



Green Energy
Markets

Small-scale technology certificates Data modelling for 2017 to 2019

Draft Report to the Clean Energy Regulator

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Green Energy Markets
2 Domville Ave Hawthorn VIC 3122
T: 03 9805 0777 F: 03 9815 1066
admin@greenmarkets.com.au
www.greenmarkets.com.au

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Disclaimer

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Executive Summary

The Clean Energy Regulator (CER) has engaged Green Energy Markets Pty Ltd (GEM) to provide an estimate of the Small-scale technology certificates (STCs) likely to be created during the 2017 calendar year, and for the 2018 and 2019 calendar years.

Projections have been developed on the basis that current policy settings remain in place. We have assumed that no changes are made to the Small-scale Renewable Energy Scheme (SRES). Specifically, we have assumed that 14 years of output is deemed for solar photovoltaic (PV) systems up to and including 100 kW for 2017. For systems to be installed in 2018 we have assumed that 13 years of output is deemed and for systems installed in 2019 we have assumed 12 years of deeming. We have assumed that a net STC price of \$38.50 applies (after creation and administration costs) for the 2017 to 2019 period.

In developing our projections for small generating units (SGUs) and solar water heater (SWH) we utilised our existing models and databases. We have also made extensive use of the registry data provided by the CER and interviewed a range of solar industry participants. Our forward estimates exclude solar PV systems above 100 kW in size which will be registered as power stations and not eligible to create STCs.

In determining the level of STCs to be created we have initially forecast the likely level of SGU and SWH installations in each of the forecast years and then estimated the resulting level of certificates. We then make adjustments for the lag in certificate creation to arrive at the number of STCs to be submitted to the CER for approval in any given year.

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

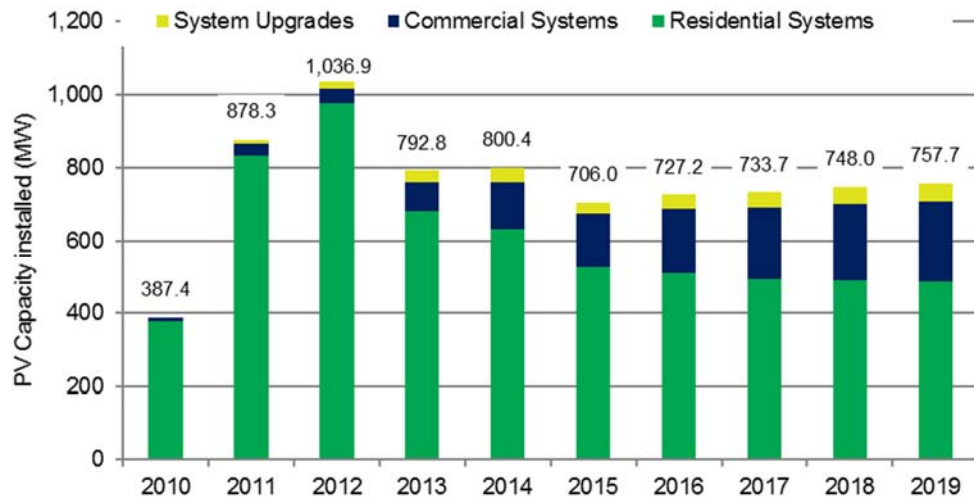
- SGU PV – Residential market
- SGU PV – Non-residential (commercial market)
- SGU PV – Upgrade market
- SWH – New building market
- SWH - Replacement or existing dwelling market

In assessing the solar market to date the following considerations are worth noting:

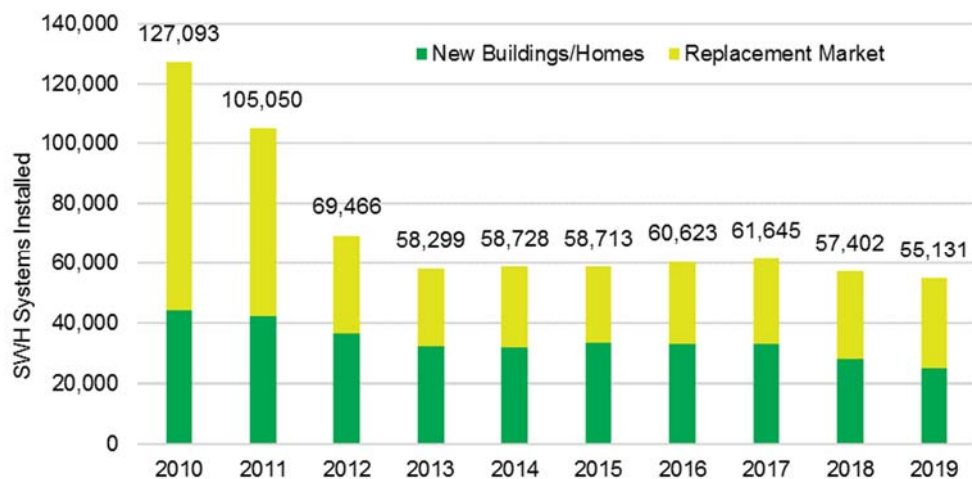
- The number of new residential PV installations continues to fall with 2016 installations being 10 per cent lower than 2015 levels, which in turn were 22 per cent lower than 2014 levels;
- The average system size for new residential installations has continued to increase reaching an average of 4.5 kW per system in 2016 compared to 4.2 kW per system in 2015;
- The number of commercial size PV system installations (greater than 10 kW) has continued to increase and accounted for 25 per cent of installed PV capacity in 2016 compared to 21 per cent in 2015;
- The STC price has been extremely stable over the last few years and has traded at very close to the Clearing House Price of \$40. The Clearing House has remained in deficit for nearly all of 2016;
- The number of SWH systems installed in new homes that have created STCs continues to remain reasonably stable, generally following the level of new home installations; and
- The number of SWH systems installed in the replacement market appears to be recovering increasing by 9 per cent in 2016.
- The surge in STC creation in the last two months of 2016 will mean that STC creation for 2016 will end only 3.4% below the target level.

