ACIL ALLEN CONSULTING

REPORT TO
**CLEAN ENERGY REGULATOR**

16 JANUARY 2019

# SMALL SCALE TECHNOLOGY CERTIFICATES

## PROJECTIONS 2019 TO 2021

**FINAL REPORT**

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# EXECUTIVE SUMMARY

ACIL Allen Consulting (ACIL Allen) was engaged by the Clean Energy Regulator (CER) to undertake projections of the likely creation of Small-scale Technology Certificates (STCs) under the Commonwealth Government's Small-scale Renewable Energy Scheme (SRES) over the period 2019 to 2021.

It is intended that the projections would be used to inform the setting of the Small-scale Technology Percentage (STP) for the 2019 compliance year, as well as corresponding, non-binding, estimates for 2020 and 2021 compliance years as required under the *Renewable Energy (Electricity) Regulations 2001* (the Regulations).

As part of the project the CER provided ACIL Allen with two datasets: one pertaining to SGU installations and one pertaining to SWH installations. These datasets cover the period since the beginning of the RET in 2001 through to the 31st of December 2018. The data contains information for each installation including:

— Date of installation; date of REC/STC creation
— Number of RECs/STCs created, passed audit and registered
— Installation city/town, state, postcode
— Installation capacity
— Several other fields.

The datasets show that aggregate solar PV capacity installed in Australia was 6,595 MW at the end of calendar year 2017. This is estimated to have increased substantially in 2018, reaching 8,237 MW[1] by the end of December 2018. The rate of installed capacity in 2018 is estimated to have increased to 1643 MW, up from around 1118 MW in 2017 (a 47% increase). This was driven by a 53% increase in commercial installations from 330 MW in 2017 to 506 MW in 2018. Residential installations also increased, rising from 788 MW to 1137 MW in 2017 and 2018 respectively.

The overall rate of take-up of STC-eligible technologies is heavily dependent on decisions by many thousands of individual households to spend the time and effort to research the opportunity to purchase such systems. As a result, access to information, perceptions, biases and transaction costs can affect patterns of take-up just as much as the underlying economics of an investment in these technologies.

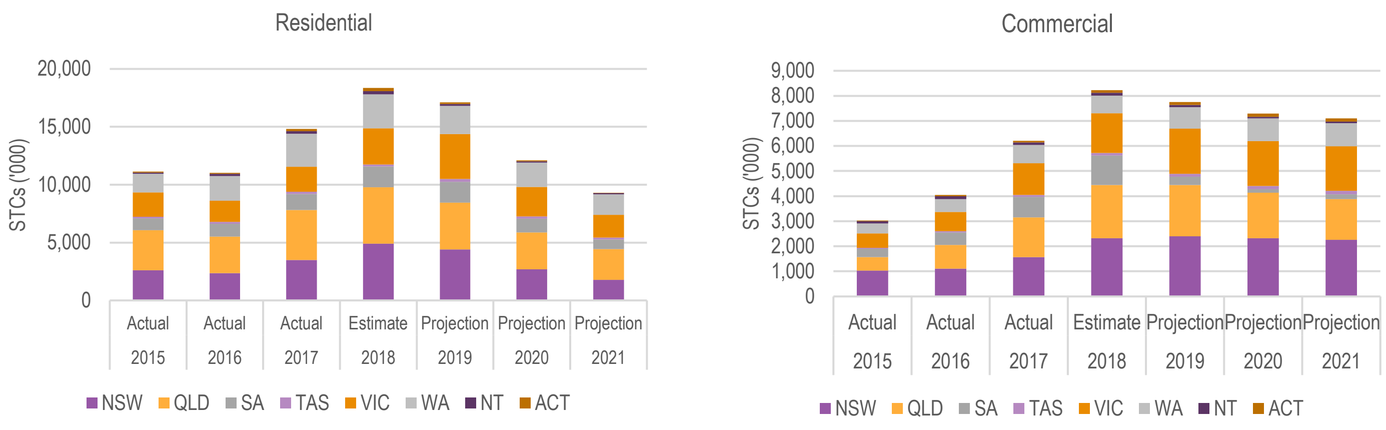
[1] This includes an estimate for the impact of the lag between installation and certificate creation.

STC creation by SGUs was modelled using an econometric regression examining the relationship between historic installation rates for solar PV systems and the discounted financial return available to owners of such systems. By then projecting financial returns for PV installations occurring during the projection period we can estimate SGU installation rates and STC creation rates. The regression model is based on observations for 36 quarters, from the start of 2010 to the quarter ending December 2018. Assumptions for the residential model relate principally to either historic uptake of solar PV (the regression model's 'dependent variable') or to the real net financial return to solar PV installations (the regression model's key 'explanatory variable').

Our model for the uptake of solar in the commercial sector is similar in nature and relates commercial installation numbers to the financial return of such installations, a linear trend representing non-financial factors and ultimately, an estimate of the roof space that is available for commercial installations.

**Figure ES 1** summarises the projected creation of STCs based on the installation year for residential and commercial premises. Projected STCs to be created from SGU units installed in 2019 total around 24.9 million, however these certificates will be created across the 2019 and 2020 calendar years due to the lag effect. Declines in 2020 and 2021 are exacerbated by the reduction in deeming period (11 years in 2020 and 10 years in 2021, compared with 12 years in 2019, 13 years in 2018, 14 years in 2017 and 15 years prior to 2017).

**FIGURE ES 1** PROJECTED STCS CREATED BY SOLAR PV – BASED ON YEAR OF INSTALLATION

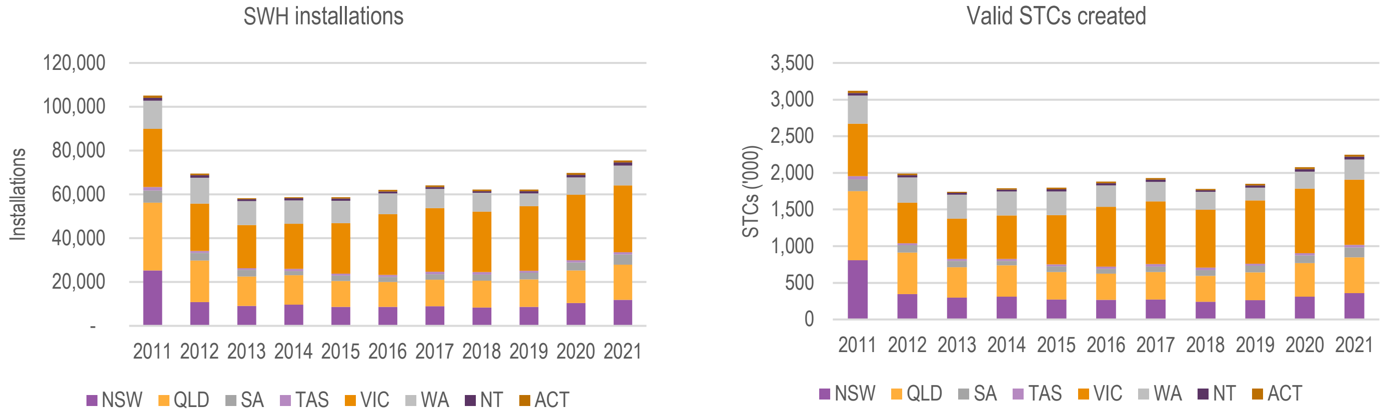



*SOURCE: ACIL ALLEN*

ACIL Allen adopts a stock model approach for projecting SWH installation and STC creation rates as the installation of SWH units. This approach attempts to distinguish between new building and replacement water heaters and discern the different driving trends (including construction trends and regulatory measures) affecting these different markets. This approach captures the key non-economic variables affecting SWH installation rates such as regulatory influences in a manner that a pure financial analysis could not.

**Figure ES 2** presents the projection results for SWH installation and implied STC creation, spliced alongside actuals for previous years. The projections show increases in the number of SWH installations in the projection period, driven mainly by installations in new build houses and increased demand for replacements of existing SWH units toward the latter part of the projection. This is due to the increasing stock of SWH units – particularly as a result of the boom in installations late last decade which are starting to come up for replacement in coming years. Implied STC creation follows a similar trajectory as shown in the figure on the right.

**FIGURE ES 2** SUMMARY OF SWH PROJECTIONS BY INSTALLATION YEAR




Note: Installations defined as all those which apply for STCs and have at least one STC pass the CER's audit process

*SOURCE: ACIL ALLEN*

The relevant number of STCs for the setting of the STP is the number of certificates that are created in each year. As such, the delay between system installation and certificate registration is an important consideration in estimating STCs to be created within a compliance year under the SRES.

ACIL Allen has applied historically observed lag factors to derive the final projection for STCs based on the year of creation (the object of this analysis) as shown in **Table ES 1**. The figures show a 35.3% increase in 2018 to around 30.2 million STCs, followed by a 9.4% decrease in 2019 to 27.4 million. STCs are then projected to decline by 20.5% in 2020 to 21.8 million, before declining a further 13.5% in 2021 to 18.8 million.

The projection indicates a significant increase in 2018 and 2019 relative to 2017, which is partially a function of rising financial paybacks for solar PV systems driven by higher retail electricity prices. The retail price of electricity is projected to decline significantly in 2020 and 2021 which puts downward pressure on the rate at which solar PV capacity is increasing.

STC creation (by year of certificate creation) is anticipated to reach a high of 30.2 million in 2018, declining thereafter primarily as a result of the reduction to deeming periods for solar PV and slower rates of installation growth of residential solar PV systems.

**TABLE ES 1** PROJECTED STCS BY YEAR OF CERTIFICATE CREATION ('000)

| | 2017 Actual | 2018 Estimate | 2019 Projection | 2020 Projection | 2021 Projection |
|---|---|---|---|---|---|
| Solar PV | | | | | |
| Residential | 14,526 | 19,560 | 17,351 | 12,428 | 9,496 |
| Commercial | 5,820 | 9,262 | 7,829 | 7,285 | 7,127 |
| Total solar PV | 20,346 | 28,263 | 25,584 | 19,712 | 16,623 |
| SWH | 1,970 | 1,925 | 1,777 | 2,050 | 2,206 |
| **Total** | **22,315** | **30,188** | **27,362** | **21,762** | **18,829** |

*SOURCE: ACIL ALLEN*

# 1 INTRODUCTION

ACIL Allen Consulting (ACIL Allen) was engaged by the Clean Energy Regulator (CER) to undertake projections of the likely creation of Small-scale Technology Certificates (STCs) under the Commonwealth Government's Small-scale Renewable Energy Scheme (SRES) over the period 2019 to 2021.

It is intended that the projections would be used to inform the setting of the Small-scale Technology Percentage (STP) for the 2019 compliance year, as well as corresponding, non-binding, estimates for 2020 and 2021 compliance years as required under the *Renewable Energy (Electricity) Regulations 2001* (the Regulations).

The CER has stipulated that the projection must consider a number of factors as set out in **Box 1.1**.

**BOX 1.1** ELEMENTS TO BE CONSIDERED IN THE PROJECTIONS

Data input into the model to estimate the number of Small-scale Technology Certificates (STCs) must include (but not be limited to):

- Eligible system STC creation for previous years showing the historical trend in small-scale technology uptake using data to be provided by the Clean Energy Regulator.
- Certificates remaining in the Renewable Energy Certificate (REC) Registry from the previous compliance period, (however delayed STC creation from installations in previous years may be relevant).
- STC price modelling (although STC price may be included as an input to the modelling exercise).
- Estimates of any over or under hang of STCs from the previous compliance year 2017.
- State and Commonwealth incentive schemes and any expected changes to these schemes over the timeframe, i.e. impact of potential change to state policies around feed in tariffs.
- State based renewable energy targets and schemes (emerging or operating).
- Relevant historical legislative changes to the eligibility rules and criteria for Solar Hot Water (SHW) and Small Generation Units (SGUs).
- Existing, and potential changes to building codes and regulations, including energy efficiency measures which affect the uptake of various technologies.
- Change in cost of STC eligible systems due to new technological and manufacturing improvements and changes in the cost of system components.
- Global financial conditions, such as changes in currency values, and changes to cost of raw materials.
- Changes in financial innovation and technological innovation (i.e. due to Clean Energy Finance Corporation loans, power purchase agreements and battery storage).
- Changes to electricity prices, network regulatory reform.
- Trends in residential and non-residential buildings (including ABS data)
- Changes in the size (kilowatts) and output of photovoltaic systems
- Impacts of phasing out deeming arrangements under the Renewable Energy Target.

Any other relevant factor the agency or the supplier deems appropriate.

*SOURCE: CLEAN ENERGY REGULATOR*

## 1.1 Background and policy context

The SRES commenced operation on 1 January 2011. The SRES supports the take up of ‘Small Generation Units’ (SGUs), particularly solar photovoltaic (PV) systems, and solar water heaters (SWHs) by households and businesses by requiring wholesale purchasers of electricity to purchase and surrender STCs, which can only be created by owners of SGUs and SWHs or agents assigned STC creation rights by the owner.

The SRES is an ‘uncapped’ scheme, meaning that the wholesale purchasers of electricity must acquire and surrender STCs set by reference to the Small-scale Technology Percentage (STP) in proportion to their overall electricity purchases in a given period (subject to some exemptions and true-up provisions that are not material to this analysis).

STCs are available for purchase and sale through a clearing house managed by the Clean Energy Regulator at a legislated fixed price (presently $40/STC), and also trade on the open market at prices around $40.

