



Green Energy
Markets

STC Data modelling 2021 - 2023

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 2021 calendar year, and for the 2022 and 2023 calendar years.

In developing our projections for small generation units (SGUs) and solar water heaters (SWH) we have updated and expanded our models and databases used in developing our STC forecasts previously undertaken for the CER in 2019. 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 incorporated 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.

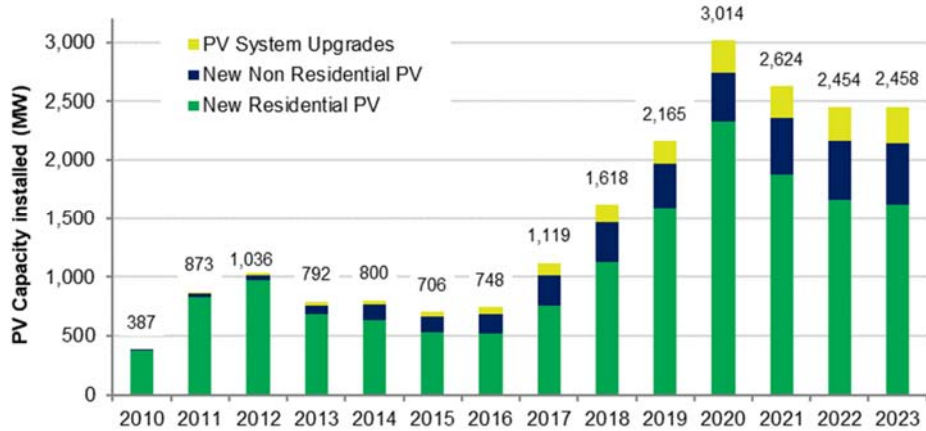
The following factors have been influential in the development of our estimates of the level of future solar installations:

- Daytime wholesale power prices are expected to continue to decline which will flow through to lower feed-in tariffs. The reduction in feed-in tariffs is not as dramatic as our past projections as retailers are expected to continue to offer tariffs exceeding the daytime wholesale price as part of customer retention and acquisition strategy;
- The Victorian Solar Homes Program is expected to underpin installations 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 residential installations is expected to continue to increase and is expected to exceed 7 kW (DC) which we had assumed to be a soft constraint in our previous projections (equivalent to 5kW AC inverter limit);
- We are now starting to see some technical and market challenges with the significant levels of roof-top PV being installed. These include low levels of minimum demand creating grid management issues, increasing levels of curtailment, moving to time of use tariffs as well as potential charges for PV exports. We have incorporated additional costs (or loss of revenue) in our payback model to account for these;
- The number of non-residential (commercial) PV system installations is expected to increase over the forecast period as these systems are typically not dependent on exporting electricity and system paybacks remain at reasonably attractive levels; and
- The number of SWH systems installed in new homes is expected to decline in 2021 and then increase from 2022 in line with expected increase in new home commencements. We expect an 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. In addition there are a number of new entrants installing air-sourced heat pumps that are also securing energy savings certificates where they replace electric storage systems.

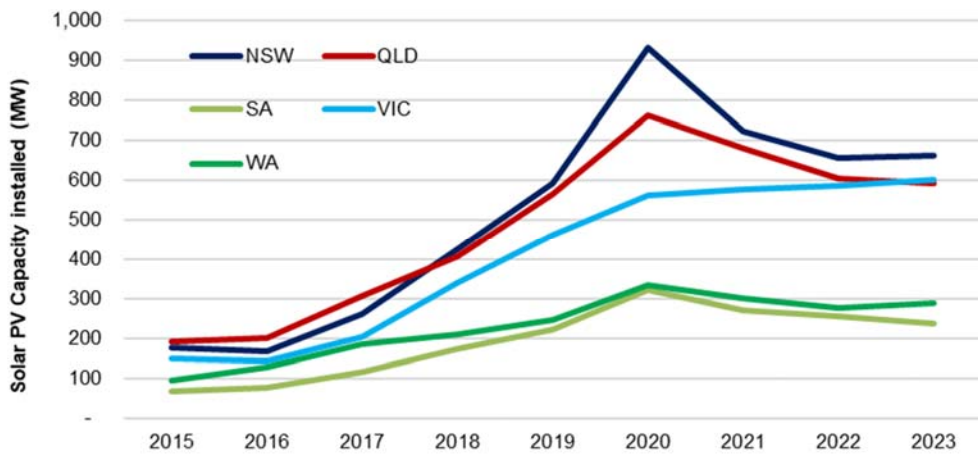
We estimate that 3,014 MW of solar PV was installed in 2020 which is a 39% increase on 2019 levels. We expect that the capacity installed in 2021 will fall by 13% to 2,624 MW and then decline to 2,458 MW by 2023.

PV Capacity installed by sector



The Victorian market underpinned by the government’s solar program is expected to remain buoyant over the forecast period as other states decline. Victoria’s share of capacity in 2023 is expected to be 24.4%, significantly higher than its 18.6% share in 2020.

PV Capacity installed by state



STC Data Modelling 2021-23

We expect that 46.1 million STCs will be submitted for registration in 2020 and 38.4 million in 2021. Summary of results are as follows:

'000 STCs	Actual 2018	Actual 2019	Estimate 2020	Forecast 2021	Forecast 2022	Forecast 2023
STCs for installations in year						
Solar PV	28,166	34,815	44,561	35,110	29,470	26,223
SWH	2,003	2,342	2,389	2,380	2,275	2,144
Total	30,169	37,158	46,949	37,490	31,745	28,368
Less						
STCs submitted following year (lag)	3,357	3,690	4,579	3,657	3,096	2,767
Add						
Previous year installs created this year	2,580	3,357	3,690	4,579	3,657	4,579
STCs submitted for creation	29,392	36,825	46,060	38,413	32,306	30,180

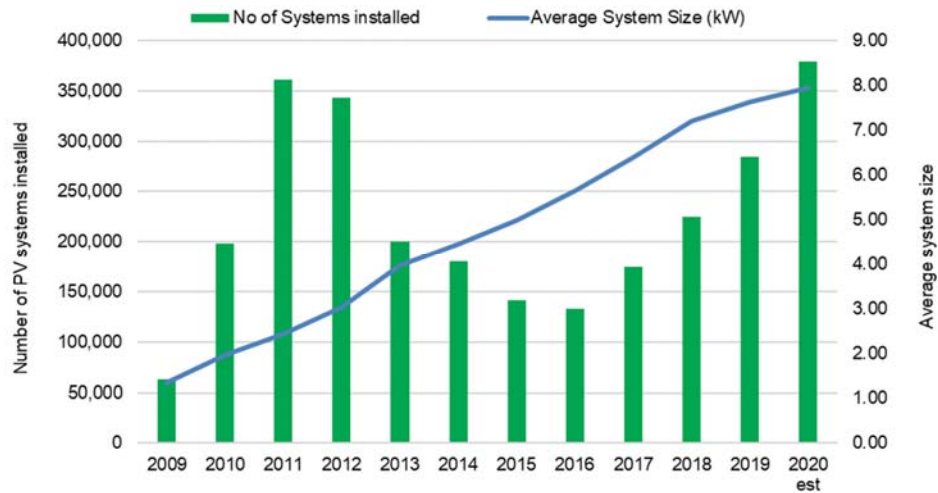
1. Introduction

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 2021 calendar year, and for 2022 and 2023 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 more than 95% of STCs.

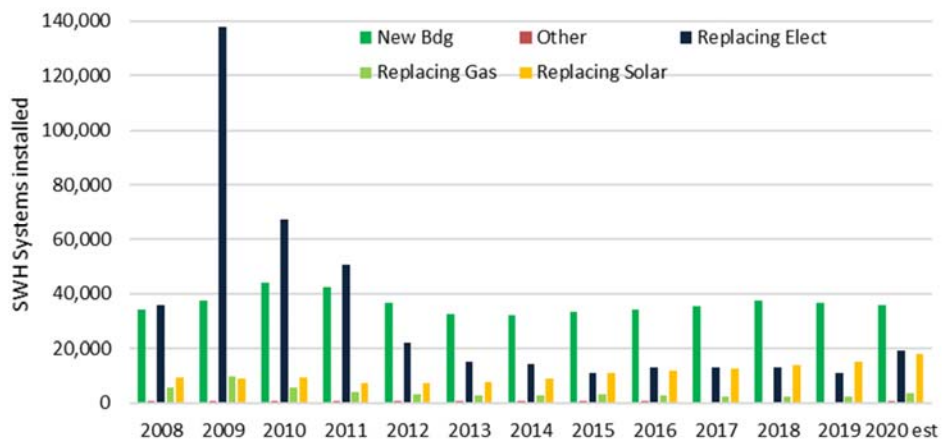
The growth in the number of solar PV installations has been primarily due to the surge in the demand from households and businesses as power prices have increased and solar PV has become a more financially attractive proposition. The average system size has continued to increase which has resulted in a significant expansion in the capacity installed and subsequent STC creation (Figure 1.1).

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



The SWH market, in contrast has been reasonably stable over the last nine years or so (Figure 1.2).

Figure 1.2 Number of SHW systems by type of system being replaced



As part of its report GEM is required to:

- model expected small-scale technology installations for 2021-2023. This will include forecasts of the number of STCs and installed capacity for the four compliance years from 2020 to 2023;
- identify key factors affecting the type, number and size of small-scale systems installed and the trends in STC creation by various categories including residential and commercial uptake across states and territories in Australia; and
- update prior years' modelling and estimates. This will include reviewing the current STC dataset and remodelling prior estimates for STC creations in light of any identified changes to circumstances. Variance between the prior and revised estimates is to be analysed and clearly specified.

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 year’s 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. This approach has been consistent with industry conventions at the time and was supported by detailed review by one of the largest certificate creators at the time. With the continued increase in average system size the notional capacity cut-off between residential and commercial has also increased and we expect it is now closer to 15 kW.

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 less 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 adjusted for changes in interest rates since 2015;
- 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. We have made a further enhancement to exclude the saturation

impact with regard to the level of new homes built over the last 15 years (refer to Section 4 for further details);

- 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 over the last two years (refer to Figure 4.1).

The six years from 2015 to 2020 provide a reasonable timeframe and cover new residential installations rising from 124,000 systems in 2015 to 327,000 systems in 2020. This now represents 6 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 developed linear equations that represent the relationship between the level of installation and the adjusted payback in that year.

Our approach can be represented by the following formula:

$$\text{Demand (year)} = \text{Systems derived from Payback equation (year)} \times \text{Relative Level of Saturation (year)} \times \text{Relative Customer Awareness Index (year)} \times \text{Relative Solar Industry Competitive Index (year)}$$

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.

3. Modelling upgrades and expansions 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 customers are expanding their systems in response to higher power prices and lower panel prices. While this market sector is still relatively small we expect it to continue to grow and become a much more important feature of the industry in future years as saturation increases and customers come off attractive historical feed-in tariffs. The commercial upgrade market at an estimated 75 MW 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). The commercial market which had been important previously is not significant and will not be separately analysed.

SWH systems in each state and each sub-market are separately modelled. Major inputs into this analysis will include building forecasts (new and total), 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.