Solar PV is expected to continue to dominate STC creation accounting for 89 per cent of certificate creation for systems installed in 2016. Installed solar PV capacity claiming STCs is expected to rise by 3 per cent in 2016 to 727 MW (compared to 706 MW in 2015). This is 30 per cent lower than the peak reached in 2012 of 1,037 MW.

We estimate that 734 MW of PV will be installed in 2017 which is 1 per cent higher than 2016 levels. Installations are projected to increase modestly in 2018 and 2019. We expect that the residential PV market will continue to decline, however the loss in residential capacity is expected to be substantially made up by the growing commercial market (refer to chart below).



The SWH market is expected to increase by 2 per cent in 2017 and then fall over the 2018 and 2019 period. We expect a modest increase in SWH installations in the replacement market which is more than offset by a reduction in systems installed in new homes.



In STC creation terms we expect that 16.6 million STCs will be submitted for registration in 2016 a reduction of 2.3 per cent from 2015 levels. We expect that 15.7 million STCs will be submitted for registration in 2017 and we expect this to reduce to 14.9 million in 2018 and to 14.0 million in 2019. The fall in creation over the 2017 to 2019 period is primarily due to the reduction in the deeming period for solar PV.

Year of Creation	2014	2015	2016	2017	2018	2019
STCs for systems installed in the year						
Solar PV	16,005	14,166	14,660	13,792	13,054	12,210
SWH	1,788	1,797	1,847	1,883	1,757	1,691
Total	17,793	15,963	16,507	15,674	14,811	13,901
Less STCs submitted the following year (lag)	1,531	1,416	1,308	1,253	1,170	1,092
Add Previous year installs created this year	1,545	1,531	1,416	1,308	1,253	1,170
STCs submitted for creation	17,807	16,079	16,616	15,729	14,894	13,979

The key uncertainties in developing the estimates have centred on:

- The extent to which the surge in activity in the last two months of 2016 carries forward into 2017;
- The likely level of contraction in the residential solar PV market as high levels of saturation are reached;
- The level of growth in the commercial PV market; and
- Expected reduction in installation of SWH in new homes.

We have undertaken a sensitivity analysis and have developed a lower-bound estimate for 2017 of 14.2 million and an upper-bound estimate of 17.3 million.

'000 STCs Submitted for Creation	2014	2015	2016	2017	2018	2019
Total Certificates - Base Case	17,807	16,079	16,616	15,729	14,894	13,979
Total Certificates - High Case	17,807	16,079	17,031	17,302	16,383	15,377
Total Certificates - Low Case	17,807	16,079	16,200	14,156	13,405	12,581

1. Project Scope

The Clean Energy Regulator (CER) has engaged Green Energy Markets Pty Ltd (GEM) to provide a forward estimate of the Small-scale technology certificates (STCs) likely to be created during the 2017 calendar year, and for the 2018 and 2019 calendar years.

Based on its in-depth knowledge of the renewable energy industry and using all the factors that impact the uptake of solar water heaters (SWH) and small scale PV systems, GEM is to provide a range of qualified projections. These projections will reflect the likely creation of STCs from eligible installations for the calendar year 1 January 2017 to 31 December 2017, and the following two calendar years 2018 and 2019.

Data input into the model to estimate the number of STCs should 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 CER;
- certificates remaining in the Registry from the previous compliance period;
- 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 in 2016 from the previous compliance year;
- 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 and Small Generation Units;
- existing, and potential changes to, building codes and regulations including energy efficiency measures which impact 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 (e.g. due to Clean Energy Finance Corporation loans, power purchase agreements) and technological (e.g. battery storage) innovation;
- 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 of deeming arrangements under the Renewable Energy Target; and
- any other relevant factor the agency or the supplier deems appropriate.

Out of Scope of this consultancy:

- Overhang of STCs from 2016; and
- Large Generation Certificates created for systems greater than 100 kW.

2. Methodology and Assumptions

GEM has utilised the same methodology as we have in previous reports for the CER. We have developed forward estimates separately for each of the small-scale technologies that are able to produce STCs over the 2017 to 2019 period. Modelling approaches have been tailored to the specific market attributes of each technology and market segment.

In determining the level of STCs to be created we have initially forecast the likely level of SGU and SWH installations in each of the forecast years and then estimated the resulting level of certificates. We then make adjustments for the lag in certificate creation to arrive at the number of STCs to be submitted to the CER for approval in any given year.

We have relied on data provided by the CER on eligible systems that have been installed and created certificates. A system is determined as valid if the number of certificates created less the number of certificates failed at audit is greater than zero.

