# Small-Scale STC Creation Report

For the Clean Energy Regulator

November 2022

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# Executive Summary

The Clean Energy Regulator (CER) has engaged Green Energy Markets Pty Ltd (GEM) to provide estimates of the Small-scale technology certificates (STCs) likely to be created during the 2023 calendar year, and for the years 2024 to 2027.

In developing our projections for small generation units (SGUs), solar water heaters (SWH) and air-source heat pumps (ASHP) 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 and Replacement Residential market
- SGU PV – New Non-residential (commercial market)
- SGU PV – Upgrade and Replacement Non-residential market
- SWH – New building market
- SWH - Replacement or existing dwelling market
- ASHP – New building market
- ASHP - Replacement or existing dwelling market

In making projections for installations of solar PV and SWH/ASHP 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 the impact of factors other than payback we separately adjust for the impact of changes in customer awareness and solar industry promotion and marketing which are informed by industry interviews. We have taken into account the short-term demand impacts of Covid-19 restrictions in 2020, 2021 and 2022. We also take into account the impacts in 2022 of high levels of rainfall and flooding in Queensland and NSW as well as supply chain challenges and access to skilled workers.

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

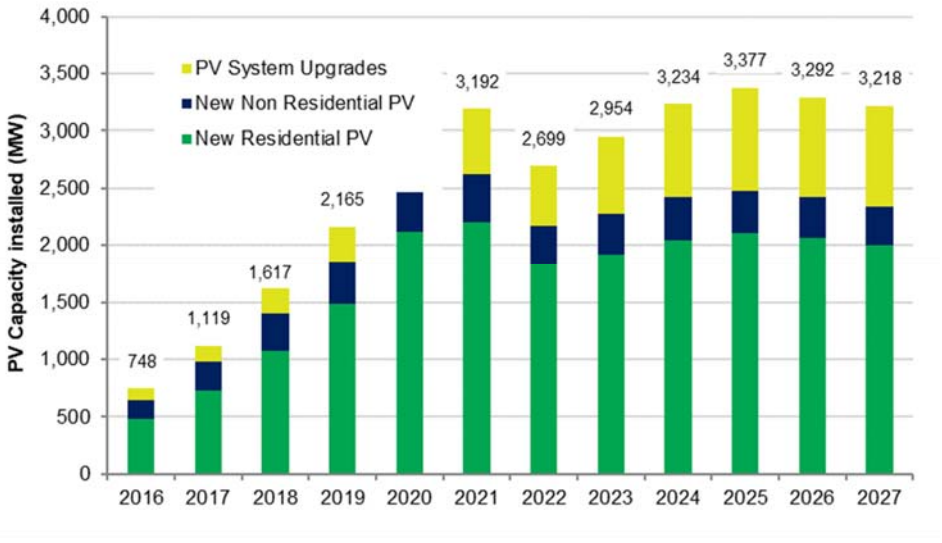
- The recent energy crisis has seen a significant increase in energy prices including feed-tariffs. Over the medium term, however, we expect to see daytime wholesale power prices continue to decline which will flow through to lower feed-in tariffs and less attractive financial paybacks;
- Lockdowns due to Covid restrictions over the 2020 and 2021 period saw an increase in PV system sales as discretionary household expenditure was directed to home improvements as opposed to travel and holidays. Once restrictions eased in 2022 the opposite situation occurred with solar sales reducing due to competition with holidays and travel for discretionary household expenditure;
- The Victorian Solar Homes Program is expected to underpin installations in Victoria over the next few years and we assume that the level of the rebate is structured to support a minimum of 50,000 new systems per year from the program over the forecast period;
- The average system size for residential installations is expected to continue to increase though at more modest levels than recent years;
- We expect that battery costs will decline long-term making paybacks of residential solar plus battery systems more attractive than solar only systems. Recent

increases in installed battery costs will mean that this will likely happen beyond the forecast period, and we exclude the impact of batteries in our projections;

- We expect that technical and market challenges will increase 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 adjusted estimates of financial attractiveness in our model to account for these changes;
- The level of non-residential (commercial) PV system installations are expected to remain resilient over the next few years and then fall slightly after 2024. Paybacks for these systems are not expected to deteriorate as much as residential systems as they are not as dependent on exporting electricity;
- We expect that the upgrade of existing PV systems as well as the replacement of older systems will continue to increase and become a more important market segment. Upgrades and replacements accounted for 19% of total PV capacity installed in 2022 and we expect that this will increase to 27% by 2027;
- The number of SWH and ASHP systems installed in new homes is expected to decrease in 2023 in line with reduction in new home completions. As home construction activity increases again in subsequent years we expect to see an increase in systems installed in this sector; and
- The replacement market for SWH and ASHP systems is expected to continue to grow strongly largely as a result of expanded government support for the replacement of electric water heaters. The expansion of the NSW energy savings scheme to incorporate SWH and ASHPs will support an increase in the number of systems over the forecast period. In addition, a number of new entrants have entered the market with competitive offerings that are specifically focusing on ASHPs.

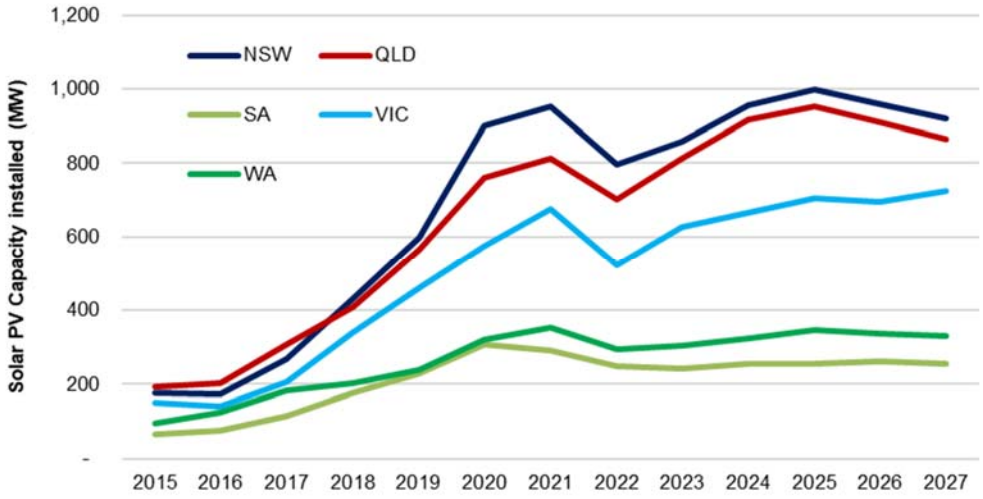
We estimate that 2,699 MW of solar PV will be installed in 2022 which is a 15% reduction on 2021 levels. We expect that the capacity installed will progressively rise to 3,292 MW in 2025 before falling slightly to 3,218 MW in 2027.

**PV Capacity installed by sector**




NSW and Queensland are expected to continue to be the leading states for PV installations. The Victorian solar program is expected to continue to support system installations in that state with Victoria's share of installed capacity increasing from 19.3% in 2022 to 22.5% by 2027.