5. Modelling other small generation unit certificates

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

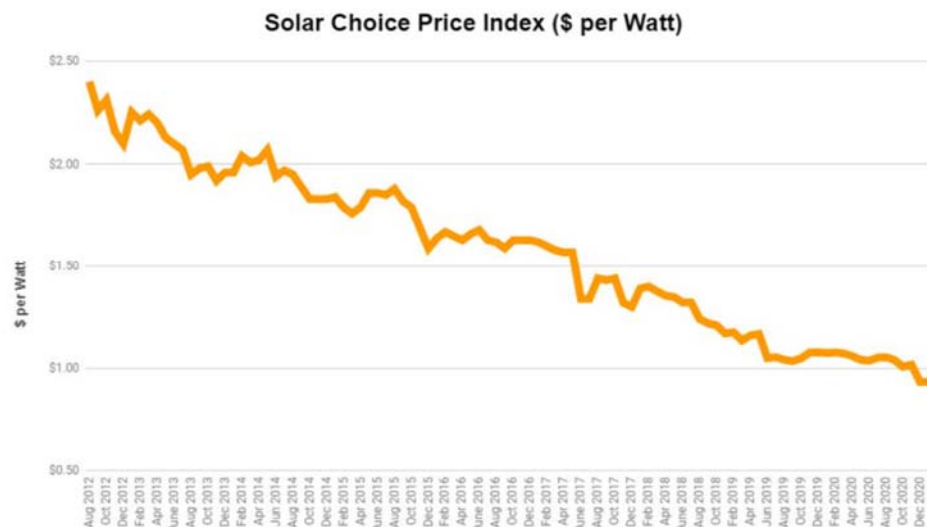
3. Assumptions

We have updated our assumptions and slightly refined our modelling approach in developing our STC forecasts for the 2021 to 2023 period. Key assumptions used are outlined in this section.

3.1 Forecasting Installed PV costs

Installed system costs (prior to STCs) have drifted lower during 2020. The most recent Solar Choice analysis shows that net system prices had levelled out over the last 12 months (Figure 3.1) and then reduced slightly in the last quarter of 2020. This equates to a reduction in gross system costs as the value of STCs generated has reduced from the start of 2020 with a reduction in the number of years deeming.

Figure 3.1 Installed system Costs (after STCs) (\$/Watt)
Source: Solar Choice, Jan 2021



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

We estimate that the average installed system cost (pre STCs) in 2020 will average \$1.48 per Watt which is slightly lower than the \$1.60 per Watt estimate for 2019. We have calibrated this cost based on the reported Solar Choice estimate of the average cost for a 7kW system of \$7,110 after STCs (we have also made allowance for the recent strengthening in the AUD/USD exchange rate).

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.

We expect to see modest reductions in module prices and continued gains in conversion efficiency, we also expect that lead generation and sales and marketing costs will increase as saturation increases and financial attractiveness reduces.

We expect to see only modest cost reductions over the next four years and as a result we assume that the current gross installed cost (prior to STCs) of \$1.48 reduces to \$1.41 per Watt by 2023 (nominal terms). The assumed cost reduction for equipment (modules and inverter etc) is consistent with CSIRO cost projections developed for AEMO (GenCost 2019-20, December 2019). For non-equipment related costs (ie. sales, marketing, administration and logistics) we have assumed that these remain constant in nominal terms.

3.2 Forecasting STC prices

Spot STC prices in 2020 have averaged \$38.55 (to end December). Spot prices averaged \$37.11 for 2019. 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 (other than for a brief period in April 2020). The resulting surplus of STCs in the market has meant that STCs have traded at a discount to the \$40 Clearing House Price (Figure 3.2).

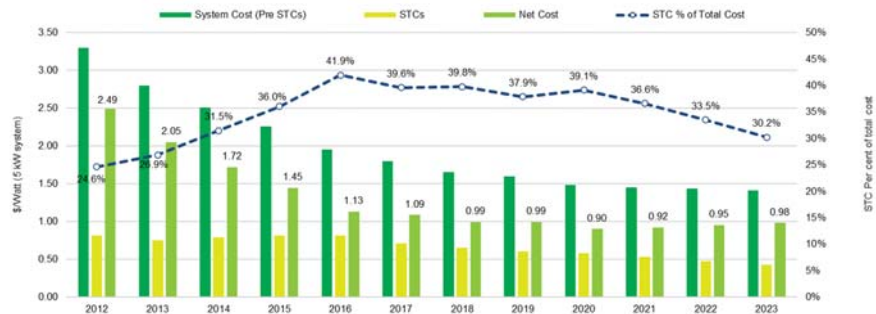
Figure 3.2 Spot STC prices and Clearing House Surplus/ Deficit



We assume that over the forecast period the STC market comes into better balance and that the Clearing House does not go into deficit. We are forecasting an underlying STC spot price of \$39 from 2021 to 2023 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 38% of the total cost of the system in 2019 and this is expected to drop considerably to 30% by 2023 as the number of years deeming reduces (Figure 3.3).

Figure 3.3 Forecast Installed system costs for residential 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 2020 Report) and is adjusted for standing charges utilising AEMC demand estimates. The electricity price that is assumed to be avoided by solar customers for the amount of electricity that they generate and consume on site is summarised in Figure 3.6.

A significant amount of large-scale solar generation capacity (8,000 MW) will be added over the 2017 to 2022 period. This is on top of even greater levels of roof-top solar PV and a further 7,000 MW of wind generation. As a result, we expect that wholesale market prices (during daytime hours when PV is generating) will drop considerably over the period to 2023 (refer to Figures 3.4 and 3.5 as examples).

These lower daytime wholesale power prices will not fully spill over into lower export prices for solar PV (Feed-in tariffs) as retailers are expected to continue to offer feed in tariffs exceeding the daytime wholesale price as part of customer retention and acquisition strategy. The price that is assumed to be paid for electricity that is exported to the grid is summarised in Figure 3.7.

We are now starting to see some technical and market challenges with the significant levels of roof-top PV being installed. These include low levels of minimum demand creating grid management issues, increasing levels of curtailment, moving to time of use tariffs as well as potential charges for PV exports. We have incorporated additional costs (or loss of revenue) in our payback model equivalent to \$30 per annum per kW from 2022 for the mainland NEM states to account for these.

Figure 3.4 Average Wholesale Electricity Prices by hour of day in NSW

Source: AEMC 2020 Electricity Price Trends (Dec 2020)

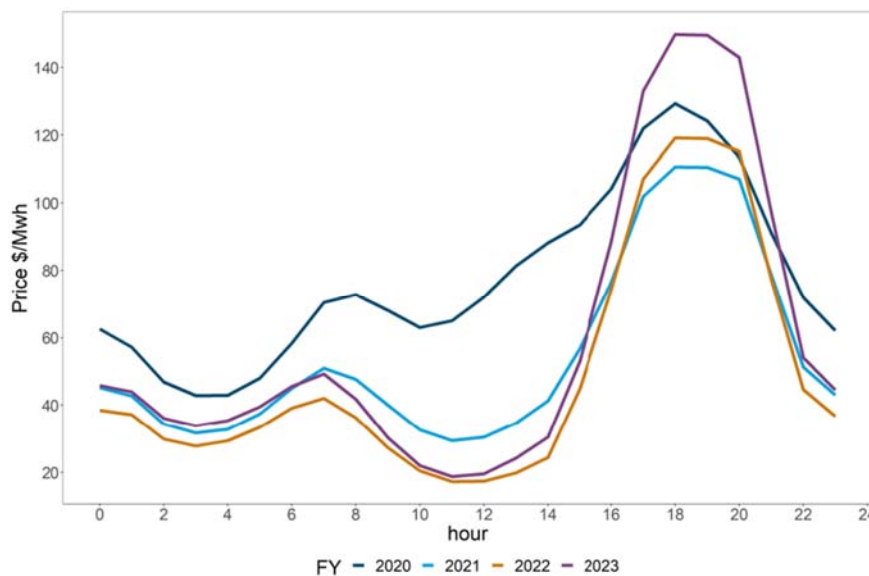


Figure 3.5 Percentage of negative prices in South Australia

Source: AEMC 2020 Electricity Price Trends (Dec 2020)

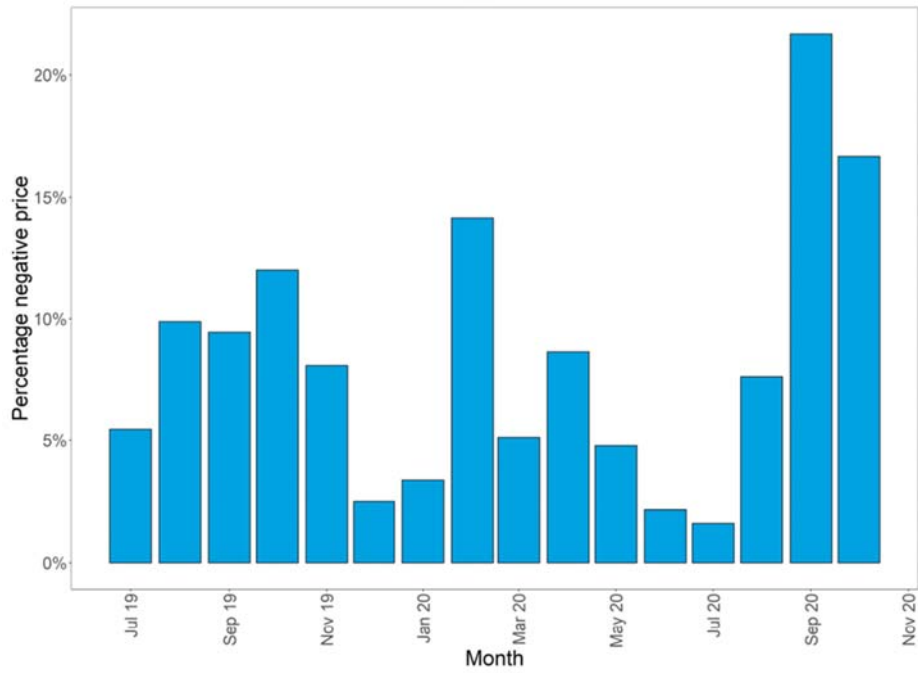


Figure 3.6 Avoidable electricity price (variable cents per kWh nominal)

