	15.4	13.8	13.4
2022	12.4	10.7	12.4	12.3	12.4	10.6	13.8	12.4	12.0
Calculated Certificates ('000) ##									
2014	2,503	2,532	4,326	1,212	1,573	288	102	92	12,628
2015	2,535	2,033	3,215	986	1,527	130	119	90	10,635
2016	2,117	1,753	2,982	1,079	2,049	158	171	91	10,401
2017	3,158	2,133	4,214	1,405	2,774	167	214	180	14,245
2018	5,112	3,609	5,292	2,007	2,895	181	276	309	19,682
2019	7,092	5,049	6,942	2,589	3,206	200	372	395	25,846
2020	4,865	5,556	5,103	1,915	2,945	207	222	190	21,003
2021	3,259	5,012	3,292	1,252	2,002	142	149	134	15,243
2022	2,748	4,488	2,763	1,071	1,686	124	126	118	13,124

Notes

These are certificates that are eligible to be created on a generation year basis and do not allow for the a delay from system installation to certificate approval

New Non Residential PV installations

Attachment 5

		2015	2016	2017	2018	2019	2020	2021	2022
Systems									
	ACT	41	71	79	128	174	193	217	224
	NSW	2,419	2,161	2,949	3,918	5,539	5,642	6,232	6,426
	NT	75	167	139	161	152	176	194	202
	QLD	1,192	1,785	2,680	3,408	4,737	4,604	4,980	5,126
	SA	702	816	1,235	1,638	1,918	1,947	2,074	2,143
	TAS	88	98	150	202	167	178	196	204
	VIC	1,540	2,063	2,792	3,492	4,040	4,103	4,478	4,633
	WA	846	1,177	1,557	1,672	1,358	1,635	1,819	1,890
		6,903	8,338	11,581	14,619	18,084	18,479	20,190	20,848
kw/System									
	ACT	34.91	29.01	31.48	30.24	30.24	30.24	30.24	30.24
	NSW	18.00	20.11	19.62	19.87	19.87	19.87	19.87	19.87
	NT	41.04	28.70	36.13	32.42	32.42	32.42	32.42	32.42
	QLD	18.52	19.15	21.06	20.10	20.10	20.10	20.10	20.10
	SA	18.31	22.57	25.75	24.16	24.16	24.16	24.16	24.16
	TAS	19.99	24.31	23.80	24.06	24.06	24.06	24.06	24.06
	VIC	18.80	18.81	22.85	20.83	20.83	20.83	20.83	20.83
	WA	22.05	20.20	21.90	21.05	21.05	21.05	21.05	21.05
		19.17	20.13	22.02	22.92	21.44	20.96	20.96	20.96
Installed capacity (kW)									
	ACT	1,431	2,060	2,487	3,785	3,929	5,835	6,569	6,787
	NSW	43,533	43,460	57,860	85,903	98,572	112,084	123,798	127,659
	NT	3,078	4,794	5,022	5,416	5,191	5,708	6,291	6,556
	QLD	22,072	34,176	56,433	69,926	93,755	92,548	100,097	103,034
	SA	12,854	18,419	31,798	42,900	44,981	47,031	50,099	51,780
	TAS	1,759	2,383	3,571	5,116	4,653	4,289	4,718	4,905
	VIC	28,952	38,796	63,798	85,040	104,803	85,463	93,273	96,487
	WA	18,653	23,770	34,095	36,948	31,927	34,420	38,290	39,782
		132,331	167,857	255,064	335,034	387,809	387,377	423,136	436,991
			26.8%	52.0%	31.4%	15.8%	-0.1%	9.2%	3.3%
Certificates/kW									
	ACT	20.72	20.71	18.97	17.62	16.26	14.91	13.55	12.20
	NSW	20.77	20.80	19.39	18.01	16.62	15.24	13.85	12.47
	NT	23.23	23.22	21.64	20.09	18.55	17.00	15.46	13.91
	QLD	20.77	20.78	19.40	18.02	16.63	15.25	13.86	12.47
	SA	20.69	20.60	19.28	17.90	16.52	15.15	13.77	12.39
	TAS	17.74	17.75	16.57	15.39	14.20	13.02	11.83	10.65
	VIC	18.18	18.24	16.88	15.67	14.47	13.26	12.06	10.85
	WA	20.75	20.62	19.37	17.98	16.60	15.22	13.83	12.45
		20.21	20.18	18.75	17.39	16.02	14.79	13.39	12.10
Certificates created									
	ACT	29,646	42,656	47,188	66,683	63,898	86,981	89,032	82,789
	NSW	904,251	904,174	1,122,150	1,547,020	1,638,609	1,707,964	1,714,974	1,591,613
	NT	71,494	111,299	108,671	108,828	96,275	97,039	97,232	91,198
	QLD	458,368	710,262	1,095,006	1,259,894	1,559,299	1,410,961	1,387,312	1,285,222
	SA	265,927	379,468	612,984	767,941	743,247	712,365	689,857	641,703
	TAS	31,211	42,298	59,160	78,708	66,077	55,839	55,835	52,240
	VIC	526,343	707,746	1,076,831	1,332,856	1,516,247	1,133,401	1,124,529	1,046,946
	WA	387,026	490,083	660,282	664,425	529,961	523,732	529,660	495,267
		2,674,266	3,387,986	4,782,272	5,826,354	6,213,614	5,728,283	5,688,433	5,286,980
			26.7%	41.2%	21.8%	6.6%	-7.8%	-0.7%	-7.1%