**PV Capacity installed by state**




We estimate that 121,230 SHW and ASHP systems will be installed in 2022 which is a 22% increase on 2021 levels. We expect that the number of systems installed will grow to more than 189,411 by 2027. This growth is predominantly from ASHP installed in the replacement market, supported by energy efficiency programs in NSW and Victoria.

| Year of installation | Estimate 2021 | Estimate 2022 | Actual 2023 | Estimate 2024 | Estimate 2025 | Forecast 2026 | Forecast 2027 |
|---|---|---|---|---|---|---|---|
| **New Buildings** | | | | | | | |
| SWH | 22,364 | 22,289 | 20,725 | 21,748 | 24,042 | 26,446 | 29,091 |
| ASHP | 11,937 | 11,232 | 10,380 | 10,912 | 11,951 | 13,165 | 14,504 |
| | **34,301** | **33,520** | **31,106** | **32,660** | **35,993** | **39,612** | **43,595** |
| **Replacement** | | | | | | | |
| SWH | 17,144 | 18,066 | 25,641 | 28,737 | 28,687 | 28,380 | 27,764 |
| ASHP | 47,885 | 69,643 | 84,177 | 94,786 | 101,732 | 109,455 | 118,052 |
| | **65,030** | **87,709** | **109,818** | **123,522** | **130,419** | **137,835** | **145,816** |
| **Total** | | | | | | | |
| SWH | 39,508 | 40,355 | 46,367 | 50,484 | 52,729 | 54,826 | 56,856 |
| ASHP | 59,823 | 80,875 | 94,557 | 105,698 | 113,683 | 122,621 | 132,556 |
| | **99,331** | **121,230** | **140,924** | **156,182** | **166,412** | **177,447** | **189,411** |

We expect that 36.6 million STCs will be submitted for registration in 2022 and 35.1 million in 2023. Summary of results are as follows:

| '000 STCs | Estimate 2021 | Estimate 2022 | Forecast 2023 | Forecast 2024 | Forecast 2025 | Forecast 2026 | Forecast 2027 |
|---|---|---|---|---|---|---|---|
| **STCs for installations in year** | | | | | | | |
| Solar PV | 42,728 | 32,643 | 31,674 | 30,365 | 27,163 | 22,056 | 17,215 |
| SWH | 2,870 | 3,308 | 3,395 | 3,281 | 2,994 | 2,658 | 2,267 |
| **Total** | **45,598** | **35,951** | **35,070** | **33,646** | **30,157** | **24,714** | **19,482** |
| Less | | | | | | | |
| STCs submitted following year (lag) | 3,606 | 2,985 | 2,912 | 2,794 | 2,504 | 2,052 | 1,618 |
| Add | | | | | | | |
| Previous year installs created this year | 3,392 | 3,606 | 2,985 | 2,912 | 2,794 | 2,504 | 2,052 |
| **STCs submitted for creation** | **45,384** | **36,571** | **35,143** | **33,764** | **30,446** | **25,166** | **19,917** |

# 1. Introduction

The Clean Energy Regulator (CER) has engaged Green Energy Markets Pty Ltd (GEM) to provide estimates of the Small-scale technology certificates (STCs) likely to be created during the 2022 calendar year, and for the years 2023 to 2027. The key outputs from this report are STC creation estimates for 2023, 2024 and 2025. These will be inputs for the 2023 small-scale technology percentage (STP) and the non-binding STPs for 2024 and 2025

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 and air-source heat pump installations. Solar PV dominates the creation of STCs accounting for more than 90% of STC creation.

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..

We include a Variance Analysis comparing results to our July 2022 projections as Attachment 10.

As part of its report GEM is required to:

- model expected small-scale technology installations for 2023-2027. This will include forecasts of the number of STCs and installed capacity;
- 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. 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. STC forecasts for SWH and ASHP** – summarises the number of SWH and ASHP 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 and Replacement Residential market
- SGU PV – New Non-residential (commercial market)
- SGU PV – Upgrade and Replacement Non-residential market
- SWH – New building market
- SWH - Replacement or existing dwelling market
- ASHP – New building market
- ASHP - Replacement or existing dwelling market

Residential and commercial solar PV 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 system size the notional capacity delineation between residential and commercial is also increasing as some residential systems get considerably bigger.

## 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. Research, including interviews with a range of industry participants, indicates that consumers tend to analyse the financial attractiveness of solar systems based on a backward looking and short-term perspective. Consequently the payback (in years) in the year of installation is determined in the model by dividing the installed system cost by the average of the expected annual savings (or revenue) delivered by the solar system using only the prices assumed to prevail in the year of installation and the year prior to installation.

- The expected savings 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.

In estimating payback the model analyses not just the revenue and cost of a solar system but also a solar system combined with a battery. In the event that combining a battery with the solar system provides a shorter payback than a solar system alone, then this shorter payback will be used in evaluating PV demand. Due to recent increases in battery costs, the payback period is now shorter when calculated on solar systems alone. Given that battery costs are expected to remain high over the forecast period they have been excluded from the model for this analysis. This situation may change where additional financial support is provided. 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
- Relative level of saturation – represented by scaling factor that reduces as saturation increases. This is then also converted into an index with an average of 2019 as the base.
- Relative customer awareness – heightened media concerns over high power prices has been demonstrated (through market interviews, refer to Section 4.1) 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 2019 as the base; and
- Relative solar industry competitiveness and marketing – the level of new market entrants (and exit), as well as 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 2019 as the base.

The last two factors (customer awareness and industry promotion and marketing) are extremely subjective but have clearly impacted on the level of demand particularly over the last two years.

Our baseline year is an average of the 2019 and 2020 level of installations by state. We believe that this better reflects the current market characteristics and reflects a level of market maturity. This provides a reasonably large market size ranging from 234,000 new systems in 2019 to 296,000 systems in 2020. 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:

Demand (year) = Systems derived from Payback equation (year) x Relative Level of Saturation (year) x Relative Customer Awareness Index (year) x 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 representing over 15% of installed capacity.

This market sector is also now reasonably mature and we use a similar approach to new residential systems with an average of 2019 and 2020 installations as our base. Forecast installations are based on relative financial attractiveness (relative to the 2019/20 base year). We have also incorporated a consumer awareness and industry competitiveness scaling factor to reflect improved industry attractiveness as more solar businesses target this sector.

**3. Modelling upgrades and replacements of residential and commercial systems**

The Upgrade and replacement market has grown dramatically over the last few years and in 2022 will account for 19% of total installed PV capacity. We expect that this share will increase to more than 27% by 2027. New system information collected by the CER from late 2020 indicates that the level of upgrades was more

than 70% higher as it now includes both the upgrade of existing system as well as the replacement of older systems. Only 5 months of data was available using the new data field and we have pro-rated these levels back to 2015.

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. This market sector is expected 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. We use expected 2021 installations as the baseline and then overlay this with relative financial attractiveness and then allow for an additional 15% per annum growth rate to reflect a progressive replacement of smaller older systems as they age beyond 10 years.

The commercial upgrade market at an estimated 80 to 120 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 back in 2010 is currently 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)

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.