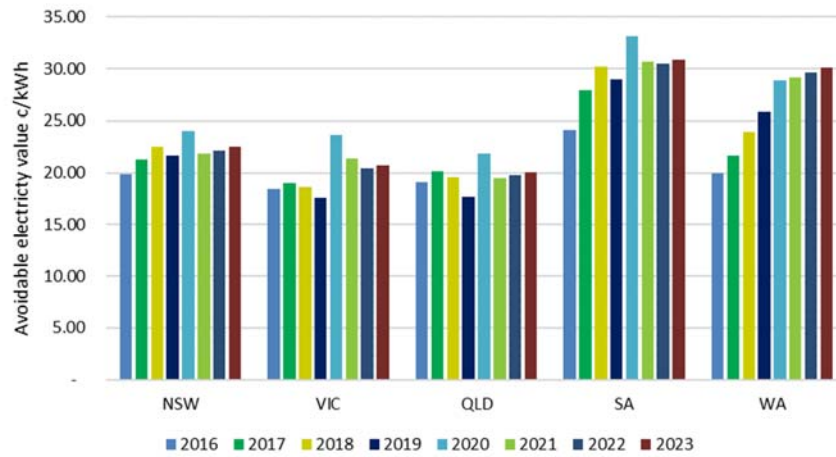
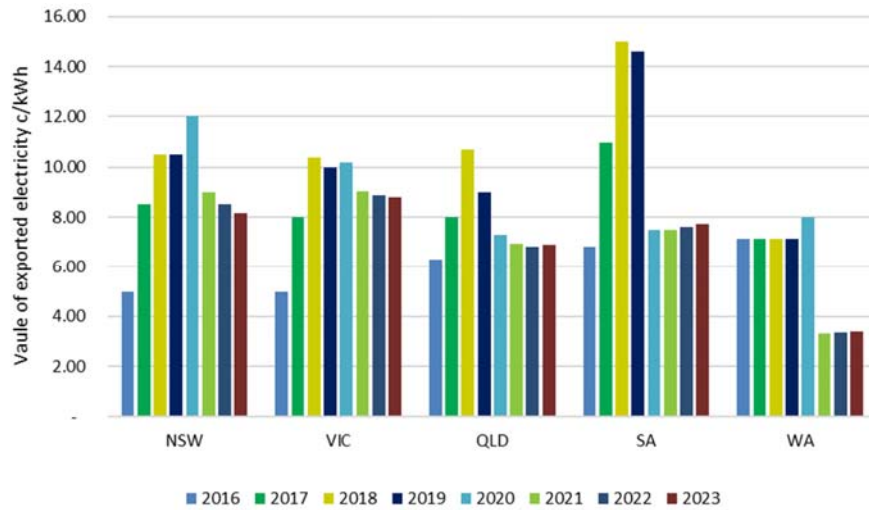


Figure 3.7 Value of exported electricity for key states (cents per kWh nominal)



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 have used a generic average system size for each state that is typical of what is currently being installed and is assumed to be generally 7.0 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 65% in the NT to 75% 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
- We assume that most of the power generated is consumed on site and that 20% of the electricity generated has no value (either not exported or exported at zero value).

Average system paybacks dropped dramatically in most NEM states since 2018 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 (Figures 3.8 and 3.9).

Figure 3.8 Simple Payback for typical residential PV system

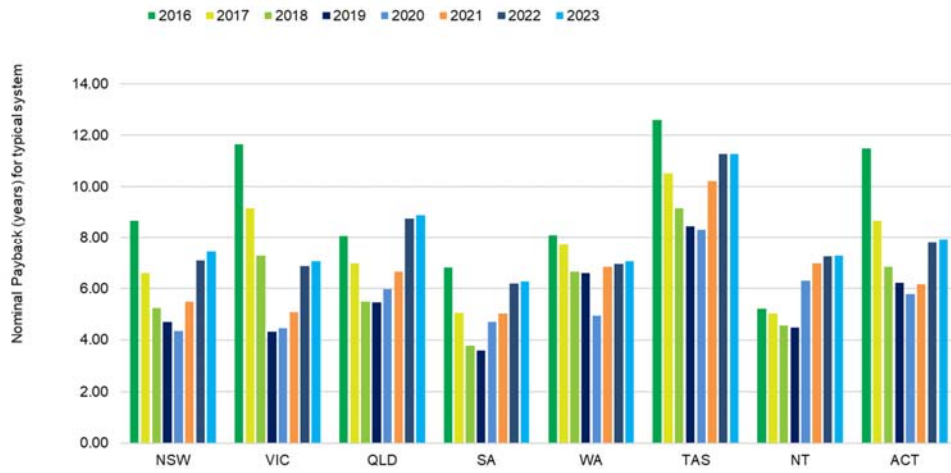
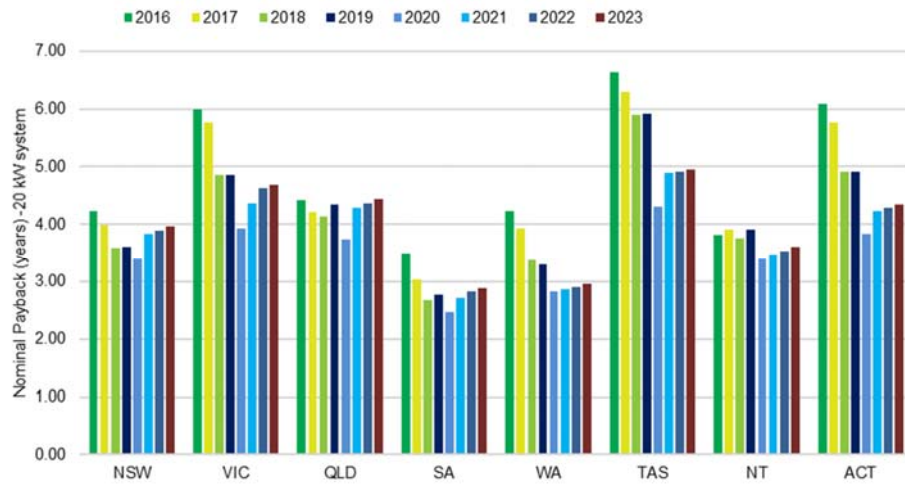


Figure 3.9 Simple Payback for typical Commercial PV system



4. Updated STC Forecasts for solar PV

We have updated our assumptions and slightly refined our modelling approach in developing our STC forecasts for the 2021 to 2023 period.

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:

- Still quite strong interest from households for solar PV as its performance (from both technical and financial perspective) is now well understood and accepted;
- Covid-19 and the resultant activity downturn initially had the impact of shrinking solar retailers work pipeline and potentially bringing sales and installations forward. Covid-19 has had a greater impact on the commercial market with sales taking longer to close and the uncertain economic outlook means many businesses are taking a "wait and see" approach;
- Concerns are starting to arise regarding additional costs or constraints being placed on solar PV (ie. new South Australian inverter standards requiring remote disconnection and voltage ride-through) and potential impact of curtailment. This may mean that battery systems become more attractive;
- Battery systems are still too expensive however there is an expectation that bundled with PV they may get within reasonable paybacks in the medium term;
- Increasing demand for electricians from other sectors (eg. energy efficiency programs) has resulted in some capacity constraints emerging and upward pressure on the cost of installing solar systems;
- Cost of generating sales leads is increasing, and conversion taking longer with higher levels of saturation; and
- Panel prices tend to have stabilised with recent strong Australian dollar offsetting some increase in equipment costs.

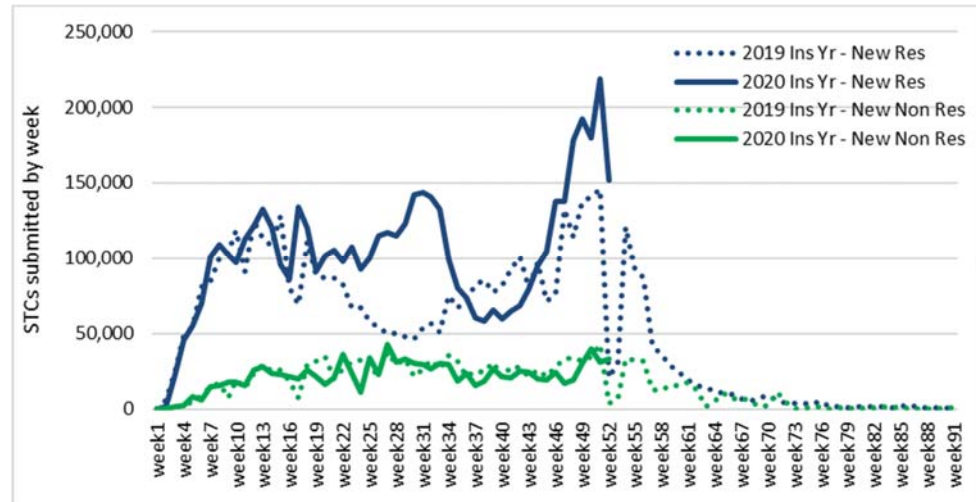
4.2 Estimated STCs to be created for 2020 Installations

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 2020 creation will be similar to that experienced in 2018 and 2019 with adjustments for the following:

- Observed quicker submittal of STC claims to the CER with the increasing use of Serial Panel Number Verification;
- Impact of new proposed inverter standards for PV in South Australia that may slow the market over the medium term;
- Significant growth in NSW and South Australia during 2020 likely due to (i) Covid-19 restrictions, particularly limitations on travel and entertainment has meant families have additional disposable expenditure which has been directed to solar and (ii) Solar retailers active in multiple states redirecting resources from Victoria to other states (including relocating installation teams); and
- Impact of the extended Lockdown stage 4 in Victoria where installations in metropolitan Melbourne ground to a halt for a number of weeks. Post lockdown

the level of activity surged in Victoria (refer to Figure 4.1). The commercial market has not been impacted as significantly.

Figure 4.1 STCs submitted on a weekly basis in Victoria by Installation year



The lag in creation for all market sectors is summarised in Attachment 9.

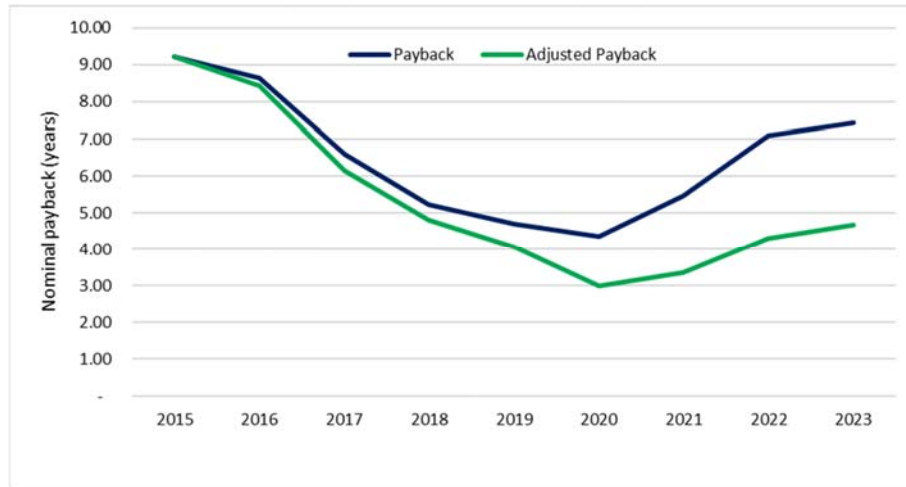
4.3 Forecasting new residential PV installations and STCs created

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). We have made a number of revisions to improve the accuracy of our projections including:

- With the reduction in interest rates over the last eight years customers will have modified their views as to what an acceptable payback is for solar. We have therefor scaled paybacks to incorporate the impact of lower interest rates. This enables the development of a more effective time series where historical paybacks and volumes can be related to and mapped against current financial parameters (refer to Figure 4.1)
- We have also incorporated the impact of the significant level of new homes that are expected to be built (approximately 100,000 per annum). We have done this by removing the saturation impact on the level of PV expected to be built on new homes built over a 15 year period. This has the impact of adding a further 6,000 installations across Australia in 2021 increasing to 9,400 by 2024.