The data provided was for systems claiming certificates up to 16 December 2016. We have reconciled this data very closely with the REC registry at the end of December 2016. A summary of the data received from the CER by market sector is included as Attachments 9 and 10.

Modelling solar PV certificates

The demand for and installation of solar PV systems in Australia continues to be driven by up-front cost, industry marketing, rising electricity prices, environmental awareness and government incentives such as feed-in tariffs and STCs. System payback periods continue to be a useful proxy for determining the attractiveness of PV and forms the basis of our modelling.

Our modelling for solar PV STCs is split into three segments, with each treated differently due to different drivers and attributes:

- Commercial (or non-residential) systems, defined as those systems with a capacity of greater than 10 kW;
- Expansions or system upgrades are those less than 10 kW and designated as "More than One SGU at Address"; and
- New residential systems then representing all other systems.

Modelling residential PV system installations

Modelling for these systems is based on inputs to our payback model, with the resultant payback period feeding into a demand curve for each state. These demand curves then forecast the proportion of eligible households which will install systems. Based on these estimates, the solar zone rating and the average system sizes, STC creation is forecast.

Payback period will be modelled using Green Energy Markets payback model. Explicit assumptions used in the model include:

- The STC price;
- State feed-in tariff rates, eligibility and other factors;
- System prices; and
- Electricity prices, particularly those variable components that can be avoided.

System prices are based on industry forecasts of equipment prices, installation costs and exchange rates. Changes in the cost of raw materials will be implied in the above. We will assume that current feed-in tariff arrangements or export pricing that is currently in place remains the same for the three year forecast period.

Modelling upgrades, expansions and replacements of residential PV systems

This market sector is increasing albeit from a low base. Many customers have small 1 kW systems that were eligible for the \$8,000 PV Rebate and are considering expanding their systems in response to higher power prices and lower panel prices. While this market sector is still very small we expect it to continue to grow and become a much more important feature of the industry in future years as saturation in the residential market increases. As a result, we separately assess this segment to determine its relative size and importance.

Modelling non-residential (commercial) PV systems

The number of commercial systems being installed is increasing and is also becoming a more important part of the market as saturation levels for residential PV increases. We develop a historical picture of these systems based on the data provided and then assess the financial attractiveness by state based on average system paybacks.

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 (including LPG) are also factors that need to be considered.

The solar water heater (SWH) market has two 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 in previous years, is not significant and will not be separately analysed.

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

The model considers relative market shares together with the following factors:

- State regulations for new/replacement systems;
- Access to reticulated gas;
- STC price;
- System prices (prior to incentives);
- Other state and federal government incentives (if any); and
- Economic factors.

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

Market Survey

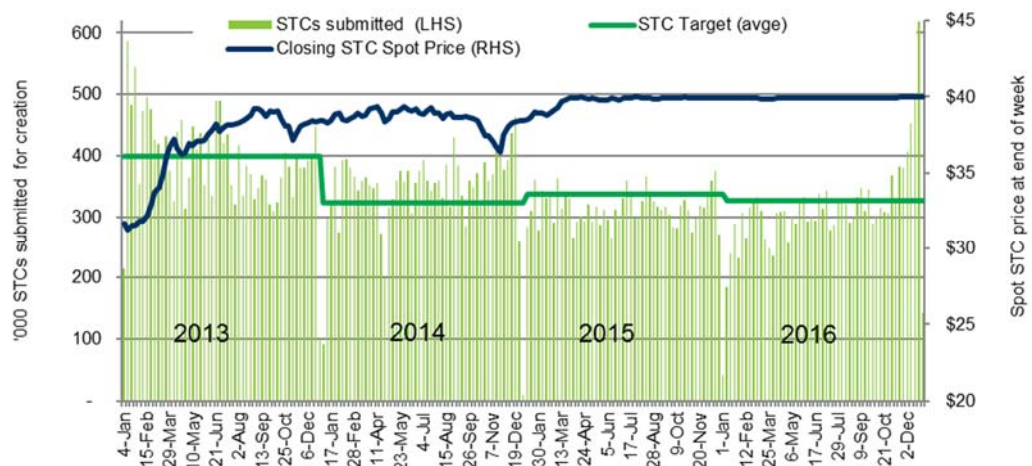
As part of the data modelling exercise we interviewed a number of market participants for their views of the solar PV and SWH market over the coming three years. The views of these businesses assisted in the development and refinement of our assumptions.

3. STC Market Overview

STC market

The level of STC creation since February 2013 has been reasonably stable after several years of considerable volatility. STC creation has been consistently below average target levels in 2015 and 2016 (Figure 3.1). This has meant that the Clearing House has been used extensively to settle certificates. The spot STC price has been fairly stable for most of 2015 and nearly all of 2016, sitting at levels just below the \$40 Clearing House price.

Figure 3.1 STC spot price and weekly STCs submitted for registration



The average STC spot price for 2014 was \$38.56, \$39.69 for 2015 and for the 12 months to the end of December 2016 averaged \$39.91. For the purposes of our analysis we have assumed that the average STC price for 2017 is \$39.75 which equates to a net cost after creation and administration costs of \$38.50 and remains at this level for 2018 and 2019.