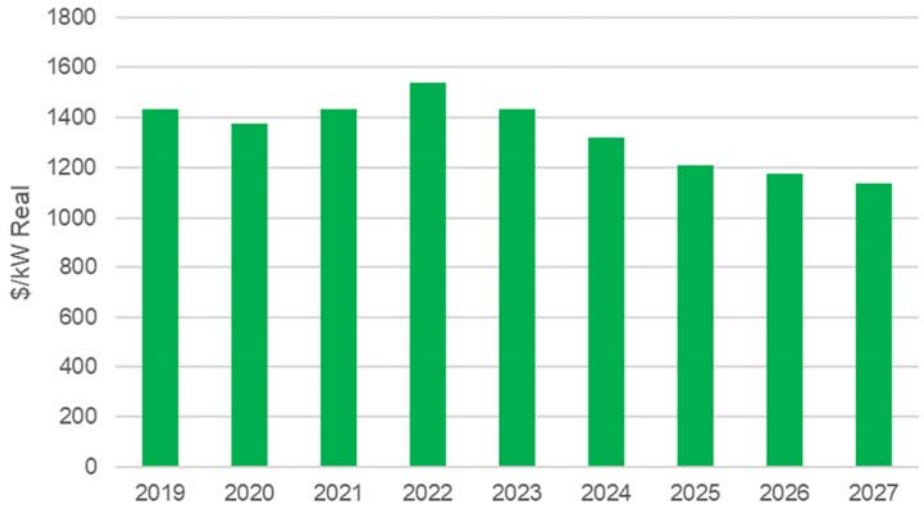
# 3. Assumptions

We have updated our assumptions and slightly refined our modelling approach in developing our STC forecasts. Key assumptions used are outlined in this section.

## 3.1 Forecasting Installed PV costs

Installed system costs for typical residential systems (6.6 kW) have risen over the past two years Increasing to $1,540 per kW in 2022. For future costs we assume system costs will resume their long running downward trajectory next year and reach just under $1,140 per kW by 2027 (2022 dollars). Costs for commercial sized systems are expected to be slightly lower in $/kW terms reaching $1,087 by 2027.

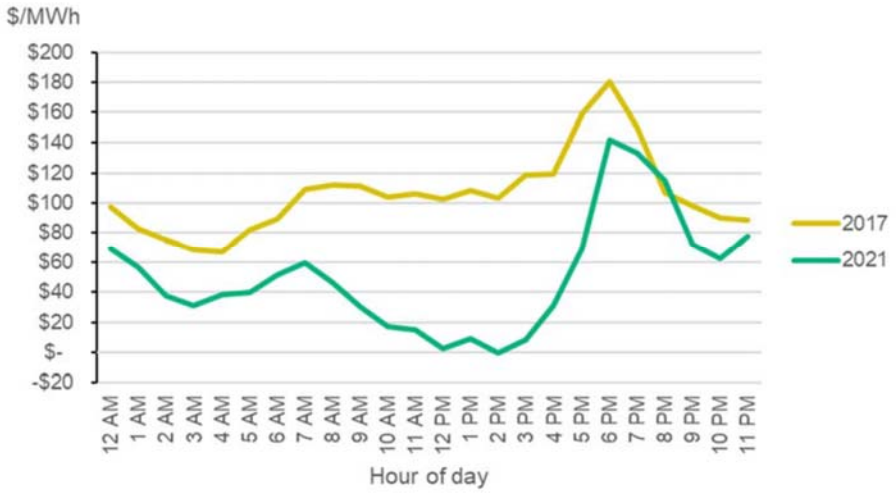
**Figure 3.1 Installed system costs for typical residential system (6.6 kW)**




## 3.2 Wholesale electricity prices

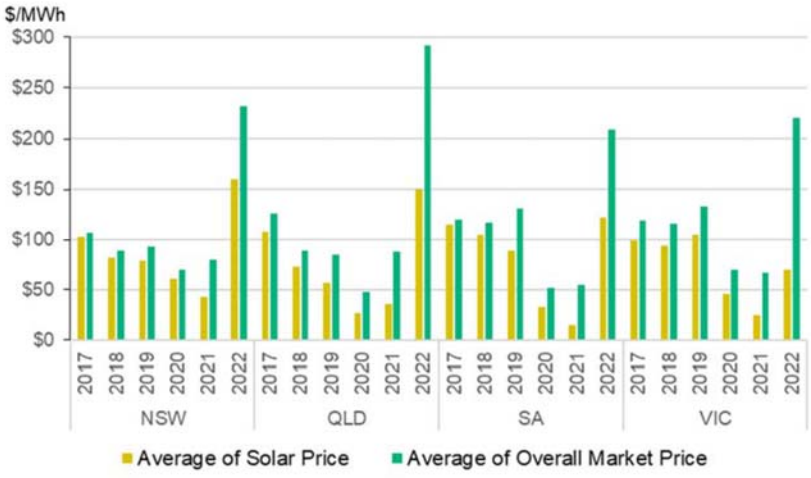
In GEM's prior years' projections modelling has assumed energy prices during daytime periods would reach very low levels. This was informed by forecasts by the Australian Energy Market Commission (Residential Electricity Price Trends 2021, December 2021) and wholesale market outcomes experienced in regions with high penetration of solar, exemplified by South Australia's wholesale market in 2021 relative to 2017 as shown in Figure 3.2 below.

**Figure 3.2 Average SA wholesale prices by hour – 2017 vs 2021**




However, the high wholesale prices which have subsequently unfolded during 2022, after the Australian Energy Market Commission (AEMC) released their most recent projections in December 2021, have forced us to make significant upward revisions in likely prices. While solar generation continues to see a large discount in the wholesale value it can capture relative to the overall market, in 2022 wholesale spot prices for solar generation were still very high by historical standards across all NEM states bar Victoria (see Figure 3.2).

**Figure 3.2 Average wholesale spot price for solar versus overall market**
(2022 figures are for 6 months only)




These prices are far above the kind of levels that were anticipated in the AEMC's Electricity Price Trends Report and therefore required us to derive wholesale energy costs via an alternative option to their report. This involved assuming wholesale costs for NEM retailers in 2023 similar to those experienced over 2022 (to Jun) but these were then scaled down over 2024 and 2025 in line with the proportional fall in ASX Baseload contract prices for 2024 and 2025 relative to the 2023 vintage contract. After this point prices were assumed to transition to levels in line with the cost of new entrant generation as detailed by CSIRO's GenCost 2022 publication.

While overall wholesale energy costs are scaled downwards in line with changes in ASX Contract Prices, the price for each tariff period are further differentiated to reflect historical discounts in wholesale energy prices during the solar and off-peak periods relative to the premium seen during the peak period.

NT and WA customers' wholesale energy costs are assumed to be more stable than what we've experienced in the NEM states recently and overall retail charges are derived from current retail offers from Synergy (for WA) and Jacana (for NT). These are then adjusted over time to align with long-run new entrant generator costs for solar and peaking power plants as estimated in CSIRO's Gencost 2022 report.

### 3.3 Forecasting STC prices

We expect that over the forecast period the STC market comes into better balance with the Clearing House coming into play regularly. We assume that STCs will on average be sold to Liable Parties at a slight discount to the $40 Clearing House price and are forecasting an underlying STC price of $39 from 2023 to 2027 and after allowing for 47 cents registration cost we have used $38.53 per STC to incorporate into our payback model.