To ensure that liable entities purchase an appropriate amount of STCs each quarter, the responsible Minister must publish a ‘small-scale technology percentage’ in advance that represents the likely rate of STC creation as a proportion of all sales of electricity that are treated as ‘relevant acquisitions’ (less exemptions) under the SRES. This defines the quantity of STCs that liable parties must surrender at the relevant surrender deadlines. To offset their obligations, liable entities must surrender small-scale technology certificates on a quarterly basis through their REC Registry account.

As per subparagraph 40A (3)(a) of the *Renewable Energy (Electricity) Act 2000*, the Clean Energy Regulator estimates the amount of small-scale technology certificates that will be created in the current year. The STP is therefore determined ex-ante for each compliance year with the 2018 STP having been set in the *Renewable Energy (Electricity) Regulations 2001* (the Regulations) in March 2018 at 17.08%, equating to 29.30 million STCs.

The small-scale technology percentage is calculated in advance, based on the estimated:

— value, in megawatt hours, of small-scale technology certificates that will be created for the year
— amount of electricity that will be acquired for the year, and
— amount of all partial exemptions expected to be claimed for the year.

Once the small-scale technology percentage is published in the *Renewable Energy (Electricity) Regulations 2001* it cannot be changed. Where the actual number of STCs created in the previous compliance year differs from the amount estimated ex-ante, the Clean Energy Regulator will adjust the SRES target for the following compliance year accordingly.

**Table 1.1** shows the STP values determined in previous compliance years and the error between estimated and actual STC creation. Prior to 2016, the estimates of STCs made were significantly below actual creation levels, resulting in the CER boosting the subsequent year's STCs targets for this shortfall. This was reversed in 2016 and 2017, when the estimate of STCs made was above the actual level of creation.

**TABLE 1.1** PREVIOUS ESTIMATES OF STC CREATION AND STP VALUES

| Year | The estimated number of STCs created (A) | Number of STCs estimated above or below the previous target (B) | STP Equals (A) + (B) | Small-scale technology percentage |
|---|---|---|---|---|
| 2018 | 22,100,000 | 7,197,525 | 29,297,525 | 17.08% |
| 2017 | 15,100,000 | -2,649,809 | 12,450,191 | 7.01% |
| 2016 | 17,021,500 | -64,476 | 16,957,024 | 9.68% |
| 2015 | 17,487,667 | 3,079,771 | 20,567,438 | 11.71% |
| 2014 | 16,708,470 | 1,948,868 | 18,657,338 | 10.48% |
| 2013 | 20,700,000 | 15,000,000 | 35,700,000 | 19.70% |

*SOURCE: CLEAN ENERGY REGULATOR*

In addition to determining the binding STP value for the forthcoming compliance year, the CER also provides non-binding small-scale technology percentage for the subsequent two compliance years.

## 1.2 Dataset provided by the Clean Energy Regulator

As part of the project the CER provided ACIL Allen with two datasets: one pertaining to SGU installations and one pertaining to SWH installations. These datasets cover the period since the beginning of the RET in 2001 through to the 31st of December 2018. The data contains information for each installation including:

— Date of installation; date of REC/STC creation
— Number of RECs/STCs created, passed audit and registered
— Installation city/town, state, postcode
— Installation capacity
— Several other fields.

One difficulty in using the CER's STC creation database is that it relies on the STC creation process to provide information about installation date, location, size and other factors. SGUs and SWHs can create STCs up until twelve months after the physical installation occurs, and then are subject to audit processes. The lag between installation and STC creation inherent in this data set means that it is not complete until at least one year after a given period has ended.

In turn, this means that estimating SGU installation rates for periods less than 12 months before the finalisation of the data set (i.e. December 2017 onwards) requires that allowance be made for this lag.

However, the uncertainty surrounding this estimation declines significantly for periods approaching 12 months ago.

## 1.3 Structure of this report

This report represents ACIL Allen's deliverable under this engagement and presents the projections of STC creation over the relevant period.

The report is structured as follows:

— Chapter 2 reviews historical STC creation trends from SGUs, discusses the methodology employed in undertaking the solar PV projections and presents projection results for SGU installation and STC creation
— Chapter 3 presents projection results for STC creation from SWH (including air source heat pumps)
— Chapter 4 summarises the overall estimated STC creation for 2018 and projection results for STC creation in future compliances years 2019 to 2021.

# 2 SGU PROJECTIONS

Although this projection is of STC creation by all SGUs, the historic portion of REC creation by micro-hydro and micro-wind generators is sufficiently small that one can focus entirely on trends in the solar PV sector to discern likely future rates of STC creation. This is illustrated by comparing the total rate of installations, REC creation and capacity installed by the three SGU types, as set out in **Table 2.1**.

**TABLE 2.1** MICRO-WIND, MICRO-HYDRO AND SOLAR PV COMPARISON 2001 TO PRESENT

| Technology | Installations | Capacity installed (MW) | STCs created ('000) |
|---|---|---|---|
| S.G.U. - Hydro (Deemed) | 18 | 0.04 | 2.6 |
| S.G.U. - Solar (Deemed) | 2,018,762 | 7,980.0 | 227,664.0 |
| S.G.U. - Wind (Deemed) | 423 | 1.5 | 23.2 |

*SOURCE: CLEAN ENERGY REGULATOR*

Accordingly, one can focus entirely on trends in the solar PV sector to discern likely future trends in STC creation by SGUs. Reflecting this, the discussion below generally uses the terms SGU and solar PV interchangeably, and trends analysed are exclusively through reference to solar PV policy settings.

## 2.1 Historic trends

**Figure 2.1** provides a range of summary historical statistics of SGU installation and SGU creation based on the date of installation.

Aggregate solar PV capacity installed in Australia was 6,595 MW at the end of calendar year 2017. This is estimated to have increased substantially in 2018, reaching 8,237 MW[2] by the end of December 2018. The rate of installed capacity in 2018 is estimated to have increased to 1643 MW, up from around 1118 MW in 2017 (a 47% increase). This was driven by a 53% increase in commercial installations from 330 MW in 2017 to 506 MW in 2018. Residential installations also increased, rising from 788 MW to 1137 MW in 2017 and 2018 respectively.

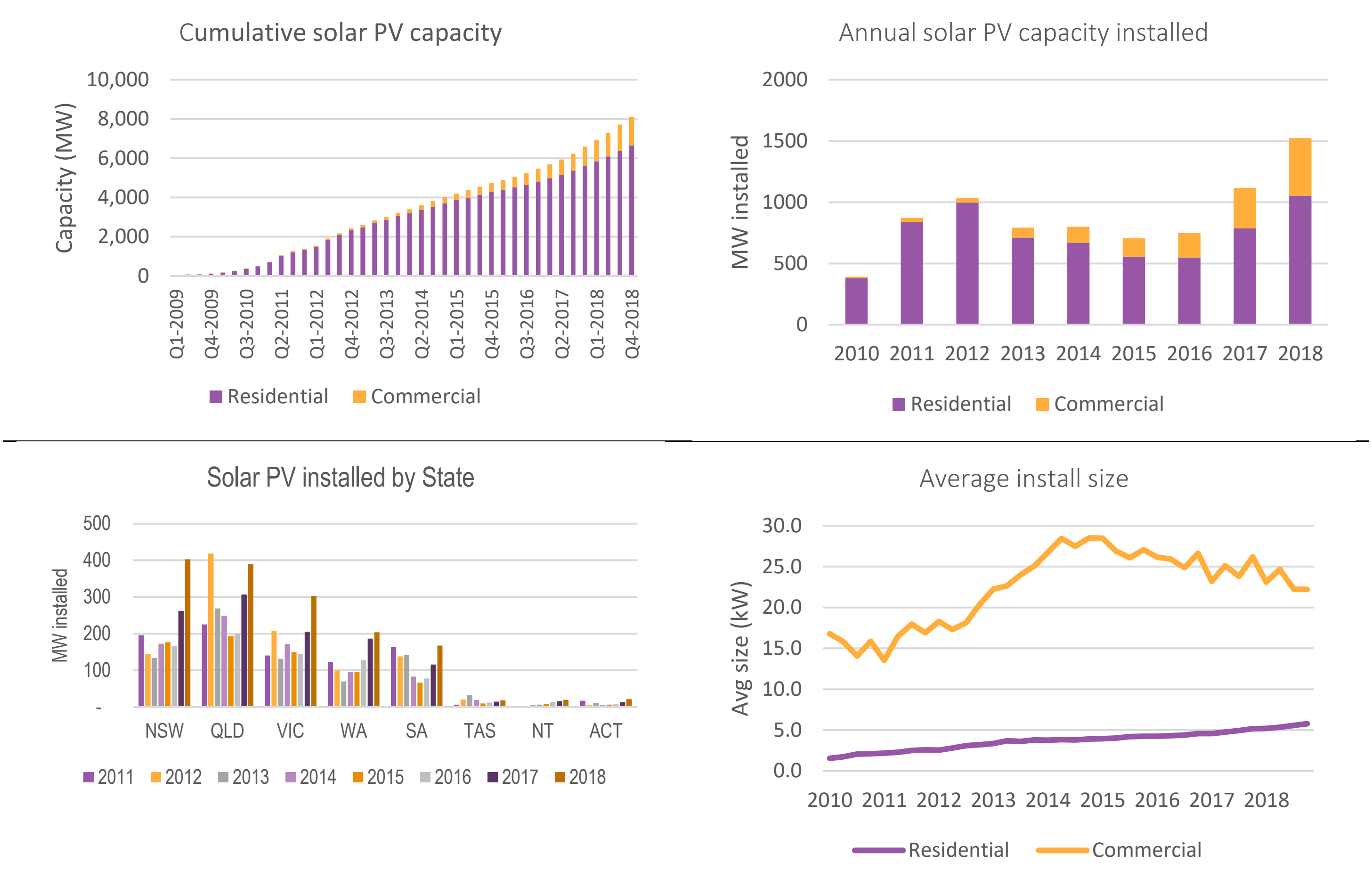
All states showed an increase in the rate of installation. Of the major regions, the rate of solar PV installation increased by 65.5% in NSW, 37.1% in Queensland, 17.8% in WA, 56.2% in SA and 59.5% in Victoria between 2017 and 2018.

**Figure 2.2** shows the market shares of various solar PV systems based on a size classification for both residential and commercial installations. The size of residential installations continues to grow strongly, with the ongoing decline of smaller installations. This is due to cost reductions which have made larger installations more accessible to households. By contrast the commercial market (defined

[2] This includes an estimate for the impact of the lag between installation and certificate creation.

as installs 10 kW and over) has a reasonable spread of installation sizes due to its diverse customer base. The size of the average installation has declined slightly over the last 12 months and is limited by the 100 kW upper bounds under the SRES.

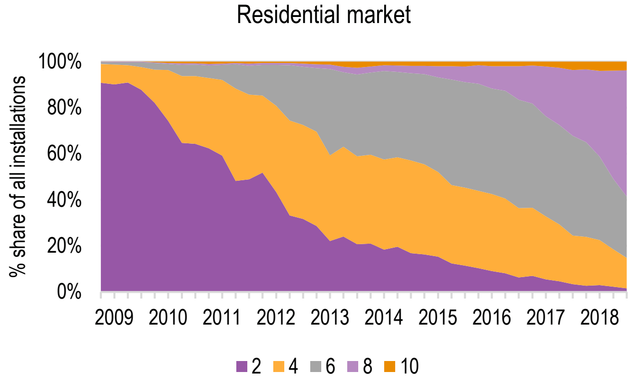
**FIGURE 2.1** SUMMARY HISTORICAL TRENDS OF SGU INSTALLATION

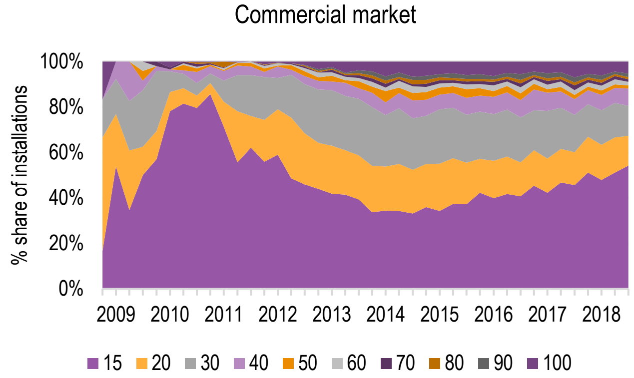



Note: Installations and capacity figures for 2018 cover the period from January to December 31.

*SOURCE: ACIL ALLEN ANALYSIS OF CER DATA*

FIGURE 2.2 MARKET SHARE OF DIFFERENT SIZED SYSTEMS BY CLASS SIZE OF INSTALLATION




Note: The size classes refer to systems that are smaller than the stated size but larger than the previous size class. For example size class 2 refers to systems that are between 0 and 2 kW in size

*SOURCE: ACIL ALLEN ANALYSIS OF CER DATA*

## 2.2 Projection methodology

The overall rate of take-up of STC-eligible technologies is heavily dependent on decisions by many thousands of individual households to spend the time and effort to research the opportunity to purchase such systems. As a result, access to information, perceptions, biases and transaction costs can affect patterns of take-up just as much as the underlying economics of an investment in these technologies.

STC creation by PV systems was modelled using an econometric regression examining the relationship between historic installation rates for PV systems and the discounted financial return available to owners of such systems. By then projecting financial returns for PV installations occurring during the projection period we can estimate SGU installation rates and STC creation rates.

Our methodology is outlined in more detail below.