Of particular interest has been the surge in STC creation over the last two months of 2016 (predominantly solar PV) which has been reminiscent of installation activity several years ago. Feedback from industry participants indicates that the recent surge can be mainly attributed to (i) more aggressive marketing by solar businesses with the impending reduction in the number of years that certificates can be claimed from 15 to 14 years and (ii) increased media coverage around rising power prices, the South Australian power blackout and the closure of Hazelwood. In addition, the cessation of attractive feed-in tariffs in NSW and the availability of lower cost batteries has also increased consumer interest in solar PV.

Feedback from the industry indicates that order books are reasonably full going into 2017 and that we are not likely to experience as dramatic a reduction in creation as witnessed in the first quarter of 2016.

Delay in creation of certificates

Registered Agents and their customers have 12 months from the date of installation of a small-scale system to create the certificates. This means that we will only know at the end of 31 December 2016 the number of certificates created from the installation of solar systems in 2015.

STC Modelling 2017-19

We have analysed the time it takes to create STCs for each of the market sectors assessed (refer to Attachment 11). For solar PV systems installed in 2015, 93.2 per cent of STCs were submitted for creation in 2015 and 6.8 per cent were created in 2016. For SWH systems installed in 2015, 17.8 per cent of STCs were created in 2016.

In forecasting the level of STCs to be eventually created for systems installed in 2016 we have used the average level of delay experienced over the 2015 and 2016 period. We assume that 6.9 per cent of PV STCs for 2016 installations will be created in 2017 and 16.1 per cent for SWH.

4. Solar PV - Market Review

The Australian solar PV market has evolved considerably since 2008 when the market amounted to only 20 MW of installations. The Australian market, unlike many international markets is predominantly a residential market with relatively few large installations, though this started to change from 2015 when several utility scale solar PV installations commenced operation.

The solar PV market grew to a peak of more than 360,000 installations in 2011 supported by attractive state-based feed in tariffs and the Solar Credit Multiplier (refer to Figure 4.1). As these support mechanisms were progressively unwound the number of installations dropped dramatically reaching 141,000 in 2015 and falling further in 2016 to an expected 131,000.

Figure 4.1 Number of Solar PV installations claiming Certificates by Segment

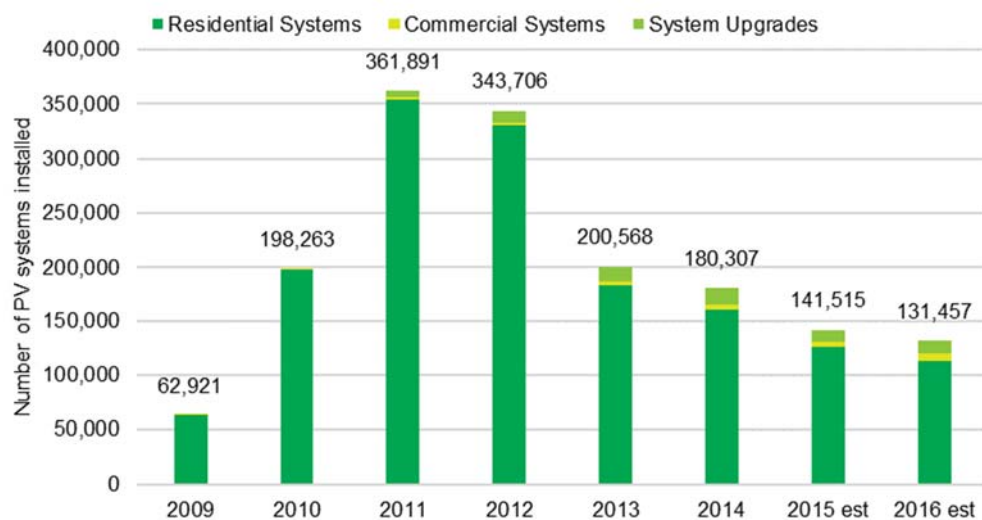
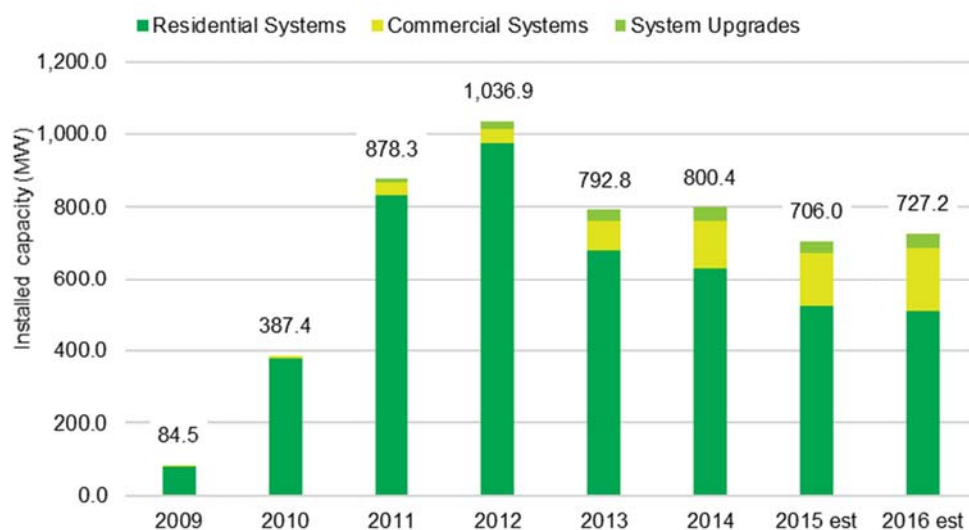