### 3.4 Forecasting new residential and commercial PV payback periods

As explained previously in section 2, 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 average value of electricity produced based on prices prevailing in the year of installation and the year prior to 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 6.6 kW. This is the most common size system installed (ie. the Mode) over the last 5 years (refer to Figure 3.3 and 3.4). For estimating the level of capacity installed and the level of STCs we assume a system size that reflects the mean of all systems which has progressively increased over time as an increasing number of very large residential systems have been installed; and
- Electricity output of the solar system differs by state and is based on annual average output per kilowatt estimated by the Clean Energy Council. Exports are determined by state based on expected average irradiance levels for the given state's capital city sourced from the Bureau of Meteorology relative to an average hourly electricity load derived from data sourced from the Smart Grid Smart City trial.

**Figure 3.3 Proportion of residential systems installed by capacity band**

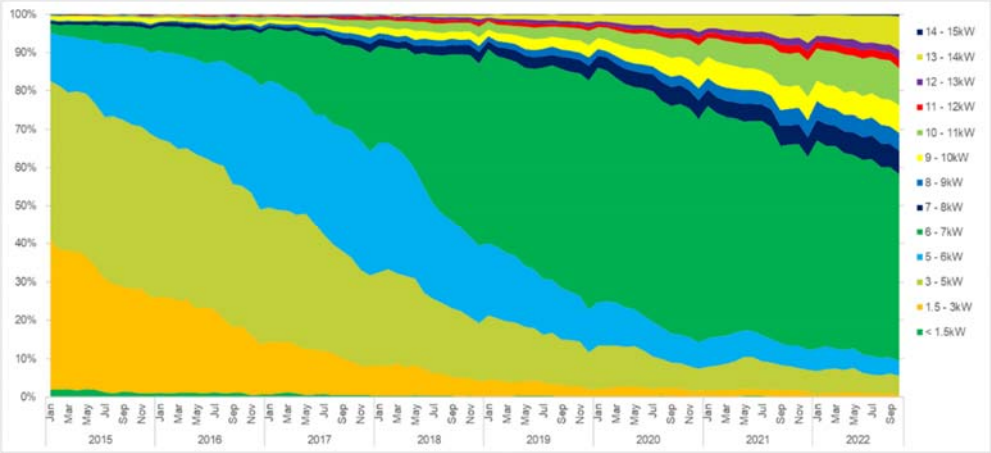
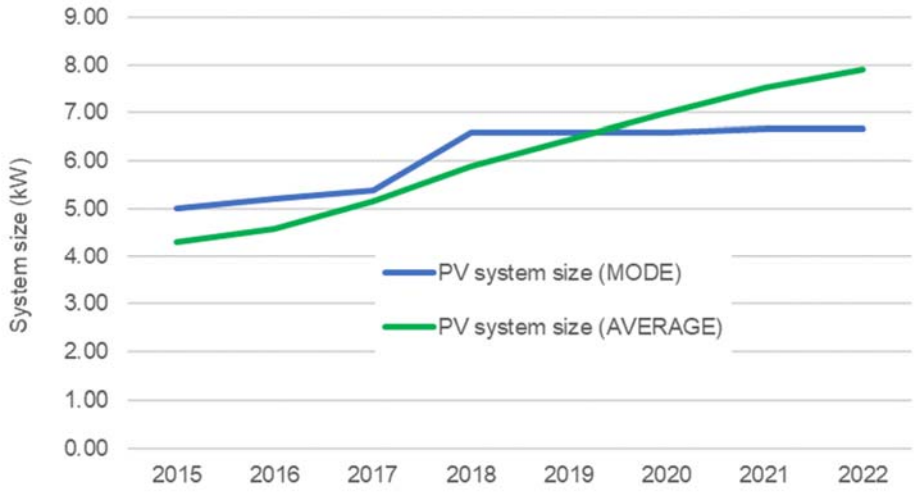



**Figure 3.4 Residential PV system size - Average and Mode**




For commercial systems:

- We model commercial paybacks on a state by state basis. 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
- The distribution of load over each hour is derived from data from substations serving predominantly business premises. The load profile is then scaled to a level that matches with feedback from interviews with solar industry participants that they typically apply a rule of thumb in sizing solar systems that aims to keep exported generation (or spilled generation where the system is prevented from exporting) to around 20% or less of total annual solar generation. Industry feedback is that the financial attractiveness of a system to customers usually significantly deteriorates once exports exceed 20% of total annual generation. For the purposes of payback calculations the generation excess to site load is assumed to generate no revenue. This is in line with the fact that many commercial systems will be prevented from exporting to the grid as a condition

of connection or in some cases are unable to secure a feed-in tariff from their retailer.

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 forecast period (Figures 3.5 and 3.6).

**Figure 3.5 Simple Payback (real) for typical residential PV system (6.6 kW)**

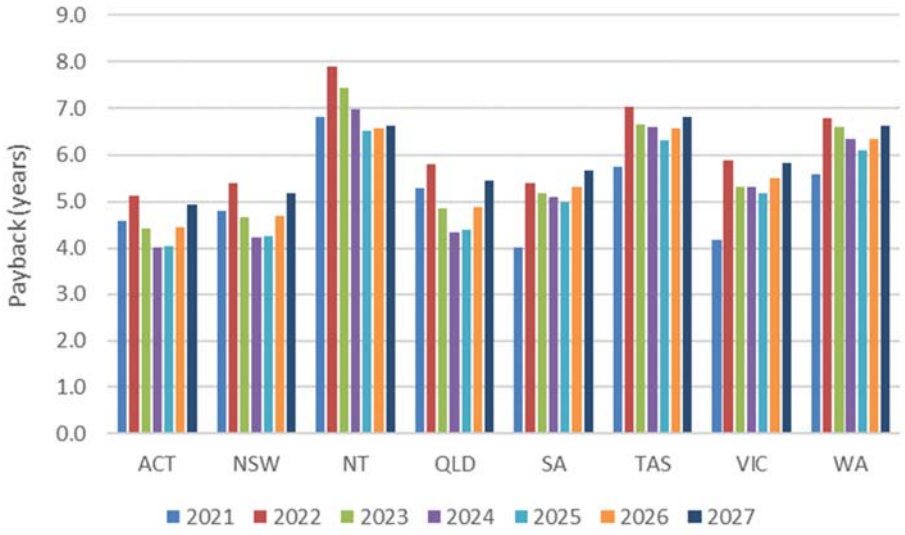
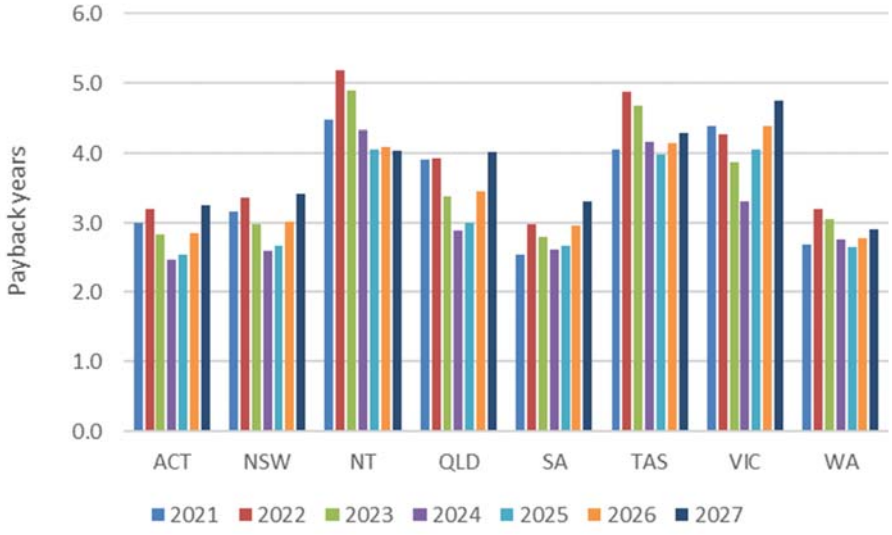



**Figure 3.6 Simple Payback (real) for typical Commercial PV system (20kW)**



### 3.5 Forecasting new home completions

New home completions are an important consideration in developing projections for new residential PV systems as well as a key driver of SWH installations. We incorporate the latest data from the 2021 census and then add new house completion data released by Australian Bureau of Statistics (ABS).