### 2.2.1 Model overview

The projections of roof-top solar installations are for photovoltaic systems with less than 100 kW capacity that are eligible to create STCs under the SRES. These generators can be installed by households and commercial or industrial premises. While the majority of historic PV installations have been made by households, commercial installations are becoming increasingly more common. In order to distinguish between residential and commercial PV installations ACIL Allen assumes that systems above 10 kW are commercial installations and we apply a separate model to project the uptake of these systems.

The model for the uptake of residential systems uses a quarterly resolution and separately estimates the uptake of PV systems for each state and territory, as the percentage of eligible dwellings where a PV system is installed. An eligible dwelling is defined as a detached or semi-detached residential dwelling. Uptake is estimated based on a regression of historical uptake rates against a measure of payback to households from installing a certain amount of solar capacity amongst other factors.

The regression model is based on observations for 36 quarters, from the start of 2010 to the quarter ending December 31 2018.

Assumptions for the residential model relate principally to either historic uptake of solar PV (the regression model's 'dependent variable') or to the real net financial return to solar PV installations (the regression model's key 'explanatory variable'). These are discussed separately below. Further, as real financial returns are driven by several distinct factors, these are discussed separately. These factors are:

— PV system installation costs

- Rebates and subsidies
- Retail electricity prices and the structure of these charges to consumers
- Payments for exported electricity, generally known as 'feed-in tariffs' or 'buyback rates'
- System output and export assumptions.

The majority of historical PV installations have been in the residential sector but in recent years commercial installations have experienced significant growth. The decision making process for a commercial entity to install a solar system differs from that of a residential customer. Commercial entities may expect investments to pay off within shorter time frames than residential customers and are likely to apply are more comprehensive financial evaluation that a solar PV installation provides.

The real or perceived cost of capital required to invest in a PV system is typically lower for households than for commercial entities.

The emergence of new financing models such as solar leasing and solar power purchase agreements for roof-top solar installations has made PV installations more attractive to commercial customers by removing the need for any upfront investment.

Our model for the uptake of solar in the commercial sector relates commercial installation numbers to the financial return of such installations, a linear trend which captures the impact of factors other than financial return (such as the number of providers offering solar PPA or leasing arrangements) and an estimate of the roof space that is available for commercial installations.[3]

It should be noted that a range of other factors may affect household and business decisions to install solar PV systems. Many of these factors are not easily quantifiable, such as environmental attitudes, marketing and anecdotal responses to the experiences of friends and family. Nevertheless, it is still reasonable to project future installation rates for this technology as being related to the financial attractiveness of the systems, even if the decision-making process of the households and businesses making the decision is not directly or exclusively financial.

### 2.2.2 PV system costs

The cost of installing a PV system has decreased over time. ACIL Allen's estimates of historic system cost were derived by taking a national average system cost which was scaled to account for differences in cost due to system size and to account for differences in system costs between different states and territories. No allowance was made for the cost of inverter replacement or for ongoing system maintenance costs.

For the period from October 2012 to July 2018 (inclusive) the national average cost of installing a PV system was based on SolarChoice's *PV Price Check* publication (renamed more recently to the residential and commercial solar PV price index).[4] That publication sets out offered prices for systems of different sizes in each capital city. ACIL Allen modifies these price points for GST and rebate values available at the time to estimate an underlying total system cost. The city level estimates were used to derive a national average system cost by weighting in proportion to the size of the market in each state or territory.

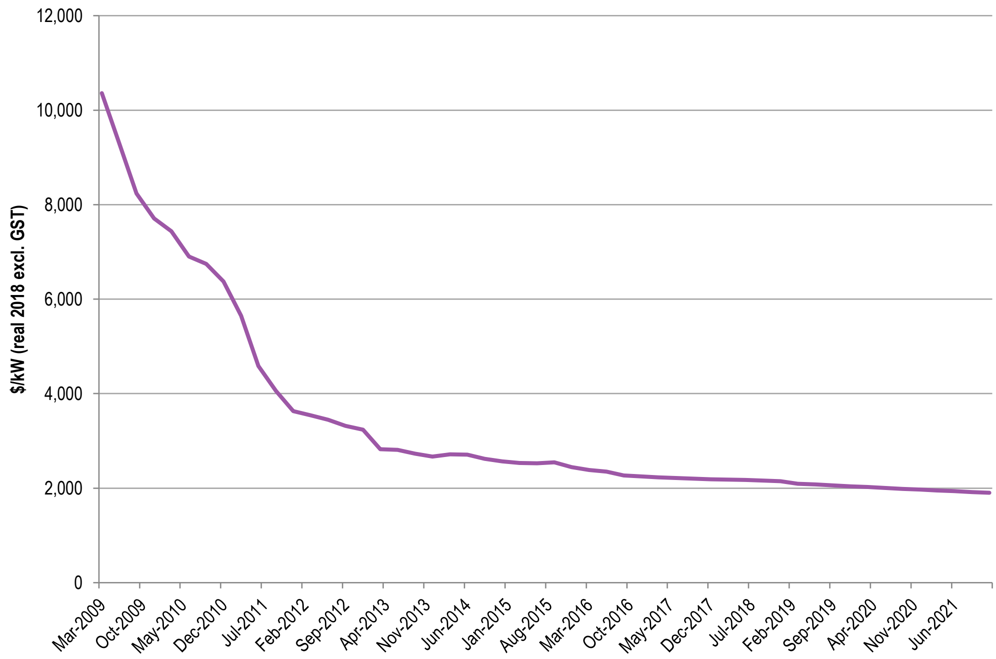
Prior to December 2012 this data was unavailable, so different data sources were used in order to recreate a complete historical time series for regression purposes. The estimated national average cost of installing a PV system between January 2009 and September 2012 (inclusive) is based on:

- from 2009 to mid-2010, AECOM analysis of PV system costs for the NSW Government (published October 2010),
- from 2010 to November 2011, ACIL Allen (then ACIL Tasman) reviews of internet quotes for PV systems undertaken as part of analysis for the Clean Energy Regulator (late 2010, mid-2011, late 2011)
- between November 2011 and September 2012 the cost was assumed to move in a linear fashion between ACIL Allen's last estimate and Solar Choice estimates.

[3] Given the relatively short projection period for this exercise (to 2021), available roof space is not a constraining factor for installations.
[4] See www.solarchoice.net.au. These are also published from time to time in sources such as Climate Spectator.

**Figure 2.3** shows ACIL Allen's resulting estimate of the national average cost of installing a roof-top residential solar PV system with a size of between 1.5 and 5kW.

**FIGURE 2.3** NATIONAL AVERAGE HISTORIC AND PROJECTED PV INSTALLATION COST




Note: cost excludes rebates, subsidies and GST. Compiled actuals to July 2018, projections thereafter

*SOURCE: AECOM, ACIL ALLEN AND SOLAR CHOICE*

The system cost projections used anticipate a continuation of recent cost trends in solar PV, with system prices flattening on a per kW basis. ACIL Allen projects a slight decline in real terms over the period to 2021. The main factors at play in the solar PV market include changes in the AUD/USD exchange rate, competition in the domestic market and continued improvements in technical efficiency leading to further reductions in system prices.

The exchange rate appears to remain in a long-term downtrend, which if it continues will lead to further increases the Australian dollar cost of imported equipment. In 2018, the AUD/USD exchange rate has declined from 78 cents at the beginning of the year to about 70.6 cents at the end of December.

Solar Choice's *PV Price Check data* were also used to estimate a cost premium or discount for each state and territory based on averaged variations across the period. Similarly, smaller and larger systems were given a premium or discount based on observed variation from the average. The relative premia/discounts associated with different sized systems are set out in **Table 2.2**.

**TABLE 2.2** PV INSTALLATION COST PREMIUM/DISCOUNT BY SYSTEM SIZE

| Size (kW) | 1.5 | 2 | 3 | 4 | 5 | 10 | 100 |
|---|---|---|---|---|---|---|---|
| Premium/discount from average | 18% | 6% | -3% | -9% | -12% | -15% | -18% |

*SOURCE: ACIL ALLEN ANALYSIS OF SOLAR CHOICE DATA*

### 2.2.3 Rebates and subsidies

Three sources of upfront rebates and subsidies for PV installations were taken into account:

— the former Solar Homes and Communities Program (SHCP), which provided an upfront cash rebate

— the indirect subsidy provided by the creation of STCs under the SRES, including the creation of additional STCs through the 'Solar Credits multiplier'

— the Victorian Government's Solar Homes Package

Under SHCP, customers who installed PV systems received an upfront rebate of $8,000. SHCP was in place at the beginning of 2009, and was closed during June 2009. However, as systems installed in the second half of that year received assistance based on prior applications for the rebate, it is analysed as having an effect on some installations in the second half of 2009.

In addition to the upfront payment through SHCP, PV systems were eligible to create certificates for the renewable electricity they generate during the historic period. The value of these certificates (initially RECs created under the Renewable Energy Target and then STCs created under the SRES) provides an upfront subsidy to installation of PV systems.

The value of this subsidy is depended on system size and certificate price. From June 2009 until 31 December 2012, it also depended on the 'solar credit multiplier', which was established under the Solar Credits scheme and allowed eligible customers who installed PV systems were deemed to create additional RECs/STCs, thereby increasing the amount of the subsidy. The multiplier was originally 5, meaning that a PV system would create 5 solar credits for every MWh of electricity it was deemed to generate, for the first 1.5 kW of capacity installed. The multiplier then declined over time.

The SHCP was phased out in favour of Solar Credits during 2009. Customers could benefit from either the SHCP or the Solar Credits multiplier, but not both. To address the overlap between these two policies, 50% of PV installations in quarter 3 2009, and 20% in quarter 4 2009 were assumed to receive the SHCP rebate. The remainder were assumed to use the Solar Credits multiplier to generate extra certificates.

The solar multiplier and certificate values factored into the analysis are shown in **Table 2.3**. In effect, a PV system installed in 2009 was assumed to receive part of the SHCP grant and part of its entitlement through Solar Credits.

**TABLE 2.3** SOLAR CREDITS MULTIPLIER AND SHCP REBATE

| | Until July 2009 | Q3 2009 | Q4 2009 | Q1 2010 – Q2 2011 | Q3 2011 – Q2 2012 | Q3 & Q4 2012 | From January 2013 |
|---|---|---|---|---|---|---|---|
| Solar Credits multiplier | 1 | 3.0 | 4.2 | 5 | 3 | 2 | 1 |
| SHCP value | $8,000 | $4,000 | $1,600 | $0 | $0 | $0 | $0 |

*SOURCE: ACIL ALLEN, RENEWABLE ENERGY (ELECTRICITY) REGULATIONS 2001*

Unlike the SHCP payment, the value of RECs/STCs, and therefore the total rebate derived from these certificates, varied over time according the market price at the time. Up until May 2017, the STC price was very close to the Clearing house price of $40/STC. From June onwards, the STC price declined as a result of an oversupply in certificates, before recovering in late 2017.

Beyond 2018, the STC is assumed to remain constant (in nominal terms), at $37 per certificate, which is the approximate open market price in early 2019. Until 1 January 2017, all systems were assumed to create 15 years of 'deemed' RECs/STCs at the time on installation, and then cease to be eligible for further certificates after 15 years. Between 2017 and 2030 the deeming period is assumed to decline by one year in each year so that systems installed in 2030 are deemed to create certificates for one year only.

The Victorian Government's Solar Homes package will provide a rebate to eligible households of 50% of the cost of a solar PV system up to a maximum rebate of $2,225. The rebates are available for systems installed from 19 August 2018 to 30 June 2019. The impact of the rebate is incorporated into the modelling by adjusting the upfront cost of a new PV system accordingly.

### 2.2.4 Retail electricity prices

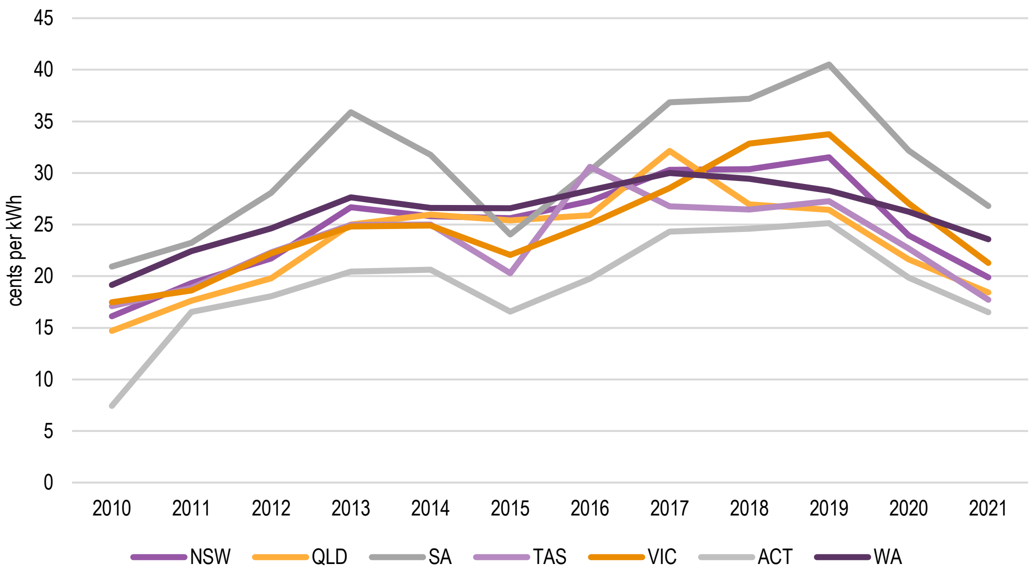
Retail electricity prices are important to the financial return on solar PV as every kWh of solar output that is consumed by the owner of the system avoids the variable component of the retail electricity price.