Residential PV Upgrades

Attachment 6

		2015	2016	2017	2018	2019	2020	2021	2022
Systems									
	ACT	41	71	146	179	191	300	255	238
	NSW	2,175	4,452	8,661	8,181	9,550	12,956	9,329	8,484
	NT	30	36	88	142	221	344	207	197
	QLD	4,334	3,864	4,915	5,291	7,085	9,482	6,029	5,530
	SA	994	948	1,462	1,954	2,547	3,662	2,215	2,052
	TAS	96	106	119	226	317	503	318	297
	VIC	1,399	1,389	2,045	2,527	2,405	3,332	2,550	2,189
	WA	1,152	1,118	1,524	1,942	2,390	4,415	3,295	3,060
		10,221	11,984	18,960	20,442	24,706	34,995	24,197	22,048
kw/System									
	ACT	3.11	5.29	4.39	6.03	6.03	6.03	6.03	6.03
	NSW	3.39	3.52	3.94	5.54	5.54	5.54	5.54	5.54
	NT	3.89	3.19	3.33	3.91	3.91	3.91	3.91	3.91
	QLD	2.95	3.99	4.88	6.47	6.47	6.47	6.47	6.47
	SA	4.40	4.23	4.77	6.17	6.17	6.17	6.17	6.17
	TAS	3.83	3.99	4.14	5.07	5.07	5.07	5.07	5.07
	VIC	3.42	3.48	3.99	5.21	5.21	5.21	5.21	5.21
	WA	2.20	3.04	3.77	5.39	5.39	5.39	5.39	5.39
		3.17	3.69	4.24	5.77	5.81	5.79	5.76	5.76
Installed capacity (kW)									
	ACT	127	376	642	1,079	1,151	1,810	1,540	1,435
	NSW	7,371	15,683	34,131	45,352	52,939	71,823	51,715	47,033
	NT	117	115	293	555	866	1,346	809	769
	QLD	12,766	15,420	23,990	34,226	45,832	61,337	38,999	35,773
	SA	4,371	4,009	6,973	12,052	15,709	22,588	13,661	12,656
	TAS	368	423	493	1,145	1,608	2,548	1,609	1,505
	VIC	4,786	4,827	8,150	13,156	12,519	17,348	13,273	11,398
	WA	2,531	3,396	5,742	10,475	12,891	23,816	17,773	16,508
		32,437	44,249	80,413	118,041	143,515	202,616	139,379	127,078
Certificates/kW									
	ACT	20.58	20.64	19.24	17.88	16.49	15.12	13.74	12.37
	NSW	20.81	20.83	19.32	17.97	16.56	15.18	13.80	12.42
	NT	23.60	23.35	21.67	20.05	18.57	17.03	15.48	13.93
	QLD	20.59	20.62	19.28	17.89	16.52	15.15	13.77	12.39
	SA	20.53	20.57	19.24	17.85	16.49	15.12	13.74	12.37
	TAS	17.64	17.63	16.44	15.29	14.09	12.92	11.75	10.57
	VIC	17.85	17.95	16.74	15.55	14.35	13.16	11.96	10.76
	WA	20.51	20.55	19.22	17.87	16.47	15.10	13.73	12.35
		20.20	20.37	19.02	17.64	16.32	14.96	13.59	12.24
Certificates created									
	ACT	2,623	7,751	12,346	19,298	18,983	27,366	21,161	17,748
	NSW	153,402	326,642	659,434	815,006	876,704	1,090,308	713,687	584,172
	NT	2,754	2,685	6,344	11,134	16,080	22,911	12,520	10,713
	QLD	262,812	318,014	462,459	612,278	757,300	929,035	537,002	443,316
	SA	89,712	82,482	134,156	215,134	259,058	341,451	187,733	156,538
	TAS	6,493	7,458	8,105	17,500	22,661	32,924	18,901	15,914
	VIC	85,453	86,642	136,457	204,553	179,663	228,223	158,741	122,688
	WA	51,911	69,786	110,356	187,139	212,358	359,634	243,988	203,953
		655,160	901,460	1,529,657	2,082,043	2,342,808	3,031,852	1,893,732	1,555,041
			37.6%	69.7%	36.1%	12.5%	29.4%	-37.5%	-17.9%