We have historically used new home projections from the Master Builders Association (MBA), however given the uncertain economic climate, with rising inflation and the prospects of reduced economic growth, new home completions are assumed to fall dramatically in 2023 and then be stagnant over the 2024 period. After 2024 we assume that completions revert to the longer-term MBA projections. The Commonwealth governments commitment to additional public housing being built will also support recovery in new home completions from 2025 onwards.

**Figure 3.6 New house completions**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
|---|---|---|---|---|---|---|---|---|
| ACT | 1,321 | 1,124 | 1,207 | 1,096 | 1,096 | 1,148 | 1,205 | 1,265 |
| NSW | 23,308 | 24,471 | 24,844 | 21,944 | 21,944 | 23,700 | 24,885 | 26,129 |
| NT | 419 | 503 | 394 | 428 | 428 | 624 | 656 | 688 |
| QLD | 19,614 | 22,586 | 26,380 | 22,960 | 22,960 | 23,753 | 24,941 | 26,188 |
| SA | 7,733 | 7,930 | 8,872 | 6,717 | 6,717 | 5,557 | 5,835 | 6,127 |
| TAS | 2,806 | 3,034 | 3,098 | 2,432 | 2,432 | 2,094 | 2,198 | 2,308 |
| VIC | 38,535 | 38,628 | 34,808 | 30,516 | 30,516 | 32,079 | 33,683 | 35,368 |
| WA | 10,559 | 11,884 | 11,971 | 11,287 | 11,287 | 13,441 | 14,113 | 14,819 |
| | **104,295** | **110,160** | **111,574** | **97,380** | **97,380** | **102,397** | **107,516** | **112,892** |

*Source: ABS, Master Builders Association, GEM projections*

# 4. STC Forecasts for solar PV

## 4.1 Solar industry participant interviews

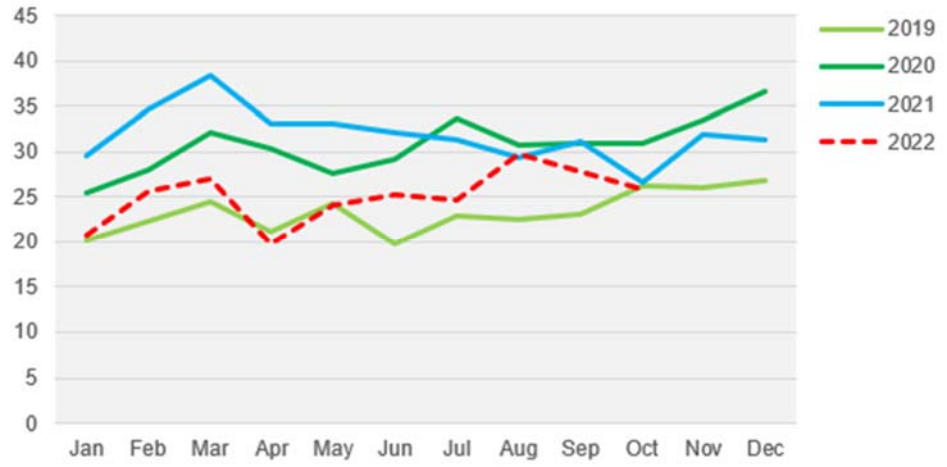
As part of the process of refining our model and developing estimates for the level of 2022 installations we undertook interviews with a small number of industry participants across the solar industry supply chain. Some key issues that emerged from these interviews are as follows:

- Equipment prices are likely to rise modestly in the short term due to the surge in demand from Europe as a result of the Russian invasion of Ukraine. Prices are expected to stabilise by the middle of 2023;
- Sales enquiries were reported as dropping considerably early in 2022 in response to competition from other discretionary expenditure (ie. holidays) once covid restrictions eased. The reporting of dramatic increases in energy prices after the invasion of Ukraine, lead to a significant increase in enquiries and sales, this did level off but was still running higher than in same time last year;
- Availability of accredited installers had been a constraint on installations, this is expected to moderate to the end of the year as housing construction eases and frees up additional skilled workers;
- High levels of rainfall and flooding in the eastern states in the first half of the year created challenges in installing systems, and resulted in lower-than-expected installations;
- We expect to see the typical increase in creation towards the end of the year as we have seen in previous years; and
- The has been an increase in enquiries and sales of batteries which has lead to a modest increase in the level of battery installations

## 4.2 Estimated STCs to be created for 2022 Installations

We have analysed the level of STCs that have been submitted for creation on a weekly basis for each of the key market sectors. The impact of Covid restrictions particularly in 2021 and the supply chain challenges and rainfall events can be seen clearly in Figure 4.1. Creation levels so far in 2022 have been well below the same time in the previous two years. We expect that level of installations will generally increase to the end of the year as it has in the previous years.

**Figure 4.1 Monthly profile of PV systems creating STCs from 2019 to Oct 2022**
'000 systems




In developing estimates of the lag in creating STCs to be applied to 2022 installations by state and sector we have used historical creation profiles for 2020 and 2021 and have also taken account of:

- Constraints in the installation of systems in NSW and Queensland in early 2022 due to significant rainfall events and flooding;
- 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 in 2020.

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:

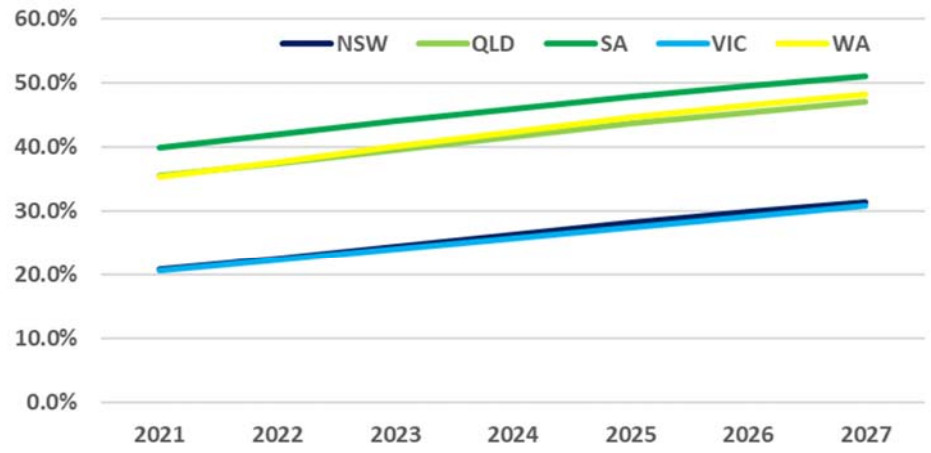
- In our modelling we have assumed that the heightened industry promotion and customer awareness remains in place for the balance of 2022 and then proceeds to get back to more normal levels by 2023; and

- We have assumed that the level of new residential installations in Victoria will be substantially governed by the Victorian Solar Homes Program. The level of installations in Victoria in 2022 will be well short of the government's target of 64,000 systems. We have assumed that the level of the rebate is progressively reduced to 2028 to the level required to support a minimum of 50,000 systems under the program.