For Tasmania, Western Australia, the Northern Territory and the Australian Capital Territory, historic retail prices were adopted based on published regulated retail prices in the relevant periods. This approach was adopted because, for the former three jurisdictions, there was no retail competition in that period, and so no other prices were available. In the case of the ACT, retail competition was in place, but the regulated prices were sufficiently low and competitive that ACIL Allen assumes minimal discounts to that level were available and the published prices are sufficiently reflective of prices paid by consumers.

In the cases of New South Wales, Victoria, Queensland and South Australia, historic retail prices are estimated based on a 'cost-stack' estimate, combining, wholesale, network, 'green scheme' and retail components. The variable component of these tariffs are assumed to be all costs other than the fixed component of network tariffs, and advanced metering infrastructure (also known as smart meters') charges in Victoria.

**Figure 2.4** shows both the historical and projected retail electricity prices used in the modelling. The figure shows a rise in electricity prices in 2019, followed by general decline in prices in prices in 2020 and 2021.

**FIGURE 2.4** HISTORICAL AND PROJECTED RETAIL ELECTRICTY PRICES, NOMINAL




*SOURCE: ACIL ALLEN*

### 2.2.5 Cost reflective network pricing

Residential electricity tariffs in Australia are typically structured as two part tariffs comprising of fixed connection fee which is charged per customer per day and a variable charge per kWh of electricity consumed. Fixed charges are independent of a households peak energy use and comprise a relatively small component of a typical household's electricity bill. This stands in contrast to the cost incurred by network businesses in serving a households electricity demand i.e. the costs are dependent on a households peak energy use and a large component of the cost is fixed.

In November 2014 the Australian Energy Market Commission (AEMC) made a new rule that requires network businesses to set tariffs that are reflective of the costs of providing network services to individual customers. Cost reflective network prices will likely contain a larger fixed component and recent shifts in network tariffs indicate this to be the case. A move towards more cost reflective network pricing will likely reduce the amount of variable network charges that can be avoided through the installation of a PV system and therefore reduce the attractiveness for consumers.

For our projections we have assumed that over time network tariffs for residential customer's transition to include a larger share of fixed charges[5], but that this occurs relatively slowly. We assume that by 2025, 80% of network costs are recovered through fixed charges that cannot be avoided through the installation of solar PV.

### 2.2.6 Feed-in tariffs and buy back rates

When solar PV systems produce more power than is required at the premises at which they are installed, the electricity is exported to the grid and on-sold to other customers. The value of this exported electricity is another important component of the financial return to PV installation.

For clarity, this report distinguishes between 'feed-in tariffs' and 'buyback rates'. Within this categorisation, 'feed-in tariff' refers to a premium rate determined by legislation that must be paid for exported electricity from eligible PV systems.

In general, exported PV output always displaces electricity that would otherwise be purchased from the wholesale market, and therefore provides some value to the retailer that on-sells this electricity. Accordingly, retailers that supply power to owners of PV systems are generally willing to pay some amount for exported PV output that is separate from, and additional to, any premium feed-in tariff that might be imposed by legislation. The term 'buyback rate' refers to these payments by retailers that reflect the value of exported PV output to the retailer, and which, whilst sometimes regulated, are not intended to offer a premium rate or purposefully subsidise PV systems.

Within this categorisation, it is necessary to distinguish between three types of feed-in tariffs:

— A 'net' feed-in tariff is the most common form, and pays a premium rate for all exported PV output
— A 'gross' feed-in tariff meters PV output in such a way that all PV output is effectively exported, earning whatever premium rate is available, and then all of the customer's electricity is then imported at the prevailing retail rate
— A 'one-for-one' feed-in tariff establishes that the payment for exported PV output must be equal to the prevailing retail rate.

With this nomenclature established, **Table 2.4** sets out the various feed-in tariffs that have been or are in operation in Australia.

[5] This is less of an issue for commercial installations as business customers tend to be on tariff structures which are closer to cost reflective levels already.

TABLE 2.4 SUMMARY OF HISTORICAL AND CURRENT FEED-IN TARIFFS BY JURISDICTION

| Jurisdiction | Initial feed-in tariff regime | Comments | Subsequent feed-in tariff | Comments | Current arrangements |
|---|---|---|---|---|---|
| New South Wales | 60c gross | Commenced early 2010, phased out through early 2011. Paid to end 2016 | 20c gross | Breached cap in Q3 2011. Paid to end 2016 | Voluntary retailer contribution between 9 and 12 c/kWh |
| Victoria | 60c net | October 2009 to September 2011. Paid to end 2024 | 25c net | Breached cap in mid-2012. Paid to end 2016 | Current minimum of 9.9c/kWh. |
| Queensland | 44c net | 2008 to mid-2013. Paid to June 2028 | 8c net until 30 June 2014 | | Voluntary retailer contribution between 7 and 16 c/kWh |
| South Australia | 44c net | 2008 to September 2011. Paid to June 2028 | 16c net | October 2011 to September 2012. Paid to June 2016 | No mandatory minimum. Currently between 7 and 16c/kWh |
| Western Australia | 40c net | Mid 2010 to mid-2011. Paid for 10 years from installation | 20c net | In place July and August 2011. Paid for 10 years from installation | Synergy offers a buyback rate of 7.135 kWh; Horizon offers location-specific rates of 10-50c |
| Tasmania | One-for-one | Until August 2013 | 8.3c net | | Rate of about 7 c/kWh set by Aurora Energy |
| Northern Territory | One-for-one | Still in place | | | One-for-one feed-in tariff |
| Australian Capital Territory | 50.05c gross, then 45.7c gross from October 2010 | April 2009 to mid-2011. Paid for 20 years from installation | One-for-one | Mid 2011 to mid-2013 | No mandatory minimum. Current buyback rate between 6 and 8c/kWh |

Note: All rates are in nominal cents per kWh

*SOURCE: ACIL ALLEN ANALYSIS*

### 2.2.7 System output and export rates

System output is estimated based on four solar zones created by the CER for the purpose of calculating REC and STC creation by solar PV, which have different assumed rates of solar output per kW of installed capacity. Each postcode is assigned a zone, whereas multiple solar zones may exist in a given state, territory or network area. These zones as the solar output values are as follows:[6]

- Zone 1: 1.622 MWh per kW of capacity
- Zone 2: 1.536 MWh per kW of capacity
- Zone 3: 1.382 MWh per kW of capacity
- Zone 4: 1.185 MWh per kW of capacity.

**Table 2.5** sets out the share of households located in each zone, and implied average output per kW of installed capacity for each state and territory.

TABLE 2.5 SHARE OF FREE STANDING DWELLINGS BY SOLAR ZONE

| Jurisdiction | Solar zone 1 | Solar zone 2 | Solar zone 3 | Solar zone 4 | Assumed Output (MWh/kW/a) |
|---|---|---|---|---|---|
| NSW | 0% | 3% | 96% | 1% | 1.38 |
| VIC | 0% | 0% | 5% | 95% | 1.19 |
| QLD | 0% | 2% | 98% | 0% | 1.38 |
| SA | 0% | 1% | 94% | 4% | 1.38 |
| WA | 3% | 5% | 87% | 5% | 1.39 |
| TAS | 0% | 0% | 0% | 100% | 1.19 |
| ACT | 0% | 0% | 100% | 0% | 1.38 |

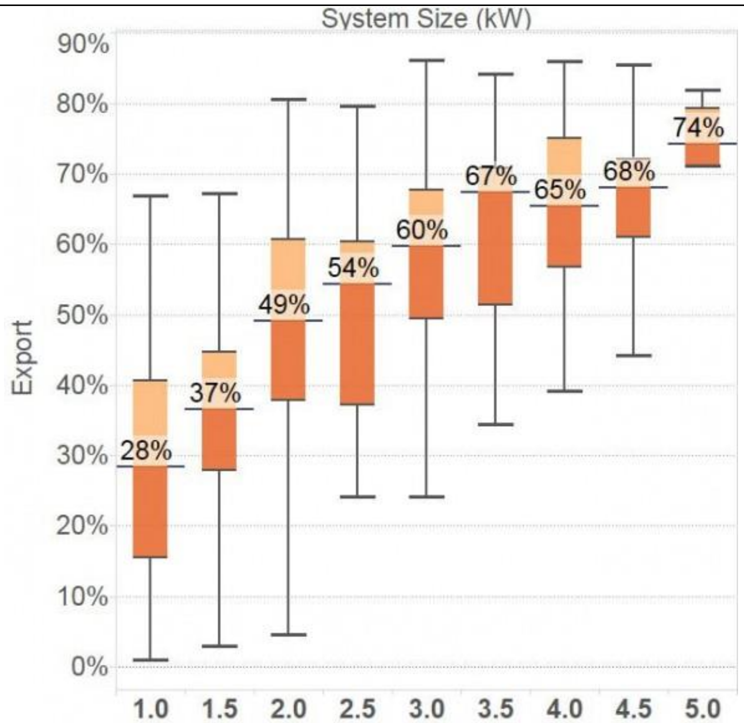
6 Clean Energy Regulations 2001, Schedule 5

| Jurisdiction | Solar zone 1 | Solar zone 2 | Solar zone 3 | Solar zone 4 | Assumed Output (MWh/kW/a) |
|---|---|---|---|---|---|
| NT | 20% | 80% | 0% | 0% | 1.55 |

*SOURCE: ACIL ALLEN ANALYSIS OF CER DATA*

We have assumed that residential solar systems exports of energy produced by roof-top solar systems broadly aligns with sampled data previously obtained from Sunwiz provided in **Figure 2.5**.[7] For commercial systems we have assumed a lower export rate of on average 10% due to the better match between commercial load profiles and solar electricity generation.

**FIGURE 2.5** SAMPLED SOLAR PV EXPORT RATES




*SOURCE: SUNWIZ*

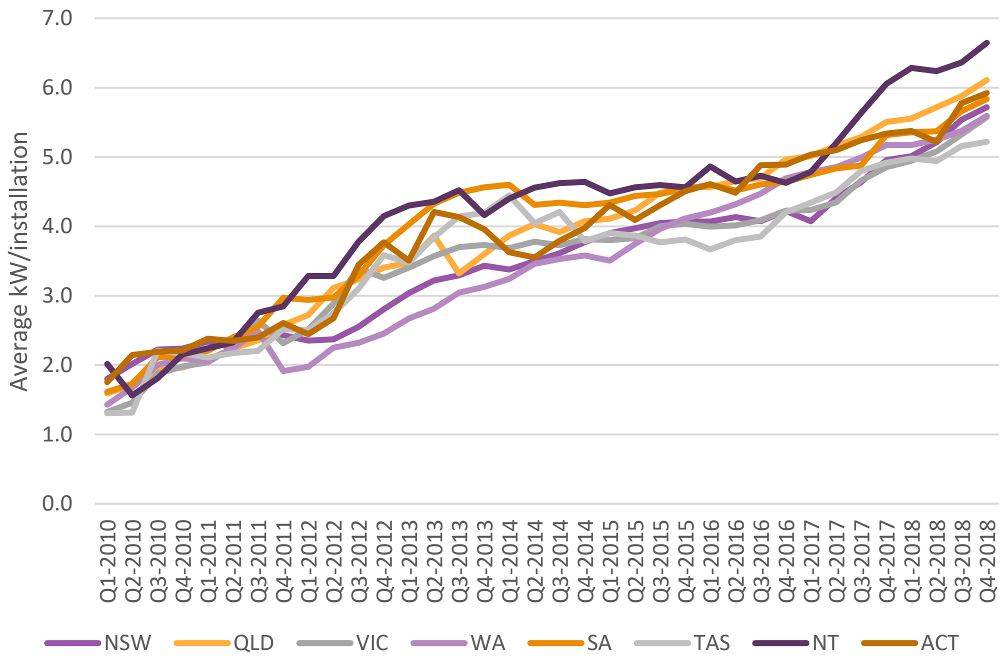
### 2.2.8 System size trends

Data on PV system uptake clearly illustrates a substantial increase in average system size over time, in particular as the incentives created by the Solar Credits formula to install smaller systems has dissipated and been overwhelmed by the attraction of lower system costs. Reductions in buyback rates and feed-in tariff payments have however limited the attractiveness of larger systems which tend to export a larger share of produced electricity to the grid. Further, space available for the installation of PV systems on a roof-top is limited and the size of systems installed on residential roof-tops cannot be expected to grow indefinitely.

Between March 2010 and 31 December 2018 the average size of new installations has grown from around 1.5 kW to 5.8 kW as shown in **Figure 2.6**.

[7] These export rates are around 10 percentage points higher than we have used previously.

**FIGURE 2.6** AVERAGE SIZE OF NEW RESIDENTIAL PV INSTALLATIONS OVER TIME




Note: For systems smaller than 10kW

*SOURCE: ACIL ALLEN BASED ON CER DATA*

For our projections we have assumed that the average size of new residential installations will continue to increase at a rate consistent with the historical trend.