Non Residential Upgrade PV installations

Attachment 6

	2015	2016	2017	2018	2019	2020	2021	2022
Systems								
ACT	8	9	5	17	24	23	23	16
NSW	207	285	400	708	610	866	870	618
NT	8	12	14	14	33	19	19	14
QLD	181	256	382	627	630	732	719	511
SA	96	126	150	347	357	423	409	292
TAS	6	11	18	41	25	52	52	37
VIC	137	163	295	477	438	581	577	411
WA	66	86	111	126	155	183	185	133
	709	948	1,375	2,356	2,271	2,878	2,854	2,032
kw/System								
ACT	23.20	13.83	28.29	12.62	20.46	20.46	20.46	20.46
NSW	13.69	18.60	17.87	21.86	19.86	19.86	19.86	19.86
NT	42.91	32.09	14.41	35.08	24.75	24.75	24.75	24.75
QLD	11.66	21.77	19.78	20.73	20.26	20.26	20.26	20.26
SA	15.20	21.73	22.60	28.09	25.34	25.34	25.34	25.34
TAS	6.32	8.03	20.07	26.61	23.34	23.34	23.34	23.34
VIC	15.26	17.12	19.00	21.22	20.11	20.11	20.11	20.11
WA	13.47	16.60	23.67	19.49	21.58	21.58	21.58	21.58
	14.04	19.44	19.66	22.31	21.11	21.03	21.01	21.01
Installed capacity (kW)								
ACT	186	124	141	214	485	461	472	336
NSW	2,835	5,301	7,147	15,477	12,115	17,209	17,279	12,285
NT	343	385	202	475	811	467	468	336
QLD	2,110	5,572	7,558	12,992	12,767	14,820	14,572	10,342
SA	1,459	2,738	3,390	9,736	9,045	10,713	10,375	7,393
TAS	38	88	361	1,082	580	1,217	1,217	873
VIC	2,091	2,791	5,605	10,113	8,813	11,691	11,599	8,273
WA	889	1,427	2,627	2,465	3,340	3,948	3,993	2,860
	9,952	18,427	27,032	52,555	47,957	60,527	59,975	42,698
Certificates/kW		85.2%	46.7%	94.4%	-8.7%	26.2%	-0.9%	-28.8%
ACT	20.71	20.70	19.33	17.94	16.56	15.18	13.80	12.42
NSW	20.84	20.79	19.45	18.05	16.67	15.28	13.90	12.51
NT	23.45	23.82	21.98	20.70	18.84	17.27	15.70	14.13
QLD	20.73	20.77	19.40	17.99	16.63	15.25	13.86	12.47
SA	20.66	20.61	19.29	17.89	16.53	15.16	13.78	12.40
TAS	17.71	17.72	16.56	15.39	14.20	13.01	11.83	10.65
VIC	17.96	18.55	17.05	15.72	14.62	13.40	12.18	10.96
WA	20.83	20.69	19.40	17.82	16.63	15.24	13.86	12.47
	20.26	20.46	18.90	17.51	16.26	14.85	13.50	12.15
Certificates created								
ACT	3,844	2,576	2,734	3,835	8,038	7,006	6,519	4,179
NSW	59,064	110,215	139,044	279,291	202,016	263,031	240,100	153,635
NT	8,050	9,172	4,436	9,841	15,273	8,062	7,343	4,749
QLD	43,749	115,748	146,649	233,685	212,345	225,950	201,966	129,004
SA	30,159	56,418	65,395	174,138	149,551	162,361	142,937	91,673
TAS	671	1,565	5,985	16,642	8,234	15,844	14,402	9,291
VIC	37,558	51,759	95,583	159,002	128,831	156,654	141,298	90,701
WA	18,523	29,537	50,974	43,930	55,533	60,185	55,333	35,673
	201,618	376,990	510,800	920,363	779,821	899,092	809,899	518,904
		87.0%	35.5%	80.2%	-15.3%	15.3%		