The level of projected system installations by state is outlined in detail in Attachment 2 together with expected penetration levels.

Penetration levels for new PV system installations reach very high levels when measured against owner occupied detached and semi-detached homes. Using historical owner-occupied homes as a metric becomes potentially less effective over time as homes move from owner occupied to rental, as a number of rental homes install solar, and solar is installed on holiday homes. We believe that a more accurate representation of saturation is to include all occupied detached and semi-detached homes (including those that are rented). Figure 4.2 summarises the saturation rate for new residential PV systems measured against the total number of occupied detached and semi-detached homes.

**Figure 4.2 Penetration of New Residential PV Systems by key state**



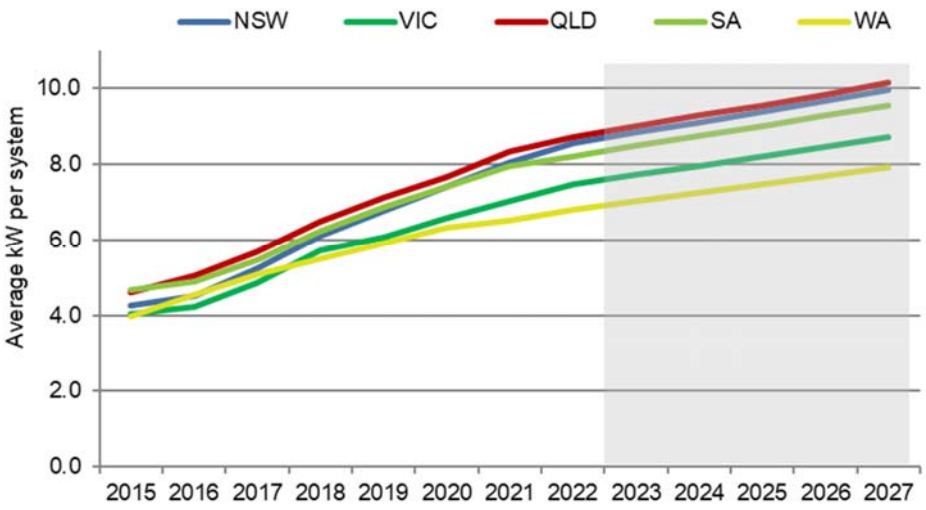

New residential system installations are expected to decline over the next four years as financial attractiveness deteriorates (Figure 4.3).

**Figure 4.3 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 assumed that the average system size increases by approximately 3% per annum increasing from 7.64 kW per system in 2021 to 8.35 kW per system in 2023 and then increasing to 9.4 kW per system by 2027.

**Figure 4.4 Average New Residential system size for NSW, Qld, SA, Vic and WA**




The capacity installed and resultant STCs created by state are included in Attachment 3. A summary of results is outlined in Figure 4.5 below:

**Figure 4.5 New residential solar installations and STC creation**

| Year of installation | Estimate 2021 | Estimate 2022 | Forecast 2023 | Forecast 2024 | Forecast 2025 | Forecast 2026 | Forecast 2027 |
|---|---|---|---|---|---|---|---|
| Number of Systems Installed | 288,565 | 226,311 | 229,843 | 236,981 | 237,312 | 226,547 | 213,597 |
| Avge kW/system | 7.64 | 8.09 | 8.35 | 8.62 | 8.87 | 9.13 | 9.39 |
| Avge Certificates/kW | 13.3 | 12.0 | 10.7 | 9.4 | 8.0 | 6.7 | 5.3 |
| MW Installed | 2,206 | 1,831 | 1,919 | 2,042 | 2,105 | 2,068 | 2,005 |
| Eligible Certificates ('000) | 29,430 | 22,040 | 20,483 | 19,095 | 16,865 | 13,784 | 10,674 |

## 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 3.4).

For the forecast period, we have assumed that the average system size in each state over the 2021 and 2022 years generally applies in future.

The total number of systems installed, and associated certificates created for the non-residential PV market is detailed in Attachment 4 and summarised in Figure 4.6.

**Figure 4.6 New non-residential solar installations and STC creation**

| Year of installation | Estimate 2021 | Estimate 2022 | Forecast 2023 | Forecast 2024 | Forecast 2025 | Forecast 2026 | Forecast 2027 |
|---|---|---|---|---|---|---|---|
| Number of Systems Installed | 20,298 | 18,347 | 18,272 | 19,476 | 19,063 | 18,094 | 17,171 |
| Avge kW/system | 20.54 | 18.83 | 20.54 | 18.83 | 19.68 | 19.63 | 19.58 |
| Avge Certificates/kW | 13.4 | 12.1 | 10.8 | 9.5 | 8.1 | 6.8 | 5.4 |
| MW Installed | 417 | 346 | 360 | 382 | 373 | 355 | 338 |
| Eligible Certificates ('000) | 5,636 | 4,194 | 3,883 | 3,614 | 3,028 | 2,401 | 1,828 |

## 4.5 Forecasting upgrade and replacement residential and commercial PV installations and STCs created

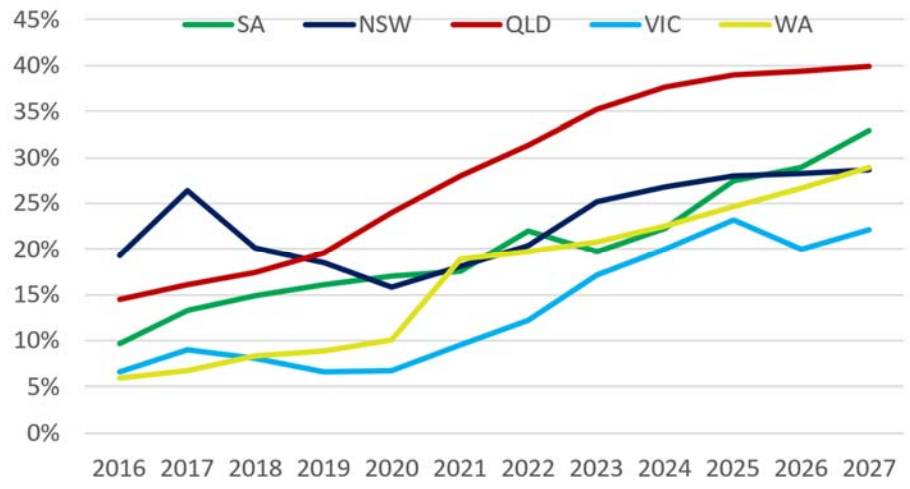
We have separately analysed the solar PV systems that have created certificates at an address that already had a system installed. These installations will either represent instances where a solar system has been upgraded (ie. the capacity has been increased) or where the previous system has been replaced.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

**Figure 4.7 Upgrade and Replacement systems as proportion of total Residential systems installed**

| | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|
| Replacement % | 2.2% | 5.2% | 8.9% | 8.6% | 9.1% | 10.4% | 12.9% | 14.0% |
| Upgrade % | 5.4% | 5.8% | 6.3% | 5.8% | 5.5% | 5.0% | 5.6% | 6.5% |
| Combined % | 7.6% | 11.0% | 15.2% | 14.3% | 14.5% | 15.4% | 18.5% | 20.5% |

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 7 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.