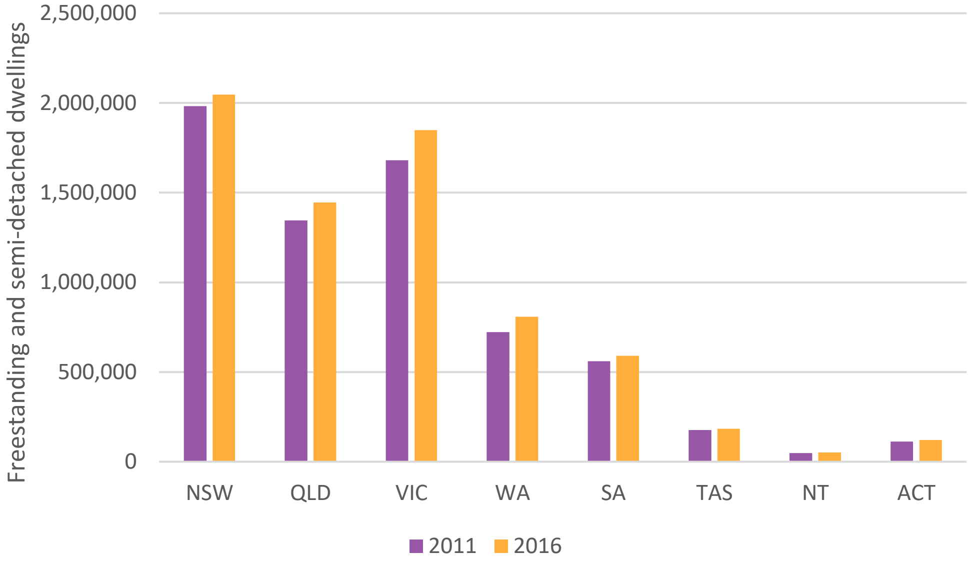
### 2.2.9 Available building stock

ACIL Allen has related the uptake of PV systems in the residential sector to the number of freestanding dwellings. For each quarter uptake was measured as the percentage of freestanding dwellings where a PV system had been installed. Each installation was assumed to reduce the pool of freestanding dwellings where a PV system could be installed.

Measuring PV uptake in this way provides a proxy for the saturation of the residential roof-top solar market. The number of freestanding dwellings in each region was obtained from the 2016 ABS Census of Population and Housing and includes freestanding houses as well as semi-detached terrace houses.

**Figure 2.7** shows the number of free-standing houses and semi-detached dwellings in each region in both 2011 and 2016. The fastest growing region over the last 5 years has been Western Australia with the number of free-standing and semi-detached dwellings increasing by 11.8% over the period. Victoria ranked second with the number of dwellings increasing by 9.9%. Queensland was the third fastest growing region with dwellings increasing by 7.4% between 2011 and 2016.

FIGURE 2.7 NUMBER OF OCCUPIED FREE-STANDING AND SEMI DETACHED DWELLINGS




*SOURCE: ABS CENSUS OF POPULATION AND HOUSING*

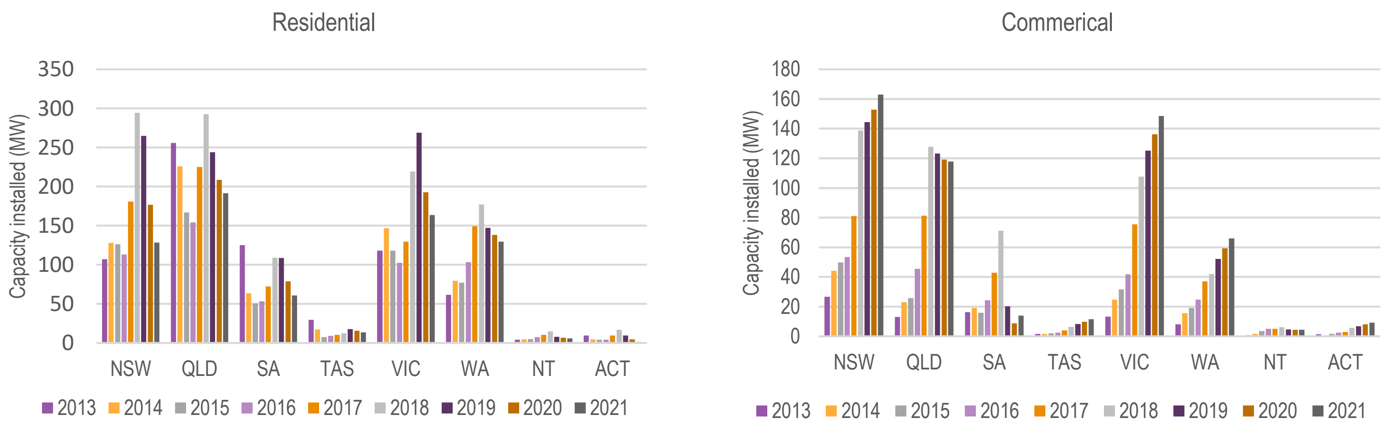
## 2.3 Projection results

The resulting projections of solar PV uptake are shown in **Figure 2.8** for both residential and commercial sized installations. The underlying data is also provided in **Table 2.6**.

Residential installations are expected to increase substantially in 2018, before abating in the subsequent three years. The abatement in the rate of increase is driven by a lower financial payoff on PV installation as a result of significantly lower forecast electricity prices, particularly in 2020 and 2021.

Commercial installations are projected to increase significantly across all regions in 2018, with installation levels remaining at elevated levels in the years up to 2021. We would note that there remains significant uncertainty in relation to commercial installations and how big a market this can become.

FIGURE 2.8 PROJECTED SOLAR PV SYSTEM INSTALLATION TO 2021 BY JURISDICTION




*SOURCE: ACIL ALLEN*

TABLE 2.6 PROJECTED SOLAR PV CAPACITY INSTALLED (MW) – RESIDENTIAL AND COMMERCIAL

| Residential | 2016 Actual | 2017 Actual | 2018 Estimated | 2019 Projected | 2020 Projected | 2021 Projected |
|---|---|---|---|---|---|---|
| NSW | 113.3 | 180.7 | 294.5 | 265.0 | 176.8 | 128.5 |
| QLD | 154.1 | 225.2 | 292.5 | 244.1 | 208.8 | 191.3 |
| SA | 53.4 | 72.3 | 109.0 | 108.8 | 78.7 | 60.9 |
| TAS | 9.3 | 10.5 | 12.3 | 17.8 | 15.8 | 13.8 |
| VIC | 102.6 | 129.7 | 219.5 | 269.1 | 192.6 | 163.6 |
| WA | 103.3 | 149.3 | 177.4 | 147.2 | 138.4 | 129.5 |
| NT | 7.7 | 10.2 | 14.9 | 8.0 | 6.6 | 6.0 |
| ACT | 4.4 | 9.6 | 16.8 | 9.8 | 4.5 | 1.4 |
| **Total** | **548.2** | **787.5** | **1,136.8** | **1,069.8** | **822.3** | **695.0** |

| Commercial | 2016 Actual | 2017 Actual | 2018 Estimated | 2019 Projected | 2020 Projected | 2021 Projected |
|---|---|---|---|---|---|---|
| NSW | 53.4 | 81.0 | 138.9 | 144.4 | 152.9 | 163.0 |
| QLD | 45.4 | 81.3 | 127.8 | 123.2 | 119.2 | 117.8 |
| SA | 24.2 | 43.0 | 71.1 | 20.1 | 8.8 | 13.9 |
| TAS | 2.5 | 4.1 | 6.4 | 8.2 | 9.9 | 11.5 |
| VIC | 41.7 | 75.4 | 107.8 | 125.1 | 136.2 | 148.6 |
| WA | 24.8 | 37.1 | 42.0 | 52.1 | 59.3 | 66.0 |
| NT | 5.0 | 5.1 | 6.1 | 4.7 | 4.3 | 4.5 |
| ACT | 2.6 | 3.0 | 5.7 | 6.9 | 8.1 | 9.3 |
| **Total** | **199.7** | **330.0** | **505.8** | **484.8** | **498.6** | **534.6** |

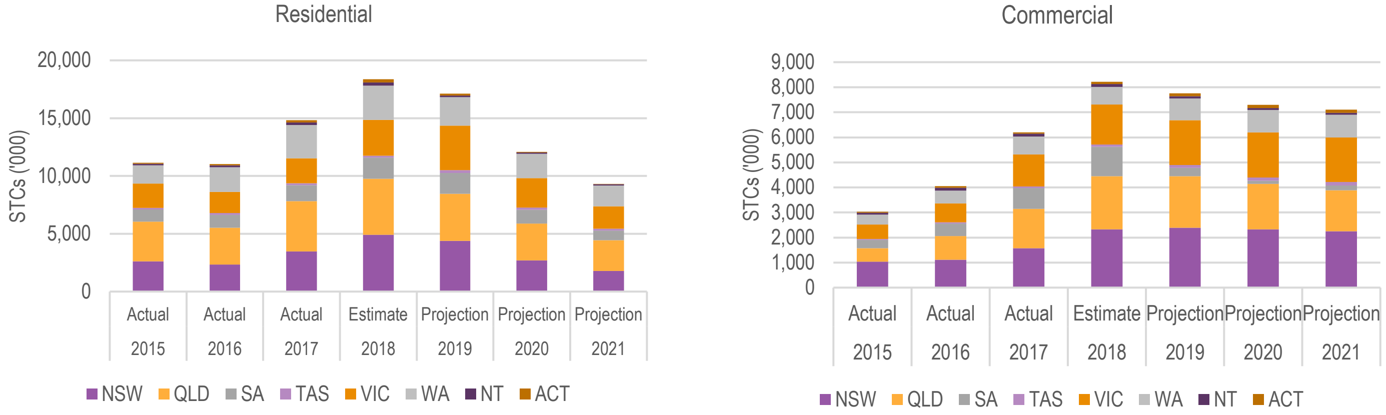
| All solar PV | 2016 Actual | 2017 Actual | 2018 Estimated | 2019 Projected | 2020 Projected | 2021 Projected |
|---|---|---|---|---|---|---|
| NSW | 166.7 | 261.7 | 433.4 | 409.4 | 329.7 | 291.5 |
| QLD | 199.5 | 306.5 | 420.4 | 367.4 | 328.0 | 309.1 |
| SA | 77.7 | 115.3 | 180.1 | 128.9 | 87.5 | 74.8 |
| TAS | 11.8 | 14.5 | 18.7 | 26.0 | 25.6 | 25.3 |
| VIC | 144.4 | 205.2 | 327.2 | 394.2 | 328.9 | 312.3 |
| WA | 128.0 | 186.3 | 219.4 | 199.3 | 197.7 | 195.5 |
| NT | 12.7 | 15.4 | 21.0 | 12.7 | 10.9 | 10.5 |
| ACT | 7.0 | 12.6 | 22.5 | 16.6 | 12.6 | 10.6 |
| **Total** | **747.8** | **1,117.5** | **1,642.7** | **1,554.6** | **1,320.9** | **1,229.5** |

Note: Based on year of installation

*SOURCE: ACIL ALLEN*

**Figure 2.9** shows the resulting STC creation implied from these installations based on the installation date. Projected STCs to be created from SGU units installed in 2019 total around 24.9 million, however these certificates will be created across the 2019 and 2020 calendar years due to the lag effect. Declines in 2020 and 2021 are exacerbated by the reduction in deeming period (11 years in 2020 and 10 years in 2021), compared with 12 years in 2019, 13 years in 2018, 14 years in 2017 and 15 years prior to 2017).

**FIGURE 2.9** PROJECTED STCS CREATED BY SOLAR PV-BASED ON YEAR OF INSTALLATION




*SOURCE: ACIL ALLEN*

**TABLE 2.7** PROJECTED STCS CREATED BY SOLAR PV – BASED ON YEAR OF INSTALLATION ('000)

| Residential | 2016 Actual | 2017 Actual | 2018 Estimated | 2019 Projected | 2020 Projected | 2021 Projected |
|---|---|---|---|---|---|---|
| NSW | 2,344 | 3,483 | 4,906 | 4,398 | 2,690 | 1,778 |
| QLD | 3,181 | 4,332 | 4,858 | 4,057 | 3,181 | 2,650 |
| SA | 1,098 | 1,388 | 1,808 | 1,798 | 1,192 | 838 |
| TAS | 164 | 172 | 177 | 253 | 206 | 163 |
| VIC | 1,834 | 2,163 | 3,115 | 3,858 | 2,531 | 1,955 |
| WA | 2,128 | 2,874 | 2,942 | 2,451 | 2,112 | 1,796 |
| NT | 178 | 220 | 273 | 150 | 113 | 93 |
| ACT | 91 | 185 | 280 | 162 | 69 | 19 |
| **Total** | **11,017** | **14,817** | **18,358** | **17,125** | **12,094** | **9,292** |

| Commercial | 2016 Actual | 2017 Actual | 2018 Estimated | 2019 Projected | 2020 Projected | 2021 Projected |
|---|---|---|---|---|---|---|
| NSW | 1,112 | 1,572 | 2,321 | 2,396 | 2,325 | 2,254 |
| QLD | 945 | 1,575 | 2,128 | 2,048 | 1,815 | 1,631 |
| SA | 500 | 829 | 1,176 | 333 | 133 | 192 |
| TAS | 45 | 67 | 92 | 117 | 128 | 136 |
| VIC | 764 | 1,275 | 1,593 | 1,794 | 1,791 | 1,775 |
| WA | 511 | 717 | 701 | 868 | 905 | 916 |
| NT | 116 | 111 | 115 | 88 | 74 | 70 |
| ACT | 53 | 56 | 96 | 114 | 123 | 128 |
| **Total** | **4,045** | **6,204** | **8,222** | **7,756** | **7,294** | **7,102** |