SWH Systems New Buildings

Attachment 7

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
SWH systems installed														
ACT	507	236	422	432	190	135	266	374	364	341	185	184	185	181
NSW	3,361	5,098	4,522	2,579	2,646	2,946	3,076	3,464	3,582	3,633	2,973	2,880	2,809	2,770
NT	346	436	522	653	578	525	655	581	547	373	212	238	264	284
QLD	10,652	10,497	9,359	9,042	6,529	5,219	4,419	4,900	5,461	5,420	5,108	5,085	5,180	5,451
SA	1,126	1,669	1,677	1,060	765	801	546	554	459	382	439	408	376	355
TAS	177	266	192	137	83	111	208	278	236	320	524	474	421	375
VIC	17,124	20,119	20,559	17,726	16,873	18,058	20,490	21,494	22,913	25,325	24,336	23,415	22,531	21,763
WA	4,123	5,728	5,077	4,710	4,652	4,000	3,603	2,537	1,804	1,538	1,595	1,697	1,864	1,995
Total	37,416	44,049	42,330	36,339	32,316	31,795	33,263	34,182	35,366	37,332	35,373	34,381	33,630	33,173
Certificates created														
ACT	18,125	7,501	13,138	12,503	6,071	4,684	9,304	12,528	12,509	10,548	5,744	5,724	5,735	5,048
NSW	131,981	172,125	145,841	83,654	87,769	97,782	98,380	110,068	108,922	112,831	93,220	90,289	88,077	78,155
NT	10,468	13,429	13,929	18,070	15,734	15,266	19,750	17,451	15,961	11,575	6,139	6,897	7,653	7,401
QLD	374,016	339,788	275,585	259,317	198,795	171,276	145,694	151,905	168,901	164,065	152,833	152,132	154,981	146,787
SA	38,281	54,845	51,074	29,642	22,678	25,088	17,466	17,122	14,229	12,390	13,323	12,380	11,417	9,686
TAS	11,377	8,115	4,994	3,889	2,401	3,429	6,115	8,356	7,047	9,543	15,334	13,859	12,304	9,860
VIC	457,839	533,397	531,095	434,730	461,636	511,680	589,200	626,379	672,769	739,403	723,294	695,931	669,645	582,155
WA	142,995	188,152	162,535	144,164	143,109	131,865	126,916	91,052	60,782	49,405	49,386	52,538	57,722	55,593
Total	1,185,082	1,317,352	1,198,191	985,969	938,193	961,070	1,012,825	1,034,861	1,061,120	1,109,760	1,059,273	1,029,749	1,007,534	894,687
Certificates per SWH System														
ACT	35.7	31.8	31.1	28.9	32.0	34.7	35.0	33.5	34.4	30.9	31.0	31.0	31.0	27.9
NSW	39.3	33.8	32.3	32.4	33.2	33.2	32.0	31.8	30.4	31.1	31.4	31.4	31.4	28.2
NT	30.3	30.8	26.7	27.7	27.2	29.1	30.2	30.0	29.2	31.0	29.0	29.0	29.0	26.1
QLD	35.1	32.4	29.4	28.7	30.4	32.8	33.0	31.0	30.9	30.3	29.9	29.9	29.9	26.9
SA	34.0	32.9	30.5	28.0	29.6	31.3	32.0	30.9	31.0	32.4	30.3	30.3	30.3	27.3
TAS	64.3	30.5	26.0	28.4	28.9	30.9	29.4	30.1	29.9	29.8	29.2	29.2	29.2	26.3
VIC	26.7	26.5	25.8	24.5	27.4	28.3	28.8	29.1	29.4	29.2	29.7	29.7	29.7	26.7
WA	34.7	32.8	32.0	30.6	30.8	33.0	35.2	35.9	33.7	32.1	31.0	31.0	31.0	27.9
Total	31.7	29.9	28.3	27.1	29.0	30.2	30.4	30.3	30.0	29.7	29.9	30.0	30.0	27.0