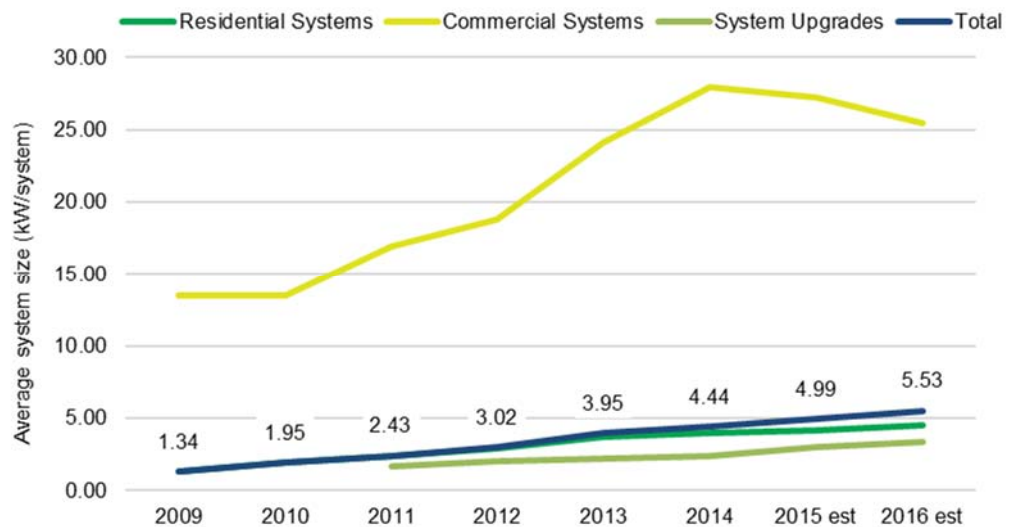
Figure 4.2 Solar PV installed capacity claiming Certificates by Segment



The number of non-residential systems (those that are greater than 10 kW) has increased steadily over the last four years and is expected to reach 180 MW in 2016 and account for 25 per cent of capacity installed for the year (Figure 4.2).

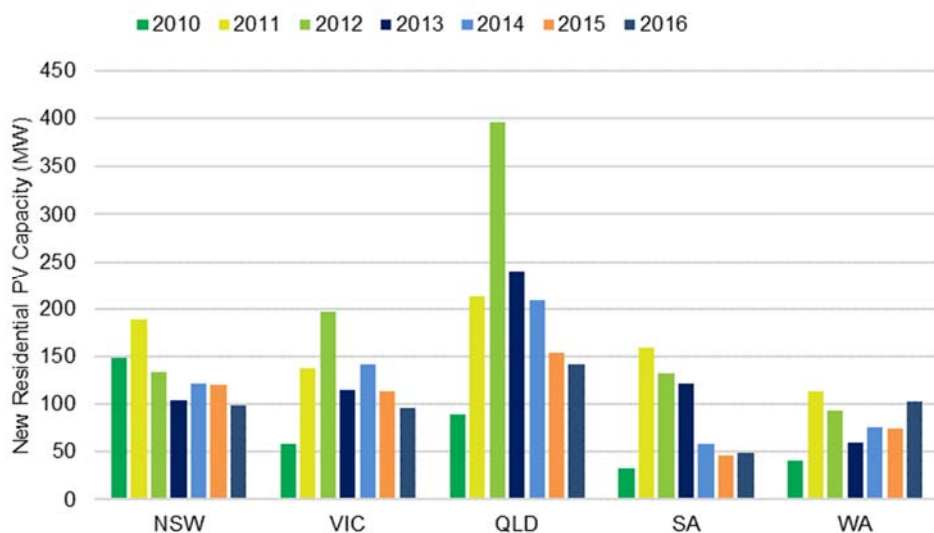
The overall average size of PV systems installed has increased considerably since 2009. The average system size was 1.34 kW per system in 2009 and in 2016 it was four times bigger at nearly 5.5 kW per system (Figure 4.3). Whilst the average size of residential systems has continued to increase the average size of commercial systems has reduced over the last two years.

Figure 4.3 Average size of system installations (Australia as a whole)



The PV market prior to 2011 was dominated by the availability of the maximum rebate of \$8,000 for 1 kW systems, and the Solar Credits Multiplier cut out after 1.5 kW which resulted in smaller systems being installed.

Figure 4.4 New Residential PV system capacity (MW) installed for key states



Queensland continues to remain the largest state market for residential PV in Australia (Figure 4.4). Queensland and South Australia were the last key states to wind back

their feed in tariffs and as a result have experienced the largest reductions in installed capacity over the last three years. These states have also achieved installation levels in excess of 38 per cent in the residential market (refer to Section 6). The level of residential capacity installed reduced in 2016 in most key states other than WA which has seen an increase of 37 per cent.