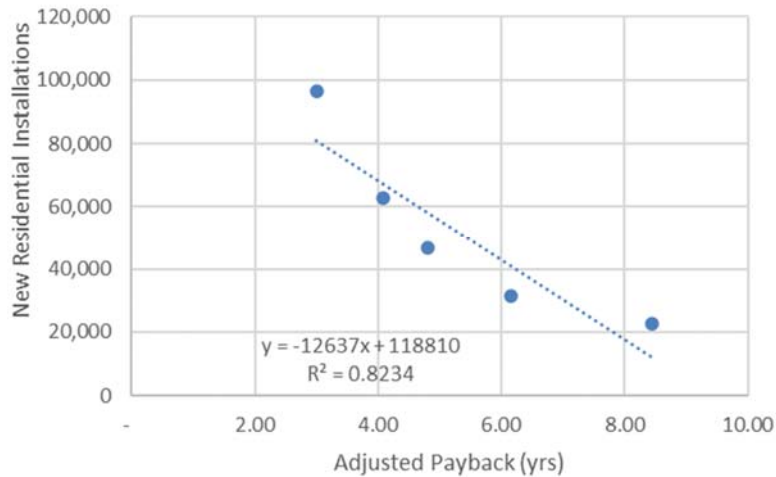
The results from our system payback model are summarised in Attachment 2 and shown in graphical form in Figure 3.6. Nominal paybacks have been adjusted to incorporate the impact of falling interest rates so that they can more meaningfully be compared to historical paybacks. The impact on paybacks for NSW installations is shown in Figure 4.2.

Figure 4.2 Nominal Payback adjusted for lower interest rates (NSW)



The adjusted payback each year for each state has been mapped against the level of installations each year to arrive at an equation that expresses the relationship between payback and the level of installations. The equation derived for NSW is shown in Figure 4.3.

Figure 4.3 NSW system installations as a function of Adjusted payback

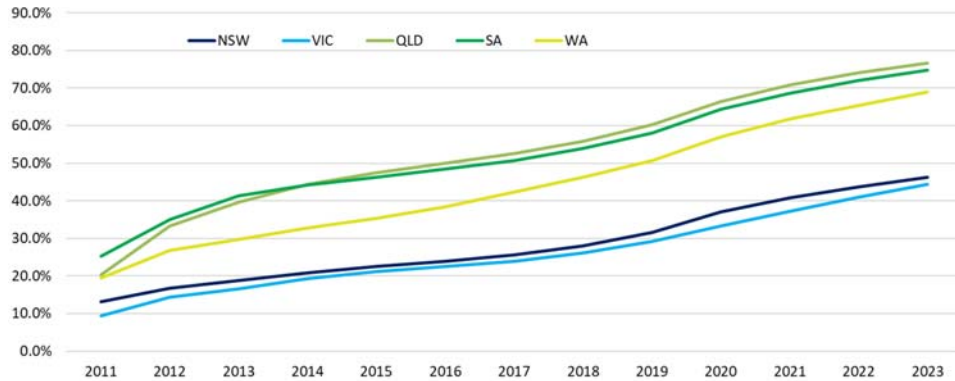


In our modelling we have assumed that the enhanced industry competitiveness and customer awareness remains in place for 2020 and 2021 similar to 2019 levels and then proceeds to get back to more normal levels by 2023.

We have assumed that the level of new residential installations in Victoria will be governed by the Victorian Solar Homes Program with the desire to support 650,000 residential PV systems over 10 years. 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.

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.

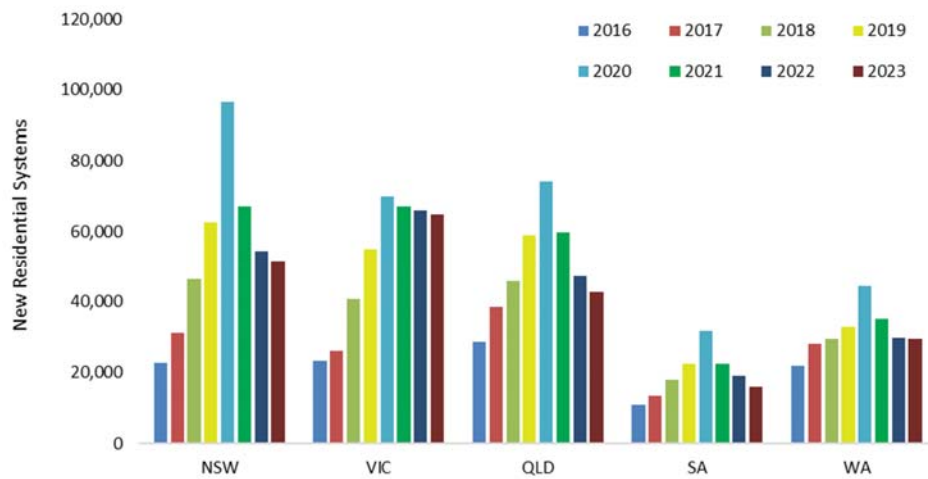
Figure 4.4 Penetration level by key state



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

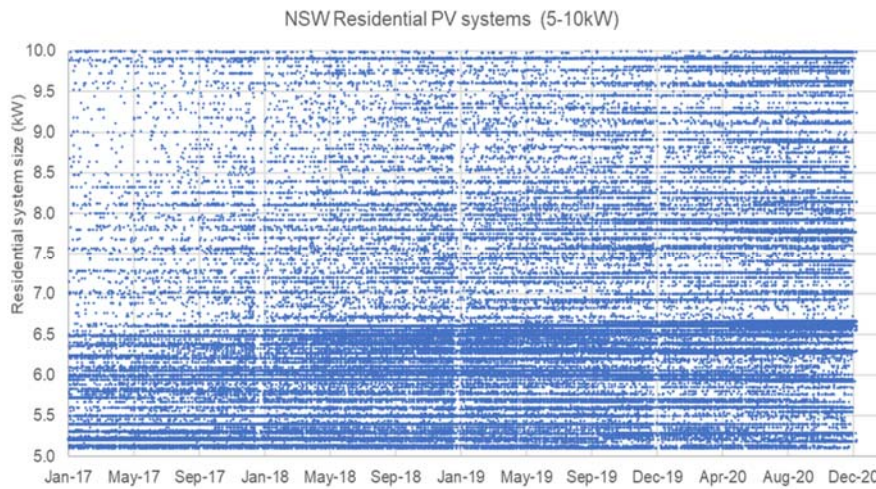
New residential system installations are expected to decline over the next three years as financial attractiveness deteriorates. The only exception is Victoria where installations are supported under the Solar Homes program (Figure 4.5).

Figure 4.5 New residential installations by key state



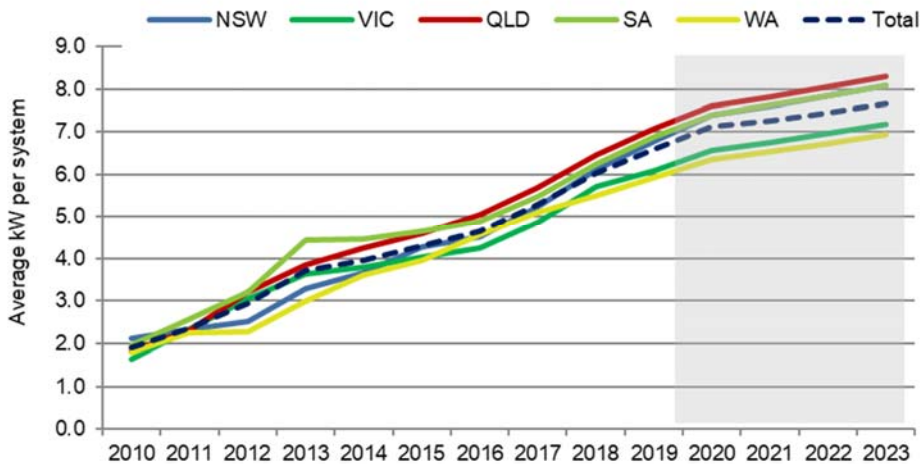
We are expecting only a modest slowdown in the increase in the average system size that has been experienced over the last few years. The soft electricity network constraint we had assumed in the past (limiting system size to between 6.5 to 7 kW) appears to no longer be the case. We have mapped the size of system installation for a number of states which shows that there are a larger number of much bigger systems being installed (refer to Figure 4.6).

Figure 4.6 Plot of residential system installations in NSW by size



We have assumed that the average system size increase by approximately 3% per annum increasing from 7.12 kW per system in 2020 to 7.65 kW per system by 2023.

Figure 4.7 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 4.8 below:

Figure 4.8 New residential solar installations and STC creation

Year of installation	Actual 2018	Actual 2019	Estimate 2020	Forecast 2021	Forecast 2022	Forecast 2023
Number of Systems Installed	187,694	240,905	327,301	258,860	222,810	211,329
Avgc kW/system	6.03	6.58	7.12	7.27	7.45	7.65
Avgc Certificates/kW	17.4	16.1	14.7	13.3	11.9	10.6
MW Installed	1,131.5	1,586.2	2,330.3	1,882.2	1,660.2	1,617.3
Eligible Certificates ('000)	19,681	25,476	34,354	25,076	19,804	17,122

4.4 Forecasting new commercial PV installations and STCs created

We identified in Section 2 of this report, that 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 year's 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 over the 2019 and 2020 years applies in future.

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 4.9.

Figure 4.9 New non-residential solar installations and STC creation

Year of installation	Actual 2018	Actual 2019	Estimate 2020	Forecast 2021	Forecast 2022	Forecast 2023
Number of Systems Installed	14,617	17,124	19,737	22,879	24,217	24,921
Avgc kW/system	22.92	22.21	20.99	21.06	21.05	21.06
Avgc Certificates/kW	17.4	16.0	14.9	13.4	12.2	10.8
MW Installed	335.0	380.4	414.3	481.7	509.7	524.5
Eligible Certificates ('000)	5,826	6,098	6,160	6,499	6,195	5,665

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. From 1 February 2018 replacement systems will no longer be eligible to create certificates. We have segmented these installations into residential and non-residential.

STC Data Modelling 2021-23

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 systems installed in recent years being above 6 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 4.10 and 4.11.

Figure 4.10 Upgrade residential solar installations and STC creation

Year of installation	Actual 2018	Actual 2019	Estimate 2020	Forecast 2021	Forecast 2022	Forecast 2023
Number of Systems Installed	20,459	23,641	30,183	27,242	29,270	32,197
Avgc kW/system	5.11	5.81	6.45	6.63	6.82	6.63
Avgc Certificates/kW	17.6	16.3	15.0	13.6	12.2	10.9
MW Installed	104.5	137.4	194.6	180.7	199.7	226.3
Eligible Certificates ('000)	1,844	2,244	2,924	2,457	2,443	2,460

Figure 4.11 Upgrade non-residential solar installations and STC creation

Year of installation	Actual 2018	Actual 2019	Estimate 2020	Forecast 2021	Forecast 2022	Forecast 2023	Forecast 2024
Number of Systems Installed	2,085	2,404	2,339	2,787	2,952	3,148	3,603
Avgc kW/system	22.32	25.52	32.07	28.41	28.44	28.41	28.44
Avgc Certificates/kW	17.5	16.2	15.0	13.6	12.3	10.9	9.5
MW Installed	46.5	61.4	75.0	79.2	84.0	89.6	102.5
Eligible Certificates ('000)	815	997	1,122	1,077	1,029	976	977

5. Updated STC Forecasts for SWH

Overview

We estimate that more than 79,000 SWH systems will be installed and create certificates in 2020 which is a 2% increase on 2019 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 that create certificates as the data point will understate the real level of SWH installations in new homes by 20-25%.