SWH Systems

Replacement Market

Attachment 8

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
SWH systems installed																
ACT	414	888	1,467	724	616	302	263	316	306	303	341	384	543	571	599	629
NSW	5,489	16,528	82,095	33,427	20,809	8,231	6,499	6,695	5,536	5,147	5,389	5,246	4,574	4,803	5,043	5,295
NT	866	826	1,385	867	745	518	306	501	408	339	418	614	678	712	748	785
QLD	6,416	10,699	26,007	23,765	21,578	9,931	6,881	8,214	7,386	6,542	6,563	6,600	6,643	6,975	7,323	7,690
SA	1,966	4,080	7,668	5,143	3,767	2,413	2,218	1,129	2,011	1,727	2,158	2,468	2,580	2,709	2,845	2,987
TAS	237	734	2,092	1,167	1,533	762	744	851	595	669	798	806	1,028	1,080	1,133	1,190
VIC	1,677	8,759	24,996	7,614	5,887	3,868	2,735	2,555	2,597	6,208	6,213	6,760	5,220	5,481	5,755	6,043
WA	6,604	8,792	11,569	10,337	7,785	7,102	6,337	6,672	6,602	6,901	6,898	6,768	7,247	7,609	7,990	8,389
Total	23,669	51,306	157,279	83,044	62,720	33,127	25,983	26,933	25,441	27,836	28,778	29,646	28,513	29,939	31,436	33,008
Certificates created																
ACT	12,141	28,397	50,169	22,897	19,099	9,354	8,345	10,163	10,135	9,535	11,177	12,111	16,881	17,860	18,753	17,722
NSW	170,768	713,696	3,021,137	1,167,325	662,471	262,431	210,361	212,620	173,598	158,119	165,374	159,822	139,186	146,237	153,548	145,103
NT	26,915	26,505	65,827	31,740	20,807	14,673	8,781	13,514	11,362	9,709	12,288	17,385	19,342	20,235	21,247	20,079
QLD	191,928	346,445	1,045,900	793,279	666,758	309,804	217,464	256,632	231,221	203,310	202,000	203,719	204,961	215,246	226,008	213,578
SA	60,666	133,496	321,816	170,271	109,047	68,624	64,718	34,607	59,195	51,229	62,987	72,090	75,535	79,221	83,183	78,608
TAS	6,653	58,209	143,895	61,940	40,289	22,502	23,303	25,070	18,256	20,408	24,859	25,068	30,729	32,920	34,566	32,665
VIC	47,899	578,923	1,652,280	398,889	184,229	118,345	85,835	79,966	83,416	188,755	186,059	204,037	159,237	166,314	174,630	165,025
WA	184,539	287,502	385,193	310,613	220,545	198,832	185,532	194,235	196,657	204,032	205,085	198,785	209,979	221,984	233,083	220,264
Total	701,509	2,173,173	6,686,217	2,956,954	1,923,245	1,004,565	804,339	826,807	783,840	845,097	869,829	893,017	855,850	900,018	945,019	893,043
Certificates per SWH System																
ACT	29.3	32.0	34.2	31.6	31.0	31.0	31.7	32.2	33.1	31.5	32.8	31.5	31.1	31.3	31.3	28.2
NSW	31.1	43.2	36.8	34.9	31.8	31.9	32.4	31.8	31.4	30.7	30.7	30.5	30.4	30.4	30.4	27.4
NT	31.1	32.1	47.5	36.6	27.9	28.3	28.7	27.0	27.8	28.6	29.4	28.3	28.5	28.4	28.4	25.6
QLD	29.9	32.4	40.2	33.4	30.9	31.2	31.6	31.2	31.3	31.1	30.8	30.9	30.9	30.9	30.9	27.8
SA	30.9	32.7	42.0	33.1	28.9	28.4	29.2	30.7	29.4	29.7	29.2	29.2	29.3	29.2	29.2	26.3
TAS	28.1	79.3	68.8	53.1	26.3	29.5	31.3	29.5	30.7	30.5	31.2	31.1	29.9	30.5	30.5	27.4
VIC	28.6	66.1	66.1	52.4	31.3	30.6	31.4	31.3	32.1	30.4	29.9	30.2	30.5	30.3	30.3	27.3
WA	27.9	32.7	33.3	30.0	28.3	28.0	29.3	29.1	29.8	29.6	29.7	29.4	29.0	29.2	29.2	26.3
Total	29.6	42.4	42.5	35.6	30.7	30.3	31.0	30.7	30.8	30.4	30.2	30.1	30.0	30.1	30.1	27.1