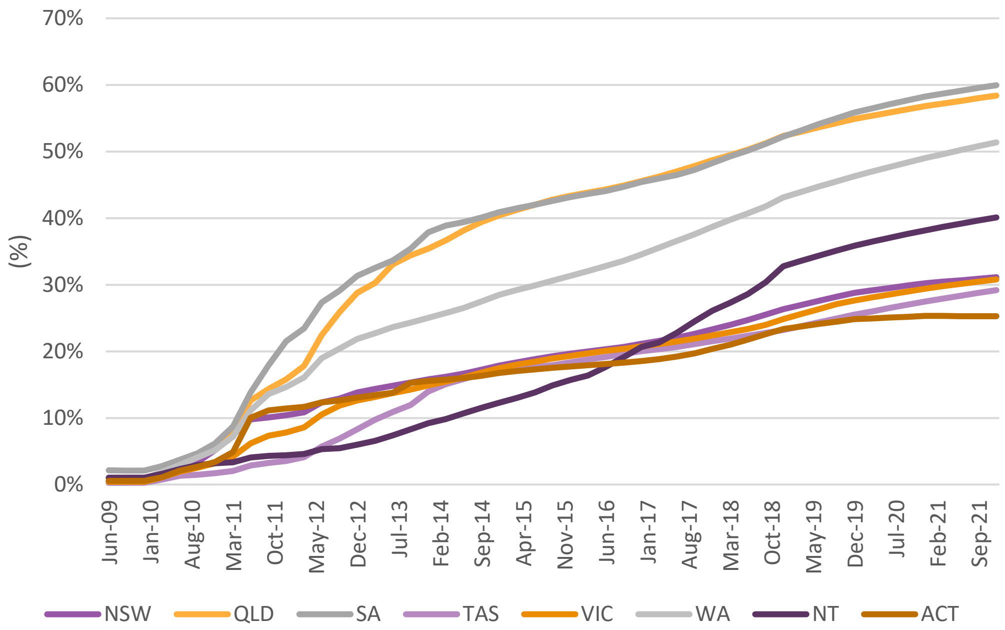
| All solar PV | 2016 Actual | 2017 Actual | 2018 Estimated | 2019 Projected | 2020 Projected | 2021 Projected |
|---|---|---|---|---|---|---|
| NSW | 3,455 | 5,056 | 7,227 | 6,794 | 5,015 | 4,032 |
| QLD | 4,126 | 5,906 | 6,987 | 6,104 | 4,996 | 4,280 |
| SA | 1,598 | 2,217 | 2,984 | 2,130 | 1,325 | 1,030 |
| TAS | 209 | 240 | 269 | 369 | 334 | 299 |
| VIC | 2,598 | 3,438 | 4,708 | 5,652 | 4,322 | 3,730 |
| WA | 2,639 | 3,592 | 3,642 | 3,319 | 3,017 | 2,712 |
| NT | 294 | 332 | 388 | 237 | 187 | 163 |
| ACT | 144 | 241 | 376 | 276 | 192 | 147 |
| **Total** | **15,062** | **21,021** | **26,580** | **24,882** | **19,388** | **16,394** |

Note: Based on year of installation

*SOURCE: ACIL ALLEN*

**Figure 2.10** shows the projected proportion of eligible residential premises with solar PV installed by region. The figure shows that there is still some way to go before the residential solar PV market reaches saturation.

**FIGURE 2.10** PROJECTED SOLAR PV PENETRATION OF ELIGIBLE RESIDENTIAL PREMISES




Note: Proportion of detached and semi-detached owner occupied dwellings with solar PV installed

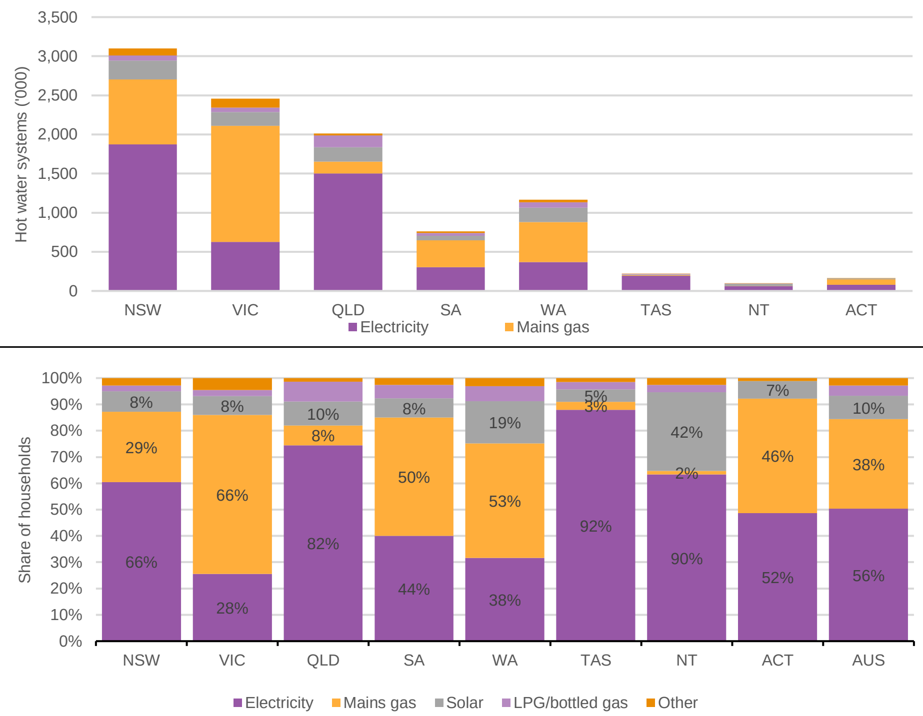
*SOURCE: ACIL ALLEN*

# 3
# SWH PROJECTIONS

Domestic water heating is the supply of hot water in dwellings for personal washing, showering and similar uses. It is typical that a Class 1 building — a house — is serviced by separate hot water systems as there are few instances of district heating systems in Australia. Water heating is a significant source of energy consumption by households, estimated to account for around 25% of household energy bills.

**Figure 3.1** shows the estimated number of systems by fuel type (top) and percentage share (bottom) used for water heating in each state and territory. At a national level, the most recent ABS survey indicates SWHs account for around 10% of systems.

**FIGURE 3.1** SOURCE OF ENERGY USED FOR HOT WATER 2014




*SOURCE: ACIL ALLEN DERIVED FROM ABS, 4602.0.55.001 ENVIRONMENTAL ISSUES: ENERGY USE AND CONSERVATION, MARCH 2014*

Alternatives to SWH include electric water heating systems running on peak or off-peak electricity, natural gas (storage or continuous) and bottled LPG fuelled systems. Solar hot water systems typically require boosting to provide hot water during extended cloudy periods. The boosting functionality is provided either through natural gas or through electricity.

The use of natural gas for water heating is most prevalent in Victoria where a large number of households are connected to the natural gas network and traditionally this has provided a low cost energy source. In most other regions electricity is used by the majority of households as the primary source of water heating. The Northern Territory has the highest share of solar water heating across states and territories with an estimated 42% of households using solar energy to heat water.

An analysis of the financial attractiveness of SWHs is more complicated than for SGUs. This is for a range of reasons, including:

- Unlike solar PV which is a discretionary investment, a water heater is effectively an essential piece of equipment for each household, meaning that decisions to install a new system are often related to the failure and replacement of an old system, or the construction of a new dwelling. Therefore, the rate at which SWH units are installed is a function of the overall level of installation of hot water systems and the proportion of these which qualify to create STCs (traditional roof mounted solar or air-source heat pumps).
- A great variety of water heating technologies are available, including traditional electric storage heaters (which in turn may use standard price 'peak' electricity or cheaper 'off-peak' electricity), gas storage heaters and instantaneous gas heaters (each of which could use reticulated natural gas or bottled liquefied petroleum gas) and either gas or electric 'boosted' SWHs. This makes analysing the financial trade-offs available in any given circumstance difficult
- Unlike electricity, where excess solar generation can be fed back to the grid, there is no accessible 'market' for unused solar-heated water: this means that individual user consumption patterns affect the financial attractiveness of these systems substantially.
- In many cases there are also information failures (where appropriate and consistent information on appliance aspects such as sizing, operating costs and payback periods is not available). Decision makers may also face 'split incentives' whereby the buyer of the water heater (for example a commercial builder) will not be responsible for the ongoing energy costs of the unit and therefore will likely err towards technologies with lower upfront costs.

In light of these considerations, ACIL Allen adopts a simpler stock model approach for projecting SWH installation and STC creation rates. This approach attempts to clearly distinguish between new building and replacement water heaters and discern the different driving trends (including construction trends and regulatory measures) affecting these different markets.

A household's decision on what type of water to install is a complex one which involve many factors including:

- The upfront capital cost of the unit and installation
- The lead time for installation (particularly relevant for replacement water heaters which suddenly cease working)
- Running costs over the life of the unit
- Perceptions about the environmental impact and reliability of particular technologies.

Solar water heaters and air sourced heat pumps have been eligible for upfront subsidies under the renewable energy target (RET) scheme since 2001. The current SRES provides a defined number of STCs per SWH installation based on an estimate of the electricity the unit displaces over its life and the solar zone in which it is installed in accordance with a Register maintained by the CER. An average household SWH installation creates around 30 STCs – providing an upfront subsidy of around $1,200 based on the $40 clearing house price.

In addition, a number of states and territories also provided additional grants for the installation of solar water heating systems between 2007 and 2009. This led to the widespread uptake of these technologies across Australia. While most state based incentives for solar water heaters or heat pumps have been abolished, funding under the RET scheme remains available and influences the choice of water heater for households.

The Council of Australian Governments (COAG) 2010 National Strategy on Energy Efficiency included a strategy on the phase out of greenhouse gas intensive hot water heaters through a mix of regulatory measures, incentives and industry development elements. The phase out affects electric resistance type water heaters and sets minimum requirements for natural gas water heaters. The Building Code of Australia regulates the type of hot water heater that can be installed in new dwellings. Some states and territories have enacted specific regulation for replacement of water heaters in existing homes.

At the present time, the only explicit State-based subsidy for the installation of SWH occurs in the Northern Territory where residential installations may be eligible for an additional rebate of up to $1,000, provided the installation replaces an existing electric system an attracts at least 20 STCs under the SRES. The rebate is only available for houses built in, or prior to the year 2000, as the rebate is designed to assist modifications to older homes to enable solar hot water systems to be installed.[8] The scheme does not have a defined end date and is assumed to continue in its current form within the projections.

## 3.1 The market for solar water heaters

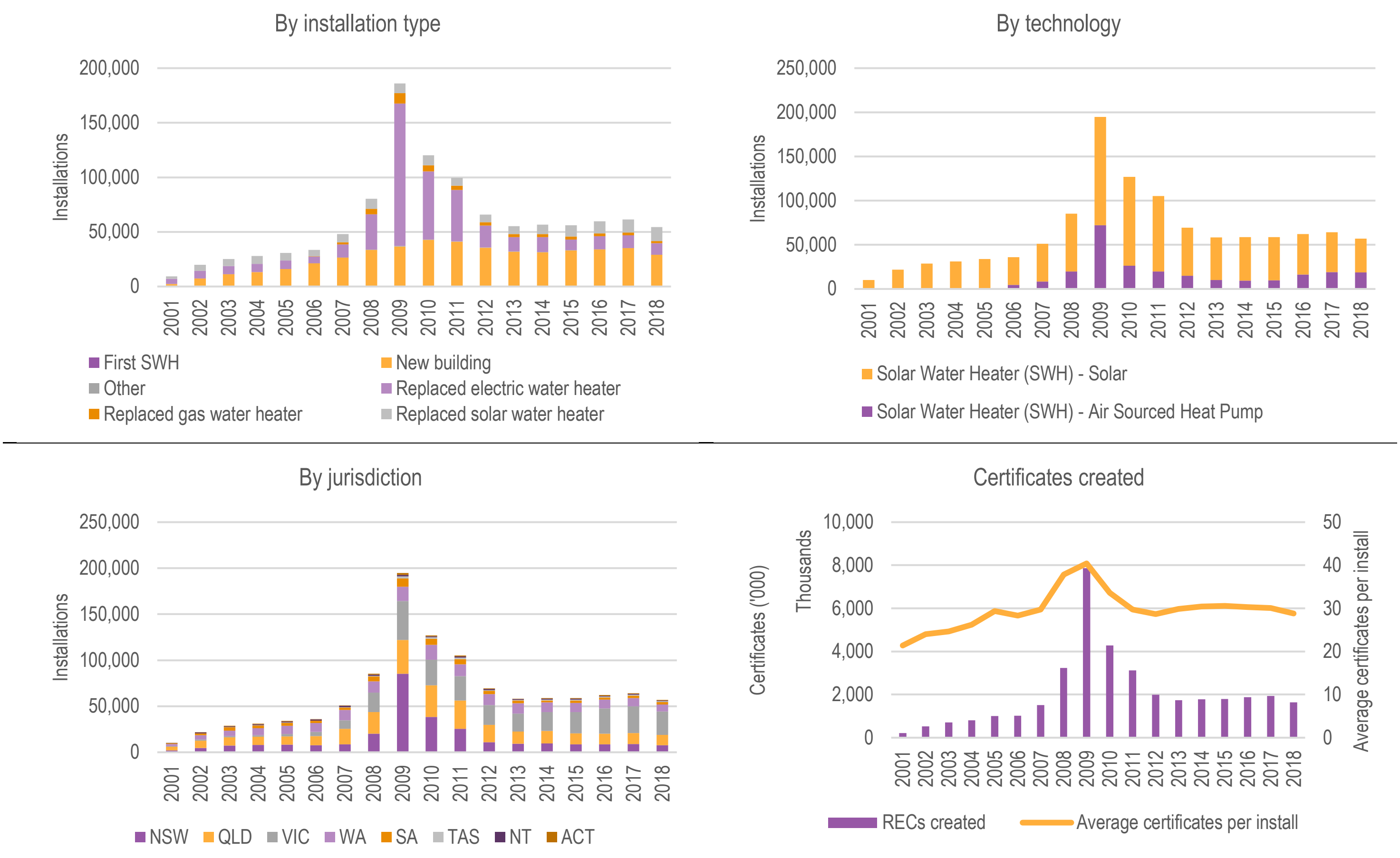
Data provided by the CER enables the split of the market for Solar Water Heaters (SWH) into three distinct segments: Installations in new buildings; replacement of gas or electric water heaters; and replacement of solar water heaters. The CER data further lists installations that were the first installation of a water heater in an existing building and installations where the type of installation was unknown. These installations represented a miniscule fraction of the overall installation volume and were included in the market for new building installations.