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 commencements is expected to fall in all states as a result of Covid-19 and subsequent economic downturn over the next year or so and then start to increase as recovery gets underway. We have used the latest forecast by the Master Builders Association (updated in August 2020) which incorporates an assessment of the impact of the economic downturn (Figure 5.1), We have derived state figures in Figure 5.1 based on the MBA's February forecast and then applied an adjustment following their August revision.

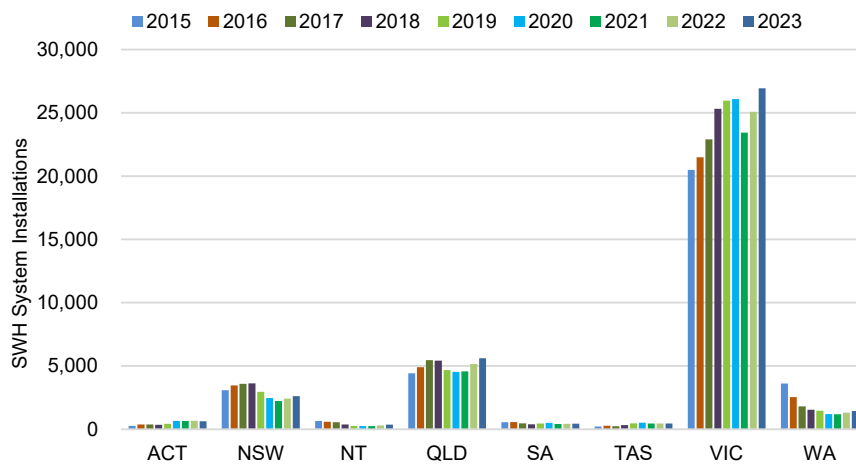
Figure 5.1 Master Builders Association (MBA) – New Home commencements

	2019	2020	2021	2022	2023	2024
ACT	0.97%	-12.97%	-2.13%	-0.82%	-7.52%	6.17%
NSW	-13.90%	-24.97%	-11.56%	5.88%	5.37%	13.16%
NT	-19.73%	-22.17%	-3.06%	17.47%	17.30%	20.69%
QLD	-15.59%	-17.61%	-1.61%	10.19%	6.25%	11.54%
SA	-9.51%	-19.47%	-18.13%	-2.20%	0.41%	11.06%
TAS	3.74%	-15.85%	-14.24%	-2.08%	-2.27%	8.84%
VIC	-9.04%	-19.76%	-12.68%	4.51%	4.95%	11.77%
WA	-12.26%	-16.11%	-3.20%	8.69%	7.02%	14.72%
	-11.71%	-20.04%	-9.29%	6.00%	5.08%	12.29%

We do not envisage any changes to new building regulations over the forecast period that will have a material impact on the level of SWH installations. We have not assumed any impact from any possible future measures from the National Construction Code 2022 Energy Efficiency project. We have used the MBA forecast of new home commencements as the basis for our 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 submarket

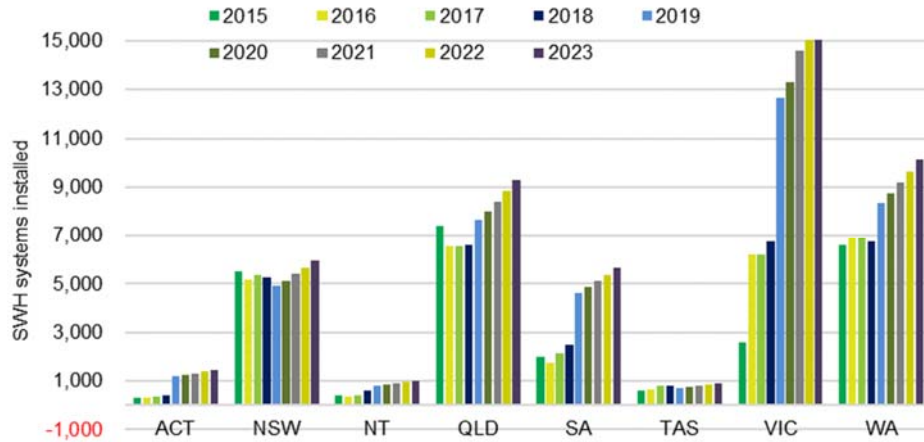
At the time of replacement, most hot water systems are replaced with the same or similar type of system. The dynamics of the replacement market, which are often dictated by a rush to replace a broken or failed water heater, mean there is little time and/or financial liquidity to make thoroughly researched 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, a EWH system replaced by a SWH system can generate approximately 30 Victorian Energy Efficiency Certificates (VEECs). With the recent increase in the VEEC price following the announcement of the expansion of the scheme, VEECs provide an added financial incentive of more than \$1000 per system. This has helped drive extra SWH system installations in Victoria. Under the Solar Homes Program a \$1000 rebate will be available on the installation of a SWH. In addition we have seen the emergence of new competitors (selling and installing ASHPs) in this market which has resulted in a higher level of overall installations.

We forecast that the replacement market will grow over the coming four-year 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 2023 forecast period will be similar to the average levels achieved over the 2019 to 2020 period.

Figure 5.4 Certificate creation from SWH

Year of installation	Actual 2018	Actual 2019	Estimate 2020	Forecast 2021	Forecast 2022	Forecast 2023
New Buildings						
Number of Systems Installed	37,330	36,645	36,179	33,196	35,801	38,474
Avg Certificates/System	29.7	29.7	30.0	29.9	26.9	23.9
Eligible Certificates ('000)	1,110	1,089	1,085	991	962	919
Replacement						
Number of Systems Installed	29,646	40,889	42,933	45,744	48,031	50,433
Avg Certificates/System	30.1	30.7	30.4	30.4	27.3	24.3
Eligible Certificates ('000)	893	1,253	1,304	1,390	1,313	1,226
Total						
Number of Systems Installed	66,976	77,534	79,112	78,940	83,832	88,907
Avg Certificates/System	29.9	30.2	30.2	30.2	27.1	24.1
Eligible Certificates ('000)	2,003	2,342	2,389	2,380	2,275	2,144

Summary of Results

Year of installation	Actual 2018	Actual 2019	Estimate 2020	Forecast 2021	Forecast 2022	Forecast 2023
1. SGUs (PV)						
1.1 New Residential						
Number of Systems Installed	187,694	240,905	327,301	258,860	222,810	211,329
Avg e kW/system	6.03	6.58	7.12	7.27	7.45	7.65
Avg e Certificates/kW	17.4	16.1	14.7	13.3	11.9	10.6
MW Installed	1,131.5	1,586.2	2,330.3	1,882.2	1,660.2	1,617.3
Eligible Certificates ('000)	19,681	25,476	34,354	25,076	19,804	17,122
1.2 Residential Upgrades						
Number of Systems Installed	20,459	23,641	30,183	27,242	29,270	32,197
Avg e kW/system	5.11	5.81	6.45	6.63	6.82	6.63
Avg e Certificates/kW	17.6	16.3	15.0	13.6	12.2	10.9
MW Installed	104.5	137.4	194.6	180.7	199.7	226.3
Eligible Certificates ('000)	1,844	2,244	2,924	2,457	2,443	2,460
1.3 New Non Residential						
Number of Systems Installed	14,617	17,124	19,737	22,879	24,217	24,921
Avg e kW/system	22.92	22.21	20.99	21.06	21.05	21.06
Avg e Certificates/kW	17.4	16.0	14.9	13.4	12.2	10.8
MW Installed	335.0	380.4	414.3	481.7	509.7	524.5
Eligible Certificates ('000)	5,826	6,098	6,160	6,499	6,195	5,665
1.4 Non Residential Upgrades						
Number of Systems Installed	2,085	2,404	2,339	2,787	2,952	3,148
Avg e kW/system	22.32	25.52	32.07	28.41	28.44	28.41
Avg e Certificates/kW	17.5	16.2	15.0	13.6	12.3	10.9
MW Installed	46.5	61.4	75.0	79.2	84.0	89.6
Eligible Certificates ('000)	815	997	1,122	1,077	1,029	976
Total PV Systems						
Number of Systems Installed	224,855	284,074	379,560	311,769	279,248	271,595
Avg e kW/system	7.19	7.62	7.94	8.42	8.79	9.05
Avg e Certificates/kW	17.4	16.1	14.8	13.4	12.0	10.7
MW Installed	1,617.5	2,165.4	3,014.1	2,623.9	2,453.5	2,457.6
Eligible Certificates ('000)	28,166	34,815	44,561	35,110	29,470	26,223
2. SWH Systems						
2.1 SWH System (New Homes)						
Number of Systems Installed	37,330	36,645	36,179	33,196	35,801	38,474
Avg e Certificates/System	29.7	29.7	30.0	29.9	26.9	23.9
Eligible Certificates ('000)	1,110	1,089	1,085	991	962	919
2.2 SWH System (Replacement)						
Number of Systems Installed	29,646	40,889	42,933	45,744	48,031	50,433
Avg e Certificates/System	30.1	30.7	30.4	30.4	27.3	24.3
Eligible Certificates ('000)	893	1,253	1,304	1,390	1,313	1,226

Summary of Results

Year of installation	Actual 2018	Actual 2019	Estimate 2020	Forecast 2021	Forecast 2022	Forecast 2023
Total SWH Systems						
Number of Systems Installed	66,976	77,534	79,112	78,940	83,832	88,907
Avg Certificate/System	29.9	30.2	30.2	30.2	27.1	24.1
Eligible Certificates ('000)	2,003	2,342	2,389	2,380	2,275	2,144
3. Small Wind/Hydro Systems						
Number of Systems	0	1	0	0	0	0
Avg Certificate/System	0.0	48.0	0.0	0.0	0.0	0.0
Eligible Certificates ('000)	0	0	0	0	0	0
TOTAL Certificates ('000)	30,169	37,158	46,949	37,490	31,746	28,368