Forecasting Installed PV costs

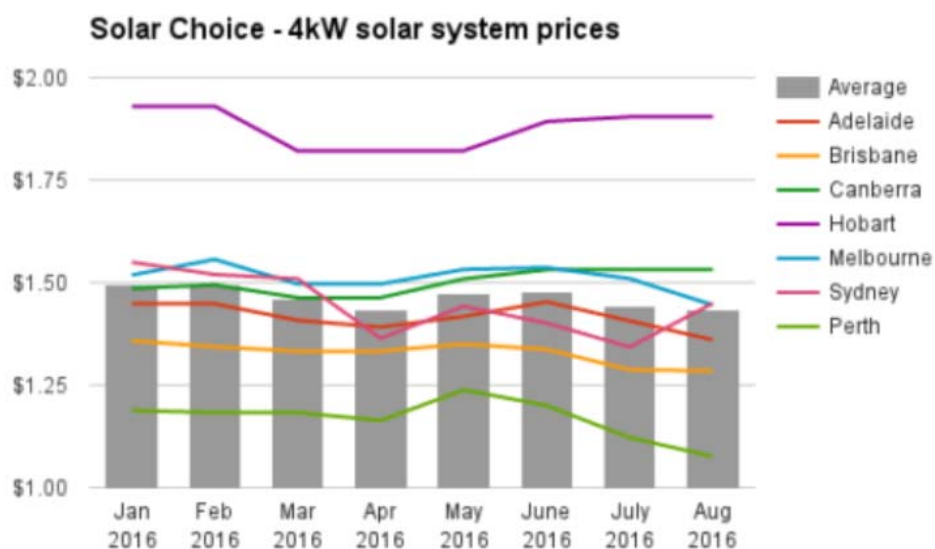
Installed system costs fell by approximately 14 per cent in 2016 as a result of (i) continued reduction in hardware costs (panels and inverters) and (ii) reduced gross margins due to increased competitive pressure as the number of installations continued to fall.

With rising saturation levels in the residential market, securing leads and closing sales continues to be difficult, expensive and time consuming. The additional time and cost to arrange connection to local distribution networks is also putting additional pressure on margins.

Whilst Australian PV module and balance of system pricing generally follows international trends, there are some differentiating factors that impact on pricing levels in Australia. Unlike most international PV markets, the Australian market has been a predominantly residential market (accounting for more than 80 per cent of installed capacity). As such it has relatively low barriers to entry and has been attractive to international suppliers that may seek to test new products, clear old models or sell Tier 2 or Tier 3 products. This has enabled Australia to achieve attractively low prices for product.

Solar Choice publishes average installed system prices (Figure 4.5) which incorporates the value of STCs and so reflects the net cost to the customer. The Solar Choice analysis shows that net system prices have drifted a bit lower over the course of 2016. The Solar Choice analysis represents pricing from Solar Choice's installer network database and as such the average price may not be representative of the market as a whole. The trend shown by the data is however reasonably representative of what the broader market is experiencing.

Figure 4.5 Installed system Costs (after STCs) for 4kW system (\$/Watt) (Solar Choice, September 2016)



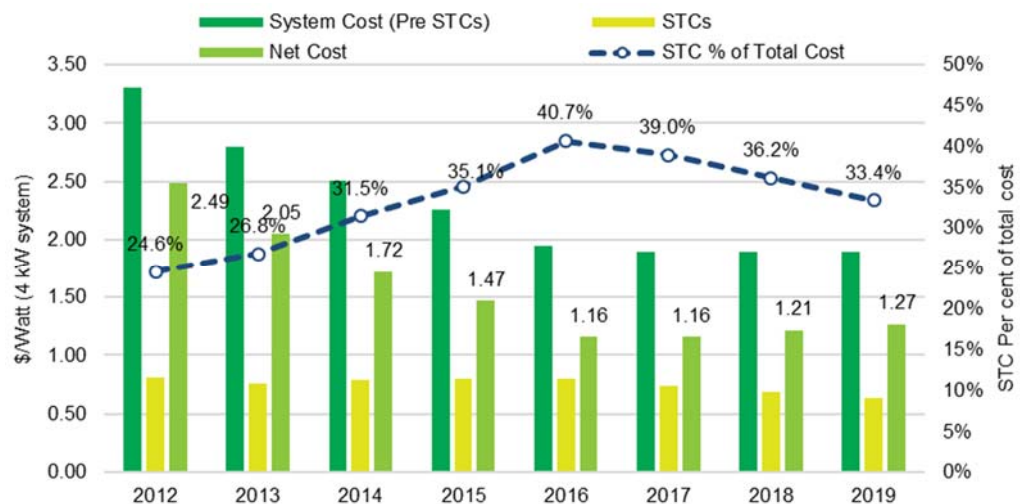
The factors that will influence system pricing over the next three years continue to be dominated by:

- Changes to the AUD/USD exchange rate;
- The continued growth in commercial and project sales will continue to favour more bankable Tier 1 brands and thus, may potentially increase average prices;
- Global supply and demand factors; and
- Continued local consolidation across the supply chain as lower volumes increases pressure on margin requirements and thus could lead to higher average prices.

We estimate that the average installed system cost (pre STCs) in 2016 is \$1.95 per Watt. We expect that the installed cost (pre STCs) in 2017 will fall slightly to \$1.90 per Watt and then remain at this level in nominal terms for 2018 and 2019 (Figure 4.6). In real terms installed system costs are expected to reduce slightly.