**Figure 3.2** shows historical installations by type, based on the year of installation implied from the CER dataset. Installations shown are only those that create valid certificates. Total annual SWH installations were just over 60,000 systems in 2016 and 2017, with the new build market accounting for around 57% annual installations.  In 2018, the number of SWH installations is expected to be about 62,000 systems.

Both Air sourced heat pumps (ASHP) and solar water heaters are eligible to create STCs. The CER has distinguished between these two technologies within its dataset and the split is also shown on the right hand side of **Figure 3.2**. In 2018, about 33% of installations have come from ASHP units. This has increased from about 30% of installations in 2017.  We have not separated the market for ASHP from the market for SWH, but included the installation of ASHP in the overall market for SWH.

[8] See http://jacanaenergy.com.au/energy_savings/save/archive/renewable_products_and_rebates/solar_hot_water_retrofit_rebate

**FIGURE 3.2** SUMMARY OF HISTORICAL STATISTICS FOR SWH INSTALLS BY INSTALLATION YEAR



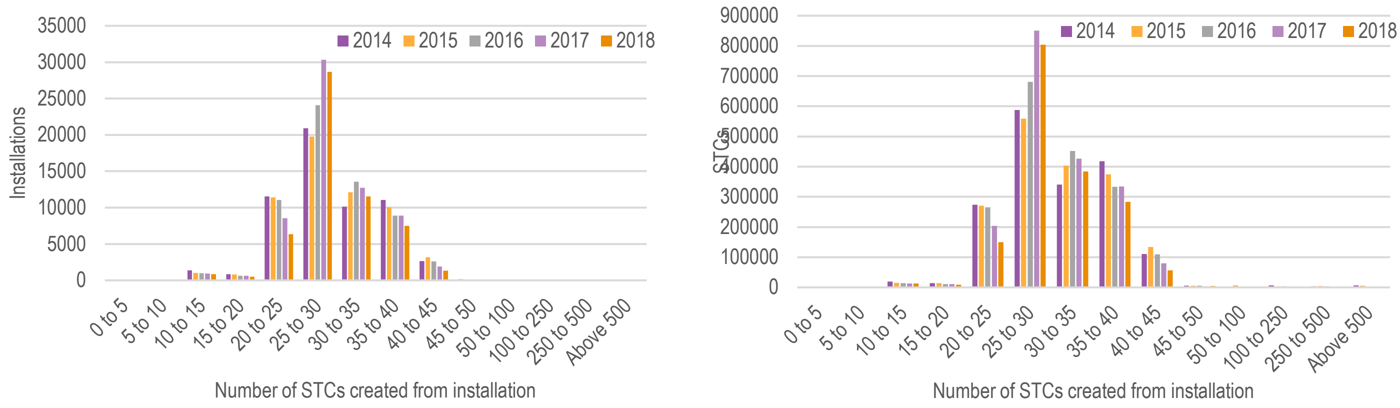

Note: Calendar year data. Installations which created valid certificates only. The 2018 calendar year only includes data from January to December 31.

*SOURCE: ACIL ALLEN ANALYSIS OF CER DATA*

**Figure 3.3** provides the distribution of installations and certificate creation by the number of STCs created. In recent years these distributions have been reasonably stable, with virtually all installations and STCs created coming from installations yielding between 20 and 50 STCs. The commercial SWH market (installs creating more than 50 STCs) is now negligible and accounts for less than 1% of STCs from SWH systems. This is in contrast to compliance years 2008 and 2009 where commercial installations accounted for around 25% of STCs from SWH units.[9]

9 Changes in eligibility of large ASHP units (above 425 litres) has been a primary driver for the decline.

**FIGURE 3.3** SWH INSTALLATIONS AND VALID CERTIFICATES CREATED GROUPED BY SIZE (NUMBER OF CERTIFCATES)




Note: Calendar year data based on year of installation. Installations which created valid certificates only

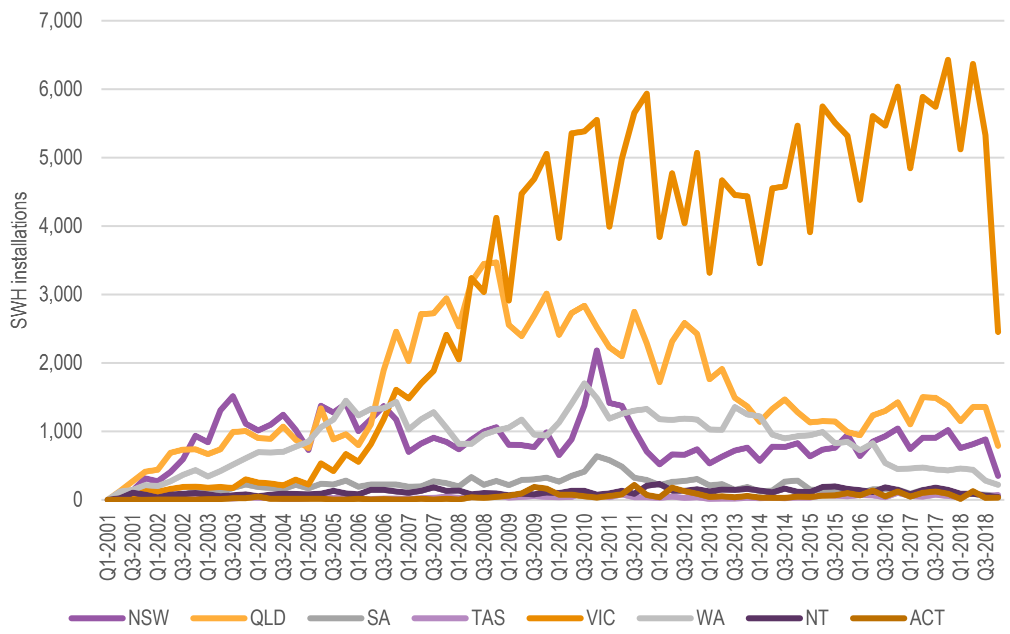
*SOURCE: ACIL ALLEN ANALYSIS OF CER DATA*

### 3.1.1 New buildings

When a new building is constructed, the choice of water heater from a number of different technologies and fuel sources can be installed. Choices of water heating technology include traditional electric resistance water heating, LPG fuelled water heaters, air-sourced heat pumps, solar water heaters or mains gas where reticulated natural gas is available. In some cases the choices are restricted by Government regulations and building codes.

As shown in **Figure 3.4**, the SWH new building market is dominated by Victoria where 6 star building standards require installation of SWH systems or rainwater tanks in new Class 1 buildings. Policies such as those in Queensland banning the installation of electric resistance water heaters have since been revoked, resulting in fall in SWH installation in new buildings.

**FIGURE 3.4** NUMBER OF SWH INSTALLATIONS IN NEW BUILDINGS CLAIMING RECS/STCS




Note: Only includes SWH installations claiming RECs/STCs

*SOURCE: ACIL ALLEN ANALYSIS OF CER DATA*

To project the number of SWH installations in new buildings, we have estimated the percentage of new buildings in each region where a solar water heater was installed. Over the period 2019 to 2021 we have assumed the proportion of new dwellings where a solar water heater installed remain similar to recent observations at a jurisdictional level. This assumes no changes to jurisdictional support mechanisms or regulations occur over the projection period.

### 3.1.2 Replacement of electric and gas water heaters

The prevalence of different types of water heating equipment differs from state to state. When water heaters fail and are replaced, they are most often replaced with the same type of technology that was installed previously. We have analysed the number of gas and electric replacement as a share of residential dwellings in each state. For the 2019 to 2021 period we assumed the same share of residential dwellings will install replacement water heaters in each region as the share that could be observed in the year to September 2018. Replacement of electric and gas water heaters with solar was estimated with reference to share of existing buildings in which a water heater was replaced.

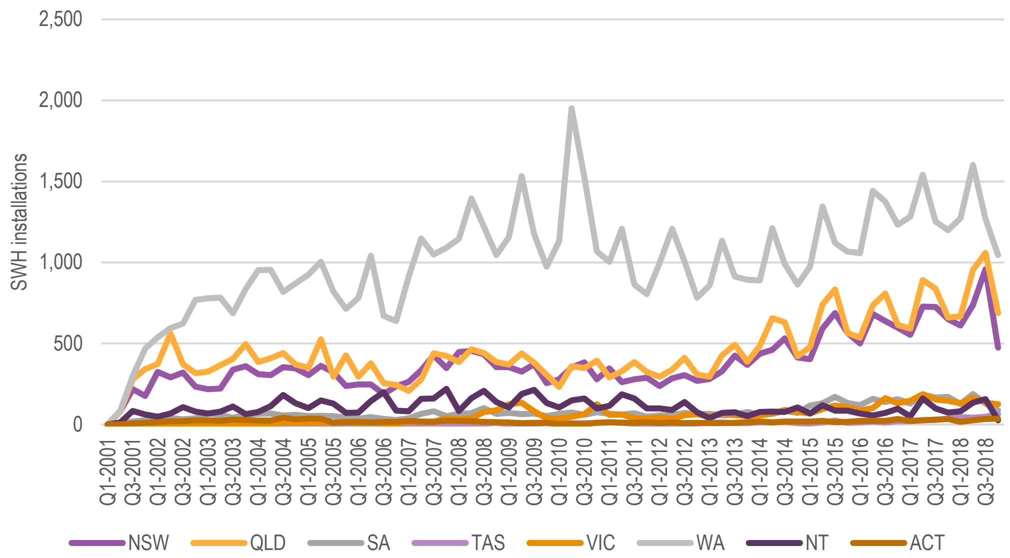
Additional financial incentives are available for replacement of existing hot water systems in Victoria through the Victorian Energy Saver Incentive (ESI), also known as the Victorian Energy Efficiency Target (VEET) scheme. The scheme works by setting a state wide target for energy savings that results in a range of energy efficient products and services being made available to homes and businesses at a discount. Energy retailers must meet an annual greenhouse gas emissions target through surrendering Victorian Energy Efficiency Certificates. Retailer liabilities are created through the setting of greenhouse gas reduction rates to a level that enables the target to be met. In August 2015, the Victorian Government announced that the ESI scheme would remain in place with future targets of 5.9 million tonnes in 2017, rising to 6.5 million tonnes by 2020. The retention of the ESI will provide ongoing assistance for SWH installations over the projection period.

Given the above, there are no significant changes to policy or regulations affecting the SWH market expected over the projection period.

### 3.1.3 Replacement of solar water heaters

To date the market to replace existing SWH has been relatively small. With a growing stock of existing SWHs, this market can be expected to grow once the stock of existing SWH reaches the end of their useful life and require replacement. Driven by subsidy schemes and financial incentives available at the time a large number of SWH were installed between 2008 and 2011 (as illustrated in **Figure 3.2**). Once the systems installed at this time reach the end of their technical life, an increase in the number of replacement SWH installed can be expected. **Figure 3.5** shows the historical replacement of SWH systems with new SWH systems.

**FIGURE 3.5** NUMBER OF SWH INSTALLATIONS THAT ARE REPLACING EXISTING SOLAR PV SYSTEMS




*SOURCE: ACIL ALLEN ANALYSIS OF CER DATA*

The figure shows a rising trend in the number of SWH installations that are replacing old SWH systems.

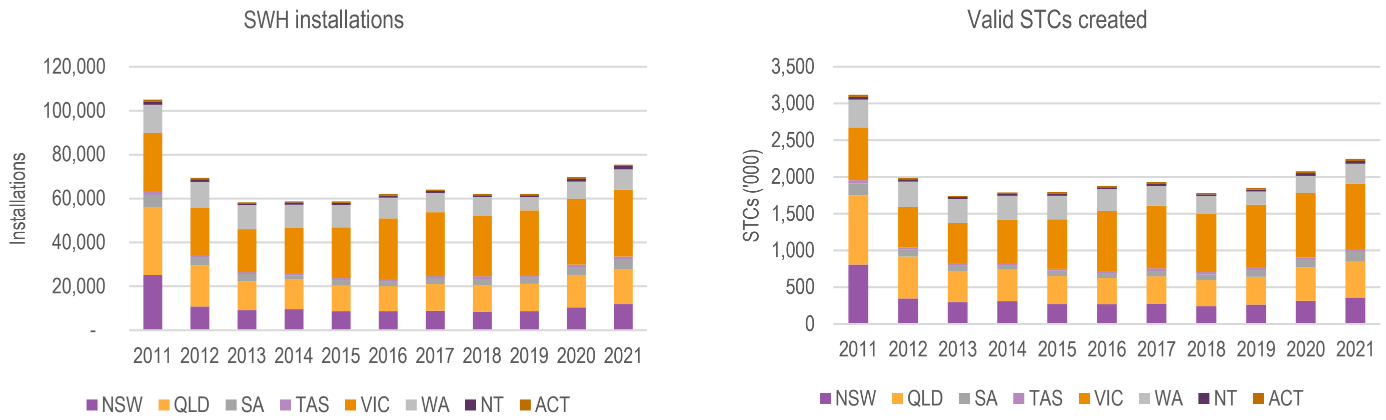
Our projections assume a median operational life for SWH units of 18 years, with 25% of units having a shorter 15 year life and 25% of units having a longer 20 year life. These assumptions result in an increase in SWH replacement installations during the projection period.