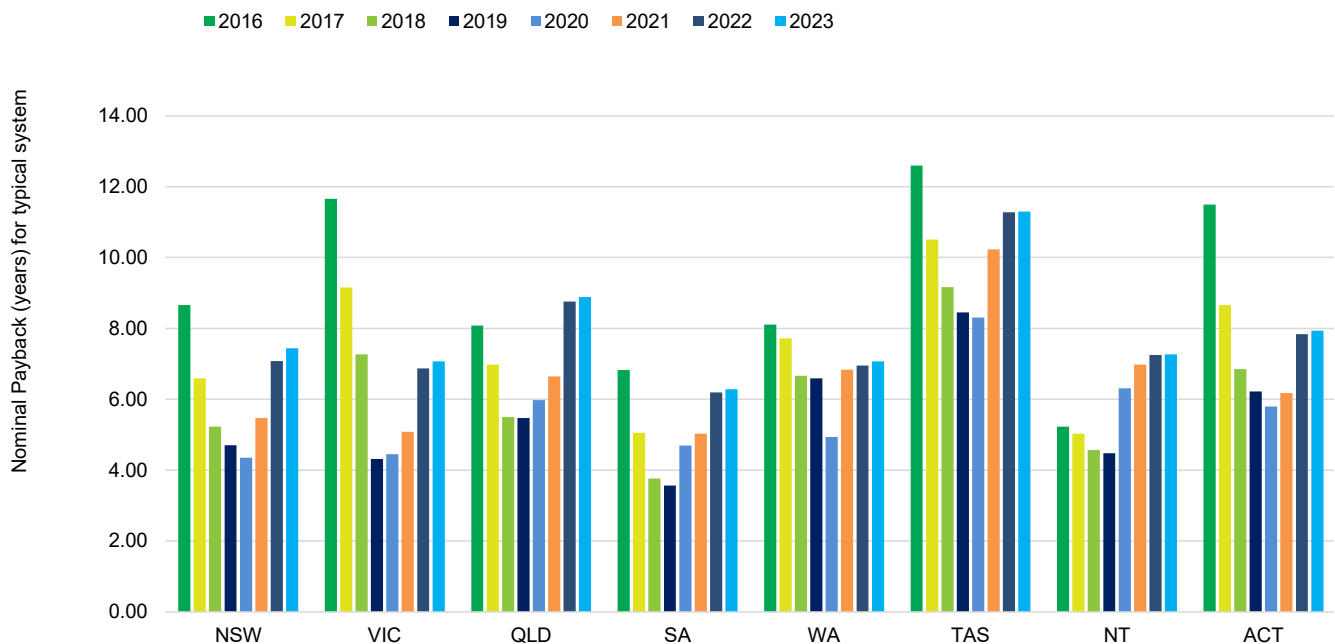
'000 STCs	Actual 2018	Estimate 2019	Estimate 2020	Forecast 2021	Forecast 2022	Forecast 2023
STCs for installations in year						
Solar PV	28,166	34,815	44,561	35,110	29,470	26,223
SWH	2,003	2,342	2,389	2,380	2,275	2,144
Total	30,169	37,158	46,949	37,490	31,745	28,368
Less						
STCs submitted following year (lag)	3,357	3,690	4,579	3,657	3,096	2,767
Add						
Previous year installs created this year	2,580	3,357	3,690	4,579	3,657	4,579
STCs submitted for creation	29,392	36,825	46,060	38,413	32,306	30,180
STCs pending audit at year end	1,125	1,566	1,988	1,658	1,394	1,303
STCs to be approved in year		36,384	45,638	38,743	32,569	30,272
Surplus from previous year			5,920	8,938		
Estimated Target for year			42,620	47,681	32,569	30,272

Attachment 2**New Residential PV Systems****PV Financial Attractiveness****Typical projected Installed cost of solar PV in NSW (nominal terms)**

	2017	2018	2019	2020	2021	2022	2023
\$ per Watt							
System Cost (Pre STCs)	1.80	1.65	1.60	1.48	1.46	1.43	1.41
STCs	0.71	0.66	0.61	0.58	0.53	0.48	0.43
Net Cost	1.09	0.99	0.99	0.90	0.92	0.95	0.98
STC % of Total Cost	41.9%	39.6%	39.8%	37.9%	39.1%	36.6%	33.5%
STC Price	\$36.81	\$36.53	\$36.53	\$38.08	\$38.53	\$38.53	\$38.53
STCs/kWatt	19.35	17.97	16.58	15.20	13.82	12.44	11.06
STC \$/Watt value	0.71	0.66	0.61	0.58	0.53	0.48	0.43

Average Nominal Payback

	NSW	VIC	QLD	SA	WA	TAS	NT
2016	8.66	11.65	8.08	6.83	8.11	12.59	5.22
2017	6.59	9.15	6.98	5.05	7.71	10.51	5.02
2018	5.23	7.27	5.49	3.77	6.66	9.16	4.57
2019	4.70	4.31	5.47	3.57	6.59	8.45	4.48
2020	4.35	4.44	5.98	4.69	4.94	8.31	6.31
2021	5.47	5.08	6.64	5.03	6.83	10.23	6.98
2022	7.08	6.87	8.76	6.19	6.95	11.27	7.25
2023	7.44	7.07	8.88	6.28	7.07	11.29	7.27

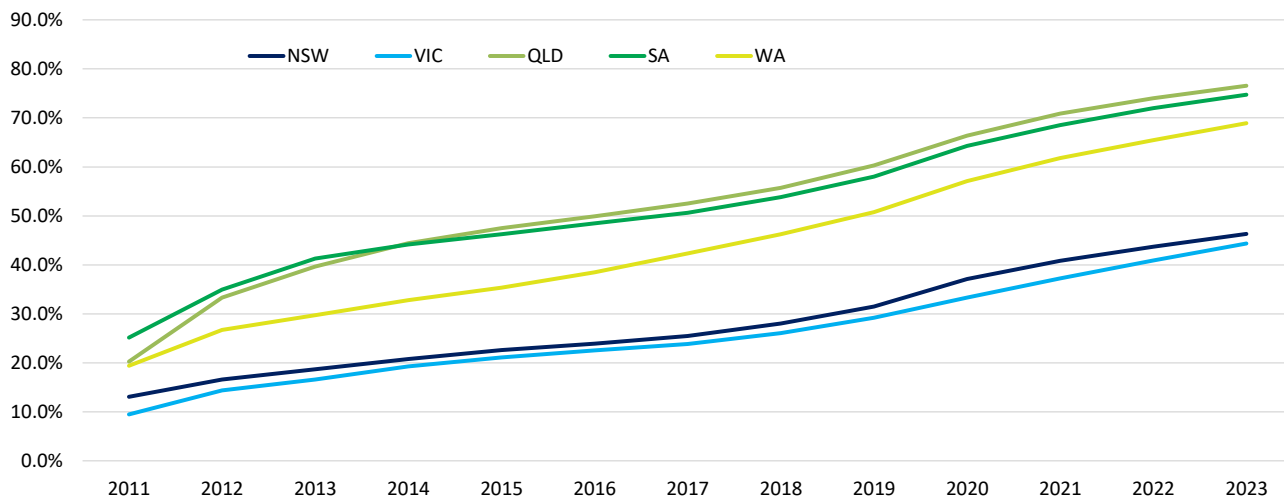
Average simple paybacks on an annual basis

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									
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	26,229	38,473	13,346	28,213	2,106	1,709	1,717	143,053
2018	46,601	40,773	45,829	17,996	29,384	2,178	2,049	2,884	187,694
2019	62,713	54,916	58,948	22,558	32,925	2,418	3,088	3,339	240,905
2020	96,485	69,851	74,079	31,633	44,370	2,935	2,781	5,167	327,301
2021	67,124	67,000	59,897	22,543	35,197	2,845	2,021	2,234	258,860
2022	54,425	66,000	47,283	19,137	29,650	2,776	1,672	1,866	222,810
2023	51,650	65,000	42,928	15,957	29,613	2,731	1,609	1,841	211,329
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	332,742	523,096	219,578	251,107	30,002	8,945	20,502	1,777,921
2018	438,550	373,515	568,925	237,574	280,491	32,180	10,994	23,386	1,965,615
2019	501,263	428,431	627,873	260,132	313,416	34,598	14,082	26,725	2,206,520
2020	597,748	498,282	701,952	291,765	357,786	37,533	16,863	31,892	2,533,820
2021	664,872	565,282	761,848	314,308	392,983	40,377	18,884	34,126	2,792,681
2022	719,296	631,282	809,132	333,445	422,633	43,154	20,556	35,992	3,015,490
2023	770,946	696,282	852,060	349,403	452,246	45,885	22,165	37,833	3,226,819
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%	26.8%	9.9%	10.6%	15.7%	21.6%
2013	18.7%	16.6%	39.6%	41.3%	29.8%	15.0%	14.0%	17.7%	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%	26.1%	55.7%	53.8%	46.3%	23.1%	37.0%	23.6%	36.8%
2019	31.5%	29.2%	60.3%	58.0%	50.8%	24.4%	46.7%	26.7%	40.6%
2020	37.1%	33.3%	66.3%	64.3%	57.1%	26.0%	55.3%	31.5%	45.9%
2021	40.9%	37.2%	70.9%	68.5%	61.8%	27.6%	61.3%	33.3%	49.9%
2022	43.7%	40.9%	74.0%	72.0%	65.4%	29.2%	65.8%	34.8%	53.2%
2023	46.3%	44.4%	76.6%	74.7%	68.9%	30.7%	70.0%	36.2%	56.1%

Penetration Rate - Larger States

As proportion of Owner Occupied detached and semi-detached homes



Certificate Creation - Solar PV Residential

	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	Total
Residential Systems installed (No.)									
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	26,229	38,473	13,346	28,213	2,106	1,709	1,717	143,053
2018	46,601	40,773	45,829	17,996	29,384	2,178	2,049	2,884	187,694
2019	62,713	54,916	58,948	22,558	32,925	2,418	3,088	3,339	240,905
2020	96,485	69,851	74,079	31,633	44,370	2,935	2,781	5,167	327,301
2021	67,124	67,000	59,897	22,543	35,197	2,845	2,021	2,234	258,860
2022	54,425	66,000	47,283	19,137	29,650	2,776	1,672	1,866	222,810
2023	51,650	65,000	42,928	15,957	29,613	2,731	1,609	1,841	211,329
Average system size (kW/system)									
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	6.78	6.08	7.08	6.90	5.94	5.79	6.95	7.03	6.58
2020	7.40	6.56	7.60	7.41	6.35	6.59	7.13	7.75	7.12
2021	7.62	6.76	7.83	7.63	6.54	5.00	7.35	7.98	7.27
2022	7.85	6.96	8.06	7.86	6.74	5.15	7.57	8.22	7.45
2023	8.08	7.17	8.31	8.09	6.94	5.30	7.79	8.47	7.65
Installed Capacity (MW)									
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	295.7	112.6	161.8	11.8	13.8	17.3	1131.5
2019	425.0	333.8	417.3	155.6	195.6	14.0	21.4	23.5	1586.2
2020	713.6	458.4	563.1	234.3	281.7	19.3	19.8	40.0	2330.3
2021	511.3	452.9	468.9	172.0	230.2	14.2	14.8	17.8	1882.2
2022	427.0	459.5	381.3	150.4	199.7	14.3	12.6	15.3	1660.2
2023	417.4	466.1	356.6	129.1	205.5	14.5	12.5	15.6	1617.3
2019 Avge Zone Rating	1.377	1.194	1.377	1.372	1.377	1.177	1.535	1.376	1.338
Average Certificates/kW installed									
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	16.1
2020	15.2	13.1	15.1	15.1	15.1	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
2023	11.0	9.6	11.0	11.0	11.0	9.4	12.3	11.0	10.7
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	5,111	3,609	5,291	2,007	2,895	181	276	309	19,681
2019	7,024	4,783	6,894	2,561	3,233	198	395	388	25,476
2020	10,811	6,020	8,528	3,535	4,268	250	335	606	34,354
2021	7,042	5,407	6,457	2,359	3,170	167	228	245	25,076
2022	5,293	4,938	4,725	1,857	2,476	151	175	190	19,804
2023	4,599	4,452	3,927	1,417	2,264	136	154	172	17,122