STCs will continue to play an important role in making solar PV attractive to customers even as years deeming starts to reduce. STCs accounted for just over 40 per cent of the total cost of the system in 2016 and this is expected to drop to 33 per cent by 2019.

Figure 4.6 Forecast Installed system costs for 4 kW system (\$/Watt)



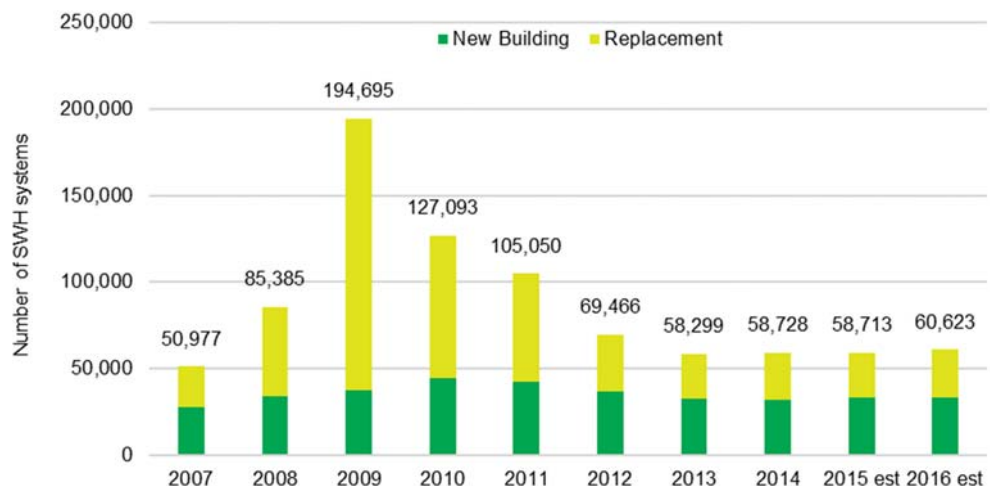
5. Solar Water Heater - Market Review

The Solar Water Heater (SWH) market in Australia has been pretty stable over the last four years with just under 60,000 SWH systems being installed that have claimed certificates. This is less than one-third the peak of 195,000 systems creating certificates in 2009.

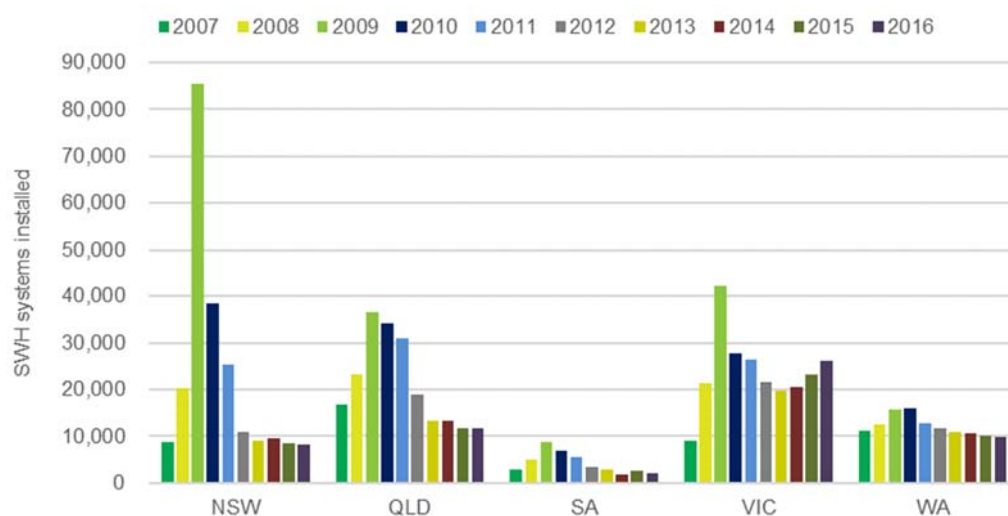
It is important to recognise that not all SWH systems installed create certificates. Industry estimates place the level of non-creation at between 10 to 15 per cent of total systems installed, predominantly related to the new building market.

The SWH market can usefully be segmented into the new building and replacement markets (Figure 5.1). The new building market has been relatively stable over the last nine years with the installation level broadly moving in line with the level of new home building. The replacement market on the other hand has proved to be very volatile and has been historically driven by the level of rebates for the replacement of electric resistance water heaters.

Figure 5.1 SWH Systems installed and creating certificates by market segment



Installations of SHW systems have reduced across all states and territories. The most marked reduction in system installation rates comes from those states with relatively low access to gas and high proportions of electric water heaters (i.e. NSW and Queensland). Commonwealth and state support programs had created significant incentives for residents in these states to replace their electric water heaters. This created significant growth in the replacement market over the 2009 -11 period (Figure 5.2). The removal of rebates has had a dramatic impact on the level of SWH systems installed in NSW and Queensland, and to a lesser extent Victoria.

Figure 5.2 SWH Systems installed in NSW, Qld, SA, Vic and WA

Victoria continues to be the largest market for SWH. The strong Victorian market reflects the support provided by the Energy Saving Incentive Scheme for replacing electric water heaters with SWH (replacement market) and strong growth in SWH installs in new homes due to building regulations and strong growth in residential building activity.