**Figure 4.8 Upgrade and Replacement systems as proportion of total Residential systems installed by key state**




The total number of systems installed, and associated certificates created for the upgrade PV market is detailed in Attachment 6 and summarised in Figures 4.9 and 4.10.

**Figure 4.9 Upgrade and replacement residential installations and STC creation**

| Year of installation | Estimate 2021 | Estimate 2022 | Forecast 2023 | Forecast 2024 | Forecast 2025 | Forecast 2026 | Forecast 2027 |
|---|---|---|---|---|---|---|---|
| Number of Systems Installed | 65,412 | 60,892 | 75,391 | 87,923 | 97,212 | 92,026 | 91,554 |
| Avge kW/system | 7.30 | 7.39 | 7.30 | 7.39 | 7.61 | 7.80 | 7.97 |
| Avge Certificates/kW | 13.4 | 12.2 | 10.8 | 9.5 | 8.1 | 6.8 | 5.4 |
| MW Installed | 478 | 450 | 573 | 685 | 775 | 753 | 766 |
| Eligible Certificates ('000) | 6,416 | 5,513 | 6,196 | 6,479 | 6,266 | 5,086 | 4,127 |

**Figure 4.10 Upgrade and replacement non-residential installations and STC creation**

| Year of installation | Estimate 2021 | Estimate 2022 | Forecast 2023 | Forecast 2024 | Forecast 2025 | Forecast 2026 | Forecast 2027 |
|---|---|---|---|---|---|---|---|
| Number of Systems Installed | 3,324 | 2,787 | 3,779 | 4,566 | 4,530 | 4,269 | 3,997 |
| Avge kW/system | 27.58 | 26.27 | 27.58 | 26.27 | 27.09 | 27.13 | 27.14 |
| Avge Certificates/kW | 13.6 | 12.2 | 10.9 | 9.5 | 8.2 | 6.8 | 5.4 |
| MW Installed | 92 | 73 | 102 | 124 | 123 | 116 | 108 |
| Eligible Certificates ('000) | 1,246 | 896 | 1,111 | 1,176 | 1,004 | 786 | 586 |

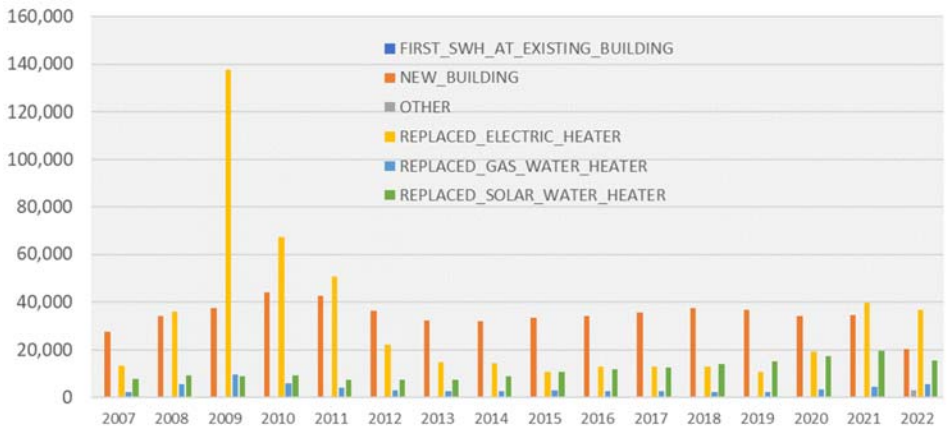
# 5. STC Forecasts for SWH and ASHP

## Overview

The number of SWH and ASHP systems installed in Australia has fluctuated considerable over the last 15 years mainly driven by government programs supporting the replacement of greenhouse intensive electric resistance water heaters. In response to the Global Financial Crisis (GFC) commonwealth and state governments implemented rebate programs for SWH and ASHP systems replacing electric systems which resulted in a surge in installations over the 2008 to 2011 (refer to Figure 5.1). In recent years energy efficiency schemes in Victoria and NSW have provided added support for the replacement of electric water heaters.

There is also growth in systems replacing solar water heater systems and whilst still modest we expect to see a continued increase in SWH and ASHP systems replacing gas water heaters. The new building market has been relatively stable over the last 15 years ranging between 30,000 and 40,000 systems per annum.

**Figure 5.1 SWH and ASHP Systems creating certificates by type of system being replaced (data up to 31 October 2022 so 2022 not a complete year)**




We estimate that more than 121,000 SWH and ASHP systems will be installed and create certificates in 2022 which is a 22% increase on 2021 levels. The most important driver for the increase has been policy support measures such as building regulations and energy efficiency schemes.

## New building market

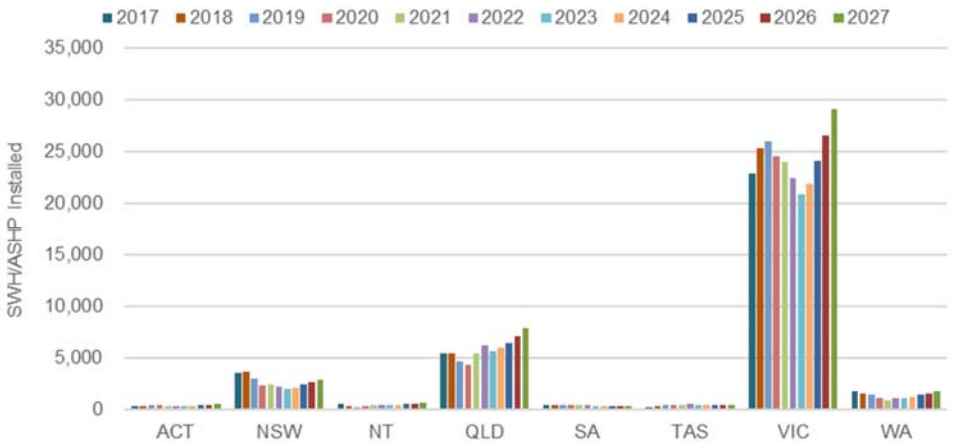
The primary drivers behind purchase behaviour in the new home market segment is the number of new dwellings and building regulations supporting lower energy use in homes.

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 the level of installations for the new-build submarket.

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 and ASHP installations. We have assumed that there is not a material impact from any possible future measures from the National Construction Code 2022 Energy Efficiency project. We expect the level of system installations to increase in line with the level of new home completions (refer to Figure 3.6). We have also incorporated a market growth factor of 5% per annum to reflect an increase in the attractiveness of solar over time due to rising energy prices.