Notes

Certificates that are eligible to be created on a generation year basis

New Non Residential PV installations

Attachment 5

	2015	2016	2017	2018	2019	2020	2021	2022	2023
Systems									
ACT	41	71	78	128	250	227	304	328	339
NSW	2,419	2,161	2,949	3,916	5,192	6,762	6,630	7,125	7,319
NT	75	167	139	161	150	184	238	256	262
QLD	1,192	1,785	2,679	3,408	4,412	4,790	5,922	6,369	6,547
SA	702	816	1,235	1,638	1,739	2,384	2,700	2,796	2,863
TAS	88	98	150	202	154	185	242	265	276
VIC	1,540	2,063	2,792	3,492	3,900	3,581	4,510	4,579	4,754
WA	846	1,177	1,557	1,672	1,327	1,625	2,333	2,499	2,561
	6,903	8,338	11,579	14,617	17,124	19,737	22,879	24,217	24,921
kw/System									
ACT	34.91	29.01	31.25	30.13	30.13	30.13	30.13	30.13	30.13
NSW	18.00	20.11	19.62	19.87	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	32.42
QLD	18.52	19.15	21.06	20.10	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	24.16
TAS	19.99	24.31	23.80	24.06	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	20.83
WA	22.05	20.20	21.90	21.05	21.05	21.05	21.05	21.05	21.05
	19.17	20.13	22.02	22.92	22.21	20.99	21.06	21.05	21.04
Installed capacity (kW)									
ACT	1,431	2,060	2,437	3,785	4,761	6,833	9,161	9,891	10,206
NSW	43,533	43,460	57,860	85,836	97,963	134,329	131,715	141,539	145,397
NT	3,078	4,794	5,022	5,416	5,018	5,960	7,714	8,286	8,509
QLD	22,072	34,176	56,428	69,926	90,490	96,299	119,054	128,038	131,626
SA	12,854	18,419	31,798	42,900	42,664	57,591	65,228	67,547	69,175
TAS	1,759	2,383	3,571	5,116	4,229	4,459	5,827	6,365	6,640
VIC	28,952	38,796	63,798	85,040	102,217	74,586	93,938	95,381	99,022
WA	18,653	23,770	34,095	36,948	33,064	34,194	49,101	52,605	53,892
	132,331	167,857	255,009	334,967	380,407	414,251	481,737	509,651	524,466
Certificates/kW		26.8%	51.9%	31.4%	13.6%	8.9%	16.3%	5.8%	2.9%
ACT	20.72	20.71	19.33	17.95	16.57	15.19	13.81	12.43	11.05
NSW	20.77	20.80	19.39	18.01	16.62	15.24	13.85	12.47	11.08
NT	23.23	23.22	21.64	20.09	18.55	17.00	15.46	13.91	12.36
QLD	20.77	20.78	19.40	18.02	16.63	15.25	13.86	12.47	11.09
SA	20.69	20.60	19.28	17.90	16.52	15.15	13.77	12.39	11.02
TAS	17.74	17.75	16.57	15.39	14.20	13.02	11.83	10.65	9.47
VIC	18.18	18.24	16.88	15.67	14.47	13.26	12.06	10.85	9.65
WA	20.75	20.62	19.37	17.98	16.60	15.22	13.83	12.45	11.07
	20.21	20.18	18.75	17.39	16.03	14.87	13.39	12.15	10.80
Certificates created									
ACT	29,646	42,656	47,120	67,944	78,900	103,797	126,504	122,930	112,748
NSW	904,251	904,174	1,122,150	1,545,809	1,628,493	2,046,937	1,824,639	1,764,654	1,611,340
NT	71,494	111,299	108,671	108,828	93,069	101,328	119,225	115,259	105,207
QLD	458,368	710,262	1,094,910	1,259,895	1,504,998	1,468,143	1,650,056	1,597,111	1,459,443
SA	265,927	379,468	612,984	767,941	704,970	872,324	898,170	837,093	762,024
TAS	31,211	42,298	59,160	78,708	60,057	58,052	68,960	67,792	62,863
VIC	526,343	707,746	1,076,831	1,332,856	1,478,833	989,150	1,132,546	1,034,948	955,068
WA	387,026	490,083	660,282	664,425	548,848	520,300	679,202	654,910	596,379
	2,674,266	3,387,986	4,782,108	5,826,405	6,098,169	6,160,031	6,499,302	6,194,698	5,665,072
		26.7%	41.1%	21.8%	4.7%	1.0%	5.5%	-4.7%	-8.5%

Residential PV Upgrades

Attachment 6

	2015	2016	2017	2018	2019	2020	2021	2022	2023
Systems									
ACT	41	71	146	179	197	328	256	282	310
NSW	2,175	4,452	8,661	8,185	9,123	10,432	9,305	10,236	11,260
NT	30	36	88	143	211	350	274	302	332
QLD	4,334	3,864	4,915	5,297	6,694	9,907	8,702	8,876	9,764
SA	994	948	1,462	1,955	2,432	3,367	3,162	3,478	3,826
TAS	96	106	119	226	300	363	390	429	472
VIC	1,399	1,389	2,045	2,530	2,457	2,921	2,703	2,973	3,270
WA	1,152	1,118	1,524	1,944	2,227	2,515	2,450	2,695	2,964
	10,221	11,984	18,960	20,459	23,641	30,183	27,242	29,270	32,197
kw/System									
ACT	3.11	5.29	4.39	5.34	5.96	6.00	6.18	6.37	6.56
NSW	3.39	3.52	3.94	4.91	5.65	6.38	6.58	6.77	6.98
NT	3.89	3.19	3.33	3.44	4.80	5.05	5.20	5.36	5.52
QLD	2.95	3.99	4.88	5.72	6.36	6.80	7.00	7.21	7.43
SA	4.40	4.23	4.77	5.46	6.20	6.61	6.80	7.01	7.22
TAS	3.83	3.99	4.14	4.49	4.83	5.75	5.92	6.10	6.28
VIC	3.42	3.48	3.99	4.60	5.23	5.98	6.16	6.35	6.54
WA	2.20	3.04	3.77	4.77	5.27	5.98	6.16	6.34	6.53
	3.17	3.69	4.24	5.11	5.81	6.45	6.63	6.82	7.03
Installed capacity (kW)									
ACT	127	376	642	956	1,174	1,970	1,584	1,795	2,033
NSW	7,371	15,683	34,131	40,163	51,520	66,604	61,194	69,333	78,555
NT	117	115	293	492	1,014	1,768	1,427	1,617	1,832
QLD	12,766	15,420	23,990	30,310	42,555	67,370	60,953	64,037	72,554
SA	4,371	4,009	6,973	10,673	15,088	22,242	21,513	24,375	27,616
TAS	368	423	493	1,014	1,448	2,088	2,309	2,616	2,964
VIC	4,786	4,827	8,150	11,650	12,861	17,472	16,653	18,868	21,378
WA	2,531	3,396	5,742	9,276	11,736	15,038	15,085	17,091	19,365
	32,437	44,249	80,413	104,535	137,395	194,552	180,719	199,732	226,296
Certificates/kW				30.0%	31.4%	41.6%	-7.1%	10.5%	13.3%
ACT	20.58	20.64	19.24	17.88	16.49	15.14	13.74	12.37	10.99
NSW	20.81	20.83	19.32	17.97	16.57	15.15	13.80	12.42	11.04
NT	23.60	23.35	21.67	20.05	18.40	16.84	15.48	13.93	12.38
QLD	20.59	20.62	19.28	17.89	16.51	15.16	13.77	12.39	11.02
SA	20.53	20.57	19.24	17.85	16.48	15.15	13.74	12.37	10.99
TAS	17.64	17.63	16.44	15.29	14.12	12.96	11.75	10.57	9.40
VIC	17.85	17.95	16.74	15.55	14.48	13.88	11.96	10.76	9.57
WA	20.51	20.55	19.22	17.87	16.51	15.17	13.73	12.35	10.98
	20.20	20.37	19.02	17.64	16.33	15.03	13.59	12.23	10.87
Certificates created									
ACT	2,623	7,751	12,346	17,090	19,362	29,820	21,768	22,197	22,355
NSW	153,402	326,642	659,434	721,755	853,850	1,009,066	844,508	861,144	867,268
NT	2,754	2,685	6,344	9,860	18,655	29,769	22,086	22,521	22,681
QLD	262,812	318,014	462,459	542,223	702,649	1,021,073	839,289	793,582	799,225
SA	89,712	82,482	134,156	190,519	248,669	336,990	295,645	301,469	303,613
TAS	6,493	7,458	8,105	15,498	20,439	27,049	27,123	27,657	27,854
VIC	85,453	86,642	136,457	181,149	186,253	242,573	199,171	203,094	204,539
WA	51,911	69,786	110,356	165,727	193,803	228,144	207,084	211,164	212,665
	655,160	901,460	1,529,657	1,843,821	2,243,680	2,924,485	2,456,674	2,442,828	2,460,200
		37.6%	69.7%	20.5%	21.7%	30.3%	-16.0%	-0.6%	0.7%

Non Residential Upgrade PV installations

Attachment 6

	2015	2016	2017	2018	2019	2020	2021	2022	2023
Systems									
ACT	8	9	5	15	24	13	20	22	23
NSW	207	285	400	627	623	553	601	645	746
NT	8	12	14	12	56	86	101	109	112
QLD	181	256	382	555	660	893	938	1,009	1,037
SA	96	126	150	306	362	253	430	445	456
TAS	6	11	18	36	26	21	33	36	38
VIC	137	163	295	422	478	403	458	465	483
WA	66	86	111	112	175	117	206	220	254
	709	948	1,375	2,085	2,404	2,339	2,787	2,952	3,148
kw/System									
ACT	23.20	13.83	28.29	12.62	31.15	45.50	38.32	38.32	38.32
NSW	13.69	18.60	17.87	21.86	25.60	29.01	27.30	27.30	27.30
NT	42.91	32.09	14.41	35.08	22.38	6.95	14.66	14.66	14.66
QLD	11.66	21.77	19.78	20.73	22.35	39.68	31.01	31.01	31.01
SA	15.20	21.73	22.60	28.14	27.15	25.23	26.19	26.19	26.19
TAS	6.32	8.03	20.07	26.61	33.32	29.44	31.38	31.38	31.38
VIC	15.26	17.12	19.00	21.22	24.70	28.87	26.79	26.79	26.79
WA	13.47	16.60	23.67	19.49	35.14	31.54	33.34	33.34	33.34
	14.04	19.44	19.66	22.32	25.52	32.07	28.41	28.44	28.45
Installed capacity (kW)									
ACT	186	124	141	189	748	604	782	844	871
NSW	2,835	5,301	7,147	13,706	15,950	16,032	16,398	17,621	20,364
NT	343	385	202	421	1,253	596	1,484	1,594	1,636
QLD	2,110	5,572	7,558	11,506	14,748	35,454	29,099	31,295	32,172
SA	1,459	2,738	3,390	8,610	9,829	6,384	11,254	11,654	11,935
TAS	38	88	361	958	866	622	1,046	1,143	1,192
VIC	2,091	2,791	5,605	8,956	11,809	11,626	12,277	12,466	12,942
WA	889	1,427	2,627	2,183	6,149	3,699	6,852	7,341	8,461
	9,952	18,427	27,032	46,529	61,352	75,016	79,192	83,957	89,573
Certificates/kW									
		85.2%	46.7%	72.1%	31.9%	22.3%	5.6%	6.0%	6.7%
ACT	20.71	20.70	19.33	17.94	16.56	15.18	13.80	12.42	11.04
NSW	20.84	20.79	19.45	18.05	16.67	15.28	13.90	12.51	11.12
NT	23.45	23.82	21.98	20.70	18.84	17.27	15.70	14.13	12.56
QLD	20.73	20.77	19.40	17.99	16.63	15.25	13.86	12.47	11.09
SA	20.66	20.61	19.29	17.89	16.53	15.16	13.78	12.40	11.02
TAS	17.71	17.72	16.56	15.39	14.20	13.01	11.83	10.65	9.46
VIC	17.96	18.55	17.05	15.72	14.62	13.40	12.18	10.96	9.75
WA	20.83	20.69	19.40	17.82	16.63	15.24	13.86	12.47	11.09
	20.26	20.46	18.90	17.51	16.25	14.96	13.60	12.25	10.90
Certificates created									
ACT	3,844	2,576	2,734	3,396	12,383	9,169	10,792	10,487	9,619
NSW	59,064	110,215	139,044	247,335	265,958	245,044	227,851	220,361	226,368
NT	8,050	9,172	4,436	8,715	23,610	10,293	23,294	22,519	20,556
QLD	43,749	115,748	146,649	206,947	245,296	540,531	403,313	390,372	356,723
SA	30,159	56,418	65,395	153,995	162,512	96,750	155,057	144,513	131,553
TAS	671	1,565	5,985	14,738	12,298	8,090	12,379	12,169	11,284
VIC	37,558	51,759	95,583	140,809	172,620	155,791	149,558	136,670	126,121
WA	18,523	29,537	50,974	38,904	102,247	56,382	94,951	91,555	93,795
	201,618	376,990	510,800	814,839	996,923	1,122,050	1,077,196	1,028,646	976,017
		87.0%	35.5%	59.5%	22.3%	12.6%			