## 3.2 Projection results

**Figure 3.6** present the projection results for SWH installation and implied STC creation, spliced alongside actuals for previous years.

The projections show moderate increases in the number of SWH installations in the projection period, driven mainly by installations in new build houses and increased demand for replacements of existing SWH units toward the latter part of the projection. This is due to the increasing stock of SWH units – particularly as a result of the boom in installations late last decade which are starting to come up for replacement in coming years. Implied STC creation follows a similar trajectory as shown in the figure on the right.

**FIGURE 3.6** SUMMARY OF SWH PROJECTIONS BY INSTALLATION YEAR




Note: Installations that generated valid STCs only.

*SOURCE: ACIL ALLEN*

The results are also presented in **Table 3.1** below.

TABLE 3.1 SUMMARY OF SWH PROJECTIONS BY INSTALLATION YEAR

| SWH systems installed | 2016 Actual | 2017 Actual | 2018 Estimate | 2019 Projected | 2020 Projected | 2021 Projected |
|---|---|---|---|---|---|---|
| NSW | 8,611 | 8,964 | 8,424 | 8,669 | 10,363 | 11,931 |
| QLD | 11,442 | 12,023 | 12,145 | 12,480 | 14,973 | 16,022 |
| SA | 2,281 | 2,616 | 2,803 | 3,095 | 3,616 | 4,646 |
| TAS | 947 | 1,033 | 1,118 | 973 | 1,004 | 1,029 |
| VIC | 27,702 | 29,119 | 27,640 | 29,345 | 29,979 | 30,473 |
| WA | 9,438 | 8,701 | 8,598 | 5,943 | 7,751 | 9,113 |
| NT | 920 | 965 | 788 | 1,017 | 1,285 | 1,462 |
| ACT | 677 | 705 | 624 | 665 | 758 | 762 |
| **Total** | **62,018** | **64,126** | **62,140** | **62,186** | **69,728** | **75,438** |

| Valid STCs created ('000) | 2016 Actual | 2017 Actual | 2018 Estimate | 2019 Projected | 2020 Projected | 2021 Projected |
|---|---|---|---|---|---|---|
| NSW | 268 | 274 | 239 | 262 | 313 | 360 |
| QLD | 355 | 371 | 356 | 381 | 457 | 489 |
| SA | 68 | 77 | 79 | 90 | 106 | 136 |
| TAS | 29 | 32 | 32 | 30 | 31 | 31 |
| VIC | 815 | 858 | 793 | 860 | 879 | 894 |
| WA | 295 | 266 | 243 | 178 | 232 | 273 |
| NT | 27 | 28 | 19 | 28 | 35 | 40 |
| ACT | 22 | 24 | 19 | 21 | 24 | 24 |
| **Total** | **1,880** | **1,930** | **1,781** | **1,849** | **2,076** | **2,246** |

| Valid STCs per install | 2016 Actual | 2017 Actual | 2018 Estimate | 2019 Projected | 2020 Projected | 2021 Projected |
|---|---|---|---|---|---|---|
| NSW | 31.1 | 30.6 | 28.4 | 30.2 | 30.2 | 30.2 |
| QLD | 31.0 | 30.8 | 29.3 | 30.5 | 30.5 | 30.5 |
| SA | 30.0 | 29.5 | 28.0 | 29.2 | 29.2 | 29.2 |
| TAS | 30.4 | 30.9 | 28.8 | 30.5 | 30.5 | 30.5 |
| VIC | 29.4 | 29.5 | 28.7 | 29.3 | 29.3 | 29.3 |
| WA | 31.3 | 30.5 | 28.3 | 29.9 | 29.9 | 29.9 |
| NT | 29.5 | 29.3 | 24.7 | 27.6 | 27.6 | 27.6 |
| ACT | 32.6 | 33.6 | 30.3 | 31.4 | 31.4 | 31.4 |
| **Total** | **30.3** | **30.1** | **28.7** | **29.7** | **29.8** | **29.8** |

Note: Based on year of installation

*SOURCE: ACIL ALLEN*

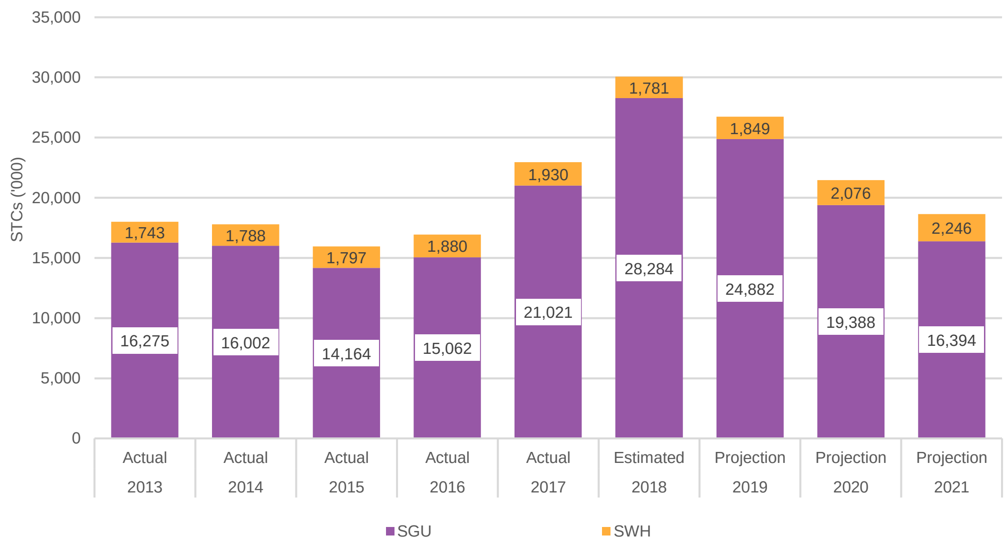
# 4 PROJECTION SUMMARY

## 4.1 Summary of STC creation by installation year

**Figure 4.1** provides a summary of the projected STC creation rates based on the year of installation of SGU and SWH units through to 2021. The projection indicates a significant increase in 2018 relative to 2017 and 2016, which is a function of rising financial paybacks for solar PV systems driven by higher retail electricity prices. The retail electricity price is projected to decline significantly in 2020 and 2021 which puts some downward pressure on the rate at which solar PV capacity is increasing.

STC creation (based on install year) is anticipated to reach a high of 30.1 million in 2018, declining thereafter primarily as a result of the reduction to deeming periods for solar PV and slower rates of installation growth of residential solar PV systems.

**FIGURE 4.1** SUMMARY OF STC CREATION BY INSTALLATION YEAR




*SOURCE: ACIL ALLEN*

That data is presented in tabular form in **Table 4.1**.

TABLE 4.1 SUMMARY OF STC CREATION BY INSTALLATION YEAR ('000)

| SGU units | 2016 Actual | 2017 Actual | 2018 Estimate | 2019 Projected | 2020 Projected | 2021 Projected |
|---|---|---|---|---|---|---|
| NSW | 3,455 | 5,056 | 7,669 | 6,794 | 5,015 | 4,032 |
| QLD | 4,126 | 5,906 | 7,439 | 6,104 | 4,996 | 4,280 |
| SA | 1,598 | 2,217 | 3,172 | 2,130 | 1,325 | 1,030 |
| TAS | 209 | 240 | 284 | 369 | 334 | 299 |
| VIC | 2,598 | 3,438 | 5,024 | 5,652 | 4,322 | 3,730 |
| WA | 2,639 | 3,592 | 3,884 | 3,319 | 3,017 | 2,712 |
| NT | 294 | 332 | 417 | 237 | 187 | 163 |
| ACT | 144 | 241 | 396 | 276 | 192 | 147 |
| **Total** | **15,062** | **21,021** | **28,284** | **24,882** | **19,388** | **16,394** |

| SWH units | 2016 Actual | 2017 Actual | 2018 Estimate | 2019 Projected | 2020 Projected | 2021 Projected |
|---|---|---|---|---|---|---|
| NSW | 268 | 274 | 239 | 262 | 313 | 360 |
| QLD | 355 | 371 | 356 | 381 | 457 | 489 |
| SA | 68 | 77 | 79 | 90 | 106 | 136 |
| TAS | 29 | 32 | 32 | 30 | 31 | 31 |
| VIC | 815 | 858 | 793 | 860 | 879 | 894 |
| WA | 295 | 266 | 243 | 178 | 232 | 273 |
| NT | 27 | 28 | 19 | 28 | 35 | 40 |
| ACT | 22 | 24 | 19 | 21 | 24 | 24 |
| **Total** | **1,880** | **1,930** | **1,781** | **1,849** | **2,076** | **2,246** |

| All units | 2016 Actual | 2017 Actual | 2018 Estimate | 2019 Projected | 2020 Projected | 2021 Projected |
|---|---|---|---|---|---|---|
| NSW | 3,724 | 5,330 | 7,908 | 7,056 | 5,328 | 4,391 |
| QLD | 4,481 | 6,277 | 7,795 | 6,485 | 5,452 | 4,769 |
| SA | 1,666 | 2,295 | 3,250 | 2,221 | 1,431 | 1,166 |
| TAS | 238 | 272 | 316 | 399 | 365 | 331 |
| VIC | 3,413 | 4,296 | 5,817 | 6,512 | 5,201 | 4,624 |
| WA | 2,934 | 3,857 | 4,128 | 3,496 | 3,249 | 2,985 |
| NT | 321 | 360 | 436 | 266 | 222 | 203 |
| ACT | 166 | 264 | 415 | 297 | 216 | 171 |
| **Total** | **16,942** | **22,951** | **30,066** | **26,731** | **21,464** | **18,640** |

Note: Based on year of installation

*SOURCE: ACIL ALLEN*

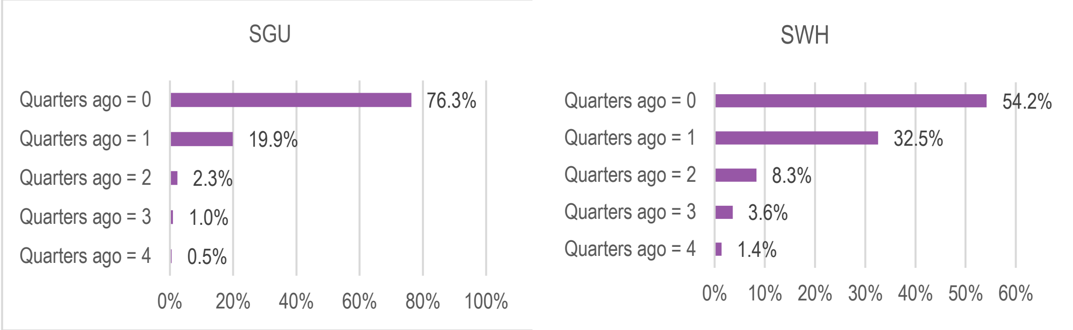
## 4.2 Lag between installation and certificate creation

STC creation can occur up to 12 months after the installation of a system eligible for the creation of STCs. After STCs have been created they undergo and audit process which can further delay the registration of STCs in the STC registry. The relevant number of STCs for the setting of the STP is the number of certificates that are created in each year. As such, the delay between system installation and certificate validation is an important consideration in estimating STCs to be created within a compliance year under the SRES.

In estimating the number of certificates that will be created in the calendar years 2019, 2020 and 2021, ACIL Allen first established the number of installations in each of these years (as summarised in the previous section). Certificates from systems installed in any of these years may either be registered in the same year or in the following year. Certificates from systems installed in 2018 will also continue to be registered throughout 2019.

**Figure 4.2** shows the lag factors we have used to adjust installed capacity in each quarter. The factors are based on data on installations over the period December 2015 to December 2017. The chart shows that 76.3% of SGU and 54.2% of SWH installations have valid certificates created in the same quarter as they were installed. An additional 19.9% of SGU and 32.5% of SWH installations had valid certificates created in the next quarter following installation.

**FIGURE 4.2** ASSUMED LAG BETWEEN INSTALLATION AND CERTIFICATE CREATION FOR SGU AND SWH SYSTEMS




*SOURCE: ACIL ALLEN ANALYSIS OF CER DATA*

## 4.3 Projected STC creation

**Table 4.2** provides the final projection for STCs based on the year of creation. The figures show a 35.3% increase in 2018 to around 30.2 million STCs, followed by a 9.4% decrease in 2019 to 27.4 million. STCs are then projected to decline by 20.5% in 2020 to 21.8 million, before declining a further 13.5% in 2021 to 18.8 million.

**TABLE 4.2** PROJECTED STCS BY YEAR OF CERTIFICATE CREATION ('000)

| Heading | 2017 Actual | 2018 Estimate | 2019 Projection | 2020 Projection | 2021 Projection |
|---|---|---|---|---|---|
| Solar PV | | | | | |
| Residential | 14,526 | 19,560 | 17,351 | 12,428 | 9,496 |
| Commercial | 5,820 | 9,262 | 7,829 | 7,285 | 7,127 |
| Total solar PV | 20,346 | 28,263 | 25,584 | 19,712 | 16,623 |
| SWH | 1,970 | 1,925 | 1,777 | 2,050 | 2,206 |
| **Total** | **22,315** | **30,188** | **27,362** | **21,762** | **18,829** |

*SOURCE: ACIL ALLEN*