The combined level of SWH and ASHP systems creating certificates is summarised in Figure 5.2 and is included in detail in Attachment 7. Victoria which has the most progressive new building regulations remains the leading state for this segment.

**Figure 5.2 SWH and ASHP Systems 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 support that is currently available is through the Energy Savings Schemes in Victoria and NSW.

Under the Victorian Energy Upgrade (VEU) an electric water heater replaced by a SWH or ASHP system can currently generate approximately 25 Victorian Energy Efficiency Certificates (VEECs). VEECs provide an added financial incentive in the order of $1500 to $2000 per system. 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.

Since April 2022 a SWH or ASHP that replace an electric water heater has also been eligible to create certificates under the NSW Energy Savings Scheme. A typical system could create approximately 30 Energy Saving Certificates (ESCs) with a value of between $800 and $1000.

In recent years we have seen an increase in the number of systems replacing solar and gas water heaters (refer to Figure 5.1). We have analysed SWH and ASPH systems claiming STCs in the replacement market by state (refer to Figure 5.3). The ACT and Victorian Governments are developing policy approaches that will support the phase out or reduction in new gas water heater installations. In addition we forecast that the replacement market will grow over the forecast period as increasing numbers of SWH and ASHP systems installed in 2009 and 2010, where the market surged due to expanded government grants, will start to be replaced.

We have generally factored in average growth rates of 5% per annum to reflect this development.

**Figure 5.3 Proportion of Replacement systems replacing Solar and Gas**

**Proportion replacing Solar**

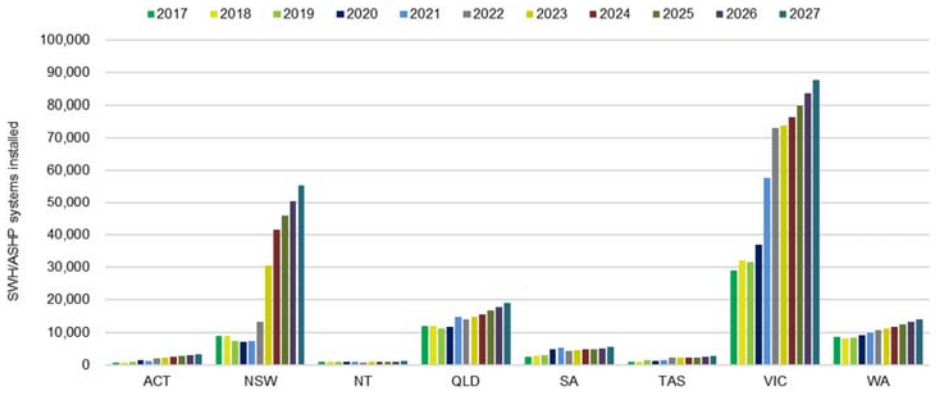
| | ACT | NSW | NT | QLD | SA | TAS | VIC | WA | Total |
|---|---|---|---|---|---|---|---|---|---|
| 2017 | 16.0% | 29.6% | 39.5% | 24.8% | 24.8% | 10.7% | 2.2% | 60.6% | 20.0% |
| 2018 | 16.4% | 33.3% | 56.7% | 29.2% | 21.6% | 19.1% | 1.9% | 65.6% | 21.0% |
| 2019 | 13.3% | 36.8% | 67.8% | 35.8% | 24.4% | 19.3% | 2.3% | 66.8% | 23.1% |
| 2020 | 18.6% | 38.2% | 65.4% | 44.0% | 15.9% | 14.1% | 2.6% | 67.8% | 23.2% |
| 2021 | 12.6% | 39.2% | 53.0% | 44.3% | 19.7% | 20.1% | 2.5% | 67.0% | 19.9% |
| 2022 | 9.1% | 26.1% | 56.3% | 44.3% | 25.0% | 33.6% | 2.7% | 66.1% | 18.9% |

**Proportion replacing Gas**

| | ACT | NSW | NT | QLD | SA | TAS | VIC | WA | Total |
|---|---|---|---|---|---|---|---|---|---|
| 2017 | 9.8% | 5.2% | 0.3% | 3.9% | 4.6% | 2.6% | 1.3% | 11.3% | 3.9% |
| 2018 | 13.2% | 3.5% | 0.5% | 3.7% | 3.7% | 1.1% | 1.5% | 8.9% | 3.3% |
| 2019 | 21.4% | 3.3% | 0.5% | 3.0% | 3.0% | 0.8% | 1.9% | 9.4% | 3.5% |
| 2020 | 38.8% | 4.4% | 0.3% | 2.6% | 3.5% | 1.7% | 2.3% | 11.5% | 4.6% |
| 2021 | 35.6% | 5.4% | 0.6% | 2.7% | 4.7% | 1.5% | 2.8% | 13.8% | 4.6% |
| 2022 | 53.8% | 5.3% | 0.2% | 3.8% | 10.5% | 3.0% | 5.3% | 14.9% | 7.1% |

The combined level of SWH and ASHP systems creating certificates is summarised in Figure 5.4 and is included in detail in Attachment 8. Victoria which has the most attractive incentive scheme (through the VEU program) is again the leading state for this segment with NSW installations increasing rapidly.

**Figure 5.4 Replacement SWH and ASHP Systems claiming certificates by state**



## Certificates created from the installation of SWH and ASHP systems

We have assumed that the average certificates per system (on a state basis) for the 2023 to 2027 forecast period will be similar to the average levels achieved over the 2020 to 2021 period adjusted for the reduction in the numbers of years deeming.

### Figure 5.5 Certificate creation from SWH and ASHP Systems

| Year of installation | Estimate 2021 | Estimate 2022 | Forecast 2023 | Forecast 2024 | Forecast 2025 | Forecast 2026 | Forecast 2027 |
|---|---|---|---|---|---|---|---|
| **New Buildings** | | | | | | | |
| Number of Systems Installed | 34,301 | 33,520 | 31,106 | 32,660 | 35,993 | 39,612 | 43,595 |
| Avge Certificates/System | 26.4 | 27.2 | 24.2 | 21.2 | 18.1 | 15.1 | 12.1 |
| Eligible Certificates ('000) | 907 | 912 | 753 | 691 | 653 | 599 | 527 |
| **Replacement** | | | | | | | |
| Number of Systems Installed | 65,030 | 87,709 | 109,818 | 123,522 | 130,419 | 137,835 | 145,816 |
| Avge Certificates/System | 30.2 | 27.3 | 24.1 | 21.0 | 17.9 | 14.9 | 11.9 |
| Eligible Certificates ('000) | 1,963 | 2,396 | 2,643 | 2,590 | 2,341 | 2,059 | 1,740 |
| **Total** | | | | | | | |
| Number of Systems Installed | 99,331 | 121,230 | 140,924 | 156,182 | 166,412 | 177,447 | 189,411 |
| Avge Certificates/System | 28.9 | 27.3 | 24.1 | 21.0 | 18.0 | 15.0 | 12.0 |
| Eligible Certificates ('000) | 2,870 | 3,308 | 3,395 | 3,281 | 2,994 | 2,658 | 2,267 |