Delay in Certificate creation

Attachment 9

Determining total number of STCs to be created for 2019 generation year

Data up to and including 31 December 2019

	Total created to 31 Dec 2019	Still to be created	Total	% to be created in 2020	% to be created as share of total to 31 Dec 2019
1. Solar PV					
New Non-Residential					
ACT	47,859	17,215	65,074	26.5%	35.97%
NSW	1,385,588	257,002	1,642,590	15.6%	18.55%
NT	84,316	12,008	96,324	12.5%	14.24%
QLD	1,337,658	221,985	1,559,643	14.2%	16.6%
SA	615,127	128,610	743,737	17.3%	20.9%
TAS	53,846	12,232	66,078	18.5%	22.7%
VIC	1,222,692	293,521	1,516,213	19.4%	24.0%
WA	469,825	62,740	532,565	11.8%	13.4%
	5,216,911	1,005,312	6,222,223	16.2%	19.3%
New Residential					
ACT	344,035	51,025	395,060	12.9%	14.8%
NSW	6,508,737	583,387	7,092,124	8.2%	9.0%
NT	344,065	27,941	372,006	7.5%	8.1%
QLD	6,542,812	399,197	6,942,009	5.8%	6.1%
SA	2,344,605	244,790	2,589,395	9.5%	10.4%
TAS	183,955	16,274	200,229	8.1%	8.8%
VIC	4,174,997	874,065	5,049,062	17.3%	20.9%
WA	3,061,626	144,019	3,205,645	4.5%	4.7%
	23,504,832	2,340,697	25,845,529	9.1%	10.0%
Upgrade and Replacement Systems					
All states	2,878,245	372,622	3,250,867	11.5%	12.9%
Total PV	31,599,988	3,718,631	35,318,619	10.5%	11.8%
2. SWH					
New Buildings	830,075	229,198	1,059,273	21.6%	27.6%
Replacement Market	787,496	68,354	855,850	8.0%	8.7%
	1,617,571	297,552	1,915,123	15.5%	18.4%