SWH Systems

New Buildings

Attachment 7

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
SWH systems installed													
ACT	422	432	190	135	266	374	364	341	423	656	658	669	636
NSW	4,522	2,579	2,646	2,946	3,076	3,464	3,582	3,631	2,953	2,465	2,242	2,430	2,621
NT	522	653	578	525	655	581	547	373	258	247	246	295	353
QLD	9,359	9,042	6,529	5,219	4,419	4,900	5,461	5,420	4,671	4,527	4,567	5,147	5,597
SA	1,677	1,060	765	801	546	554	459	382	450	500	422	423	435
TAS	192	137	83	111	208	278	236	320	460	509	450	451	452
VIC	20,559	17,726	16,873	18,058	20,490	21,494	22,913	25,325	25,963	26,088	23,433	25,075	26,943
WA	5,077	4,710	4,652	4,000	3,603	2,537	1,804	1,538	1,467	1,187	1,179	1,311	1,436
Total	42,330	36,339	32,316	31,795	33,263	34,182	35,366	37,330	36,645	36,179	33,196	35,801	38,474
Certificates created													
ACT	13,138	12,503	6,071	4,684	9,304	12,528	12,509	10,548	12,939	19,807	20,005	18,306	15,456
NSW	145,841	83,654	87,769	97,782	98,380	110,068	108,922	112,757	92,917	75,937	69,797	68,082	65,283
NT	13,929	18,070	15,734	15,266	19,750	17,451	15,961	11,575	7,414	7,395	7,209	7,784	8,289
QLD	275,585	259,317	198,795	171,276	145,694	151,905	168,901	164,065	140,304	137,259	137,829	139,791	135,138
SA	51,074	29,642	22,678	25,088	17,466	17,122	14,229	12,390	13,784	15,011	12,791	11,546	10,562
TAS	4,994	3,889	2,401	3,429	6,115	8,356	7,047	9,543	13,514	14,935	13,195	11,925	10,624
VIC	531,095	434,730	461,636	511,680	589,200	626,379	672,769	739,403	762,990	778,418	693,911	668,291	638,291
WA	162,535	144,164	143,109	131,865	126,916	91,052	60,782	49,405	45,262	36,218	36,173	36,200	35,240
Total	1,198,191	985,969	938,193	961,070	1,012,825	1,034,861	1,061,120	1,109,686	1,089,124	1,084,980	990,910	961,926	918,883
Certificates per SWH System													
ACT	31.1	28.9	32.0	34.7	35.0	33.5	34.4	30.9	30.6	30.2	30.4	27.4	24.3
NSW	32.3	32.4	33.2	33.2	32.0	31.8	30.4	31.1	31.5	30.8	31.1	28.0	24.9
NT	26.7	27.7	27.2	29.1	30.2	30.0	29.2	31.0	28.7	29.9	29.3	26.4	23.5
QLD	29.4	28.7	30.4	32.8	33.0	31.0	30.9	30.3	30.0	30.3	30.2	27.2	24.1
SA	30.5	28.0	29.6	31.3	32.0	30.9	31.0	32.4	30.6	30.0	30.3	27.3	24.3
TAS	26.0	28.4	28.9	30.9	29.4	30.1	29.9	29.8	29.4	29.3	29.4	26.4	23.5
VIC	25.8	24.5	27.4	28.3	28.8	29.1	29.4	29.2	29.4	29.8	29.6	26.7	23.7
WA	32.0	30.6	30.8	33.0	35.2	35.9	33.7	32.1	30.9	30.5	30.7	27.6	24.5
Total	28.3	27.1	29.0	30.2	30.4	30.3	30.0	29.7	29.7	30.0	29.9	26.9	23.9

SWH Systems Replacement Market

Attachment 8

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
SWH systems installed													
ACT	616	302	263	316	306	303	341	384	1,193	1,252	1,315	1,381	1,450
NSW	20,809	8,231	6,499	6,695	5,536	5,147	5,389	5,246	4,898	5,143	5,400	5,670	5,954
NT	745	518	306	501	408	339	418	614	815	856	899	944	991
QLD	21,578	9,931	6,881	8,214	7,386	6,542	6,563	6,600	7,633	8,015	8,416	8,836	9,278
SA	3,767	2,413	2,218	1,129	2,011	1,727	2,158	2,468	4,645	4,877	5,121	5,377	5,646
TAS	1,533	762	744	851	595	669	798	806	723	759	797	837	879
VIC	5,887	3,868	2,735	2,555	2,597	6,208	6,213	6,760	12,657	13,290	14,619	15,350	16,117
WA	7,785	7,102	6,337	6,672	6,602	6,901	6,898	6,768	8,324	8,740	9,177	9,636	10,118
Total	62,720	33,127	25,983	26,933	25,441	27,836	28,778	29,646	40,889	42,933	45,744	48,031	50,433
Certificates created													
ACT	19,099	9,354	8,345	10,163	10,135	9,535	11,177	12,111	37,133	38,986	40,936	38,684	36,105
NSW	662,471	262,431	210,361	212,620	173,598	158,119	165,374	159,822	149,320	156,695	164,530	155,480	145,115
NT	20,807	14,673	8,781	13,514	11,362	9,709	12,288	17,385	24,559	24,968	26,216	24,774	23,123
QLD	666,758	309,804	217,464	256,632	231,221	203,310	202,000	203,719	237,562	248,323	260,739	246,398	229,972
SA	109,047	68,624	64,718	34,607	59,195	51,229	62,987	72,090	137,518	143,525	150,701	142,412	132,918
TAS	40,289	22,502	23,303	25,070	18,256	20,408	24,859	25,068	22,265	23,071	24,225	22,892	21,366
VIC	184,229	118,345	85,835	79,966	83,416	188,755	186,059	204,037	404,210	415,046	456,551	431,441	402,678
WA	220,545	198,832	185,532	194,235	196,657	204,032	205,085	198,785	240,800	253,021	265,673	251,061	234,323
Total	1,923,245	1,004,565	804,339	826,807	783,840	845,097	869,829	893,017	1,253,369	1,303,635	1,389,569	1,313,143	1,225,600
Certificates per SWH Syst													
ACT	31.0	31.0	31.7	32.2	33.1	31.5	32.8	31.5	31.1	31.1	31.1	28.0	24.9
NSW	31.8	31.9	32.4	31.8	31.4	30.7	30.7	30.5	30.5	30.5	30.5	27.4	24.4
NT	27.9	28.3	28.7	27.0	27.8	28.6	29.4	28.3	30.1	29.2	29.2	26.2	23.3
QLD	30.9	31.2	31.6	31.2	31.3	31.1	30.8	30.9	31.1	31.0	31.0	27.9	24.8
SA	28.9	28.4	29.2	30.7	29.4	29.7	29.2	29.2	29.6	29.4	29.4	26.5	23.5
TAS	26.3	29.5	31.3	29.5	30.7	30.5	31.2	31.1	30.8	30.4	30.4	27.3	24.3
VIC	31.3	30.6	31.4	31.3	32.1	30.4	29.9	30.2	31.9	31.2	31.2	28.1	25.0
WA	28.3	28.0	29.3	29.1	29.8	29.6	29.7	29.4	28.9	28.9	28.9	26.1	23.2
Total	30.7	30.3	31.0	30.7	30.8	30.4	30.2	30.1	30.7	30.4	30.4	27.3	24.3

Delay in Certificate creation

Attachment 9

Determining total number of STCs to be created for 2020 generation year

Data up to and including 31 December 2020

	Total created to 31 Dec 2020	Still to be created	% of total yet to Total be created	% to be created as share of Created to date
1. Solar PV				
New Non-Residential				
ACT	68,465	14,135	82,600	17.1%
NSW	1,570,048	312,301	1,882,349	16.6%
NT	93,216	11,924	105,140	11.3%
QLD	1,279,286	205,113	1,484,399	13.8%
SA	671,346	107,794	779,140	13.8%
TAS	69,173	11,974	81,147	14.8%
VIC	1,152,193	279,962	1,432,155	19.5%
WA	510,778	76,517	587,295	13.0%
	5,414,505	1,019,721	6,434,226	15.8%
New Residential				
ACT	547,010	59,381	606,391	9.8%
NSW	10,024,627	782,101	10,806,728	7.2%
NT	302,077	33,542	335,619	10.0%
QLD	8,048,354	488,508	8,536,862	5.7%
SA	3,257,189	294,060	3,551,249	8.3%
TAS	229,940	20,813	250,753	8.3%
VIC	5,387,101	908,859	6,295,960	14.4%
WA	4,055,734	219,768	4,275,502	5.1%
	31,852,032	2,807,032	34,659,064	8.1%
Upgrade and Replacement Systems				
All states	3,665,596	385,736	4,051,332	9.5%
Total PV	40,932,133	4,212,489	45,144,622	9.3%
2. SWH				
New Buildings				
ACT	11,691	8,116	19,807	41.0%
NSW	58,394	17,491	75,885	23.0%
NT	5,054	2,341	7,395	31.7%
QLD	116,769	20,420	137,189	14.9%
SA	10,817	3,598	14,415	25.0%
TAS	12,638	2,297	14,935	15.4%
VIC	578,993	193,108	772,101	25.0%
WA	31,510	4,708	36,218	13.0%
	825,866	252,079	1,077,945	23.4%
Replacement Market				
ACT	33,753	3,380	37,133	9.1%
NSW	136,097	13,168	149,265	8.8%
NT	19,759	4,762	24,521	19.4%
QLD	222,283	15,024	237,307	6.3%
SA	125,103	12,149	137,252	8.9%
TAS	20,136	2,094	22,230	9.4%
VIC	354,969	48,259	403,228	12.0%
WA	224,911	15,856	240,767	6.6%
	1,137,011	114,692	1,251,703	9.2%
Total SWH	1,962,877	366,771	2,329,648	15.7%
3. Total STCs	42,895,010	4,579,260	47,474,270	9.6%