6. Solar PV Projections – New Residential

The new residential PV market is the most significant segment in Australia and has accounted for up to 95 per cent of PV capacity installed in 2011 and 2012. The residential sector has historically been specifically targeted through the Solar Credits Multiplier and through state feed-in tariffs. As these policy support measures have been unwound the new residential market share fell to 74 per cent of installed capacity in 2015 and 70 per cent in 2016.

Systems are generally sold into this market on the basis of financial attractiveness ie. payback. Our projections for the residential sector have been made on a state basis and are derived from our payback model, with the resultant payback period feeding into a state demand curve. From the state based demand curves the proportion of eligible owner occupied households expected to purchase a solar PV system is determined. Then based on this figure and estimates of the average system size, expected certificate creation is determined.

Forecasting payback periods

We have adopted a simple payback approach to represent the relative financial attractiveness of PV to consumers in each state. The system payback is derived by dividing the installed cost of the system (less the value of STCs) by the value of electricity produced in the year of installation. This slightly understates the real payback as electricity prices are generally expected to rise over the forecast period.

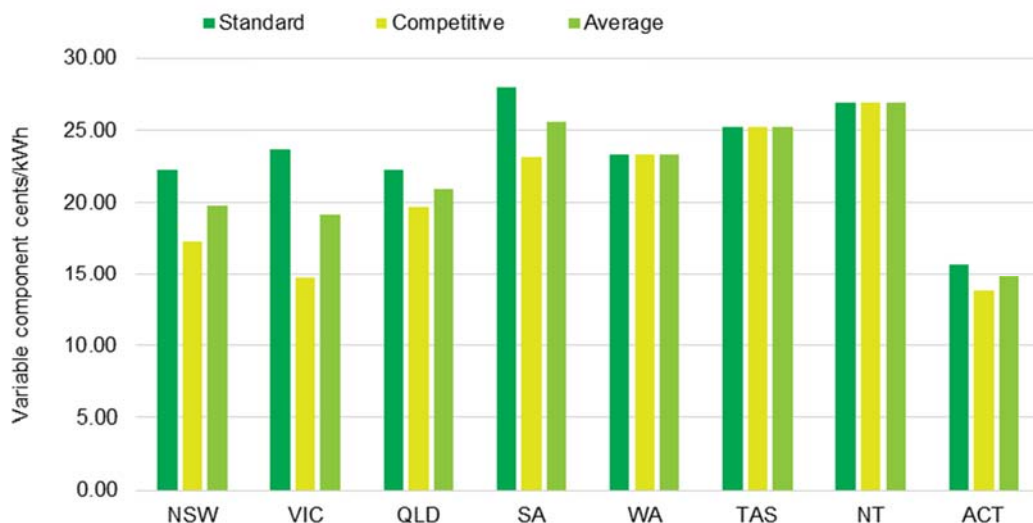
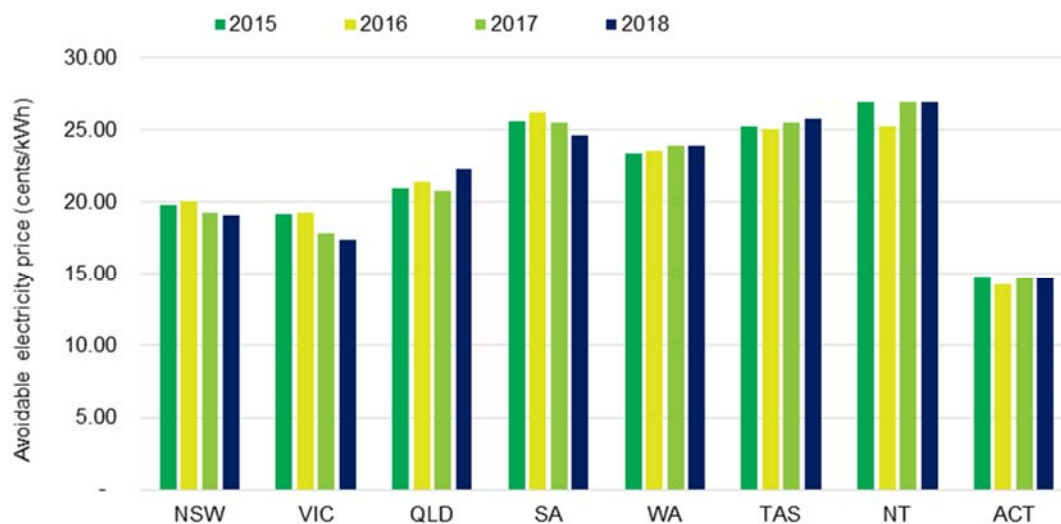
Explicit assumptions used in the model include:

- STC price of \$38.50 (after creation and administration costs) from 2017-2019;
- Export price received reflecting AEMC projections, generally assumed to be 5 cents/kWh in 2015 and increasing in line with changes to competitive market costs;
- Average system size of 4 kW;
- Electricity exports of 50 per cent of electricity generated;
- The structure of retail electricity prices to progressively become less avoidable by solar PV, and represented in the modelling by including only the variable (cents per kWh) component; and
- Total installed cost of solar PV of \$1.90 per Watt in 2017 and remain at this level in nominal terms for 2018 and 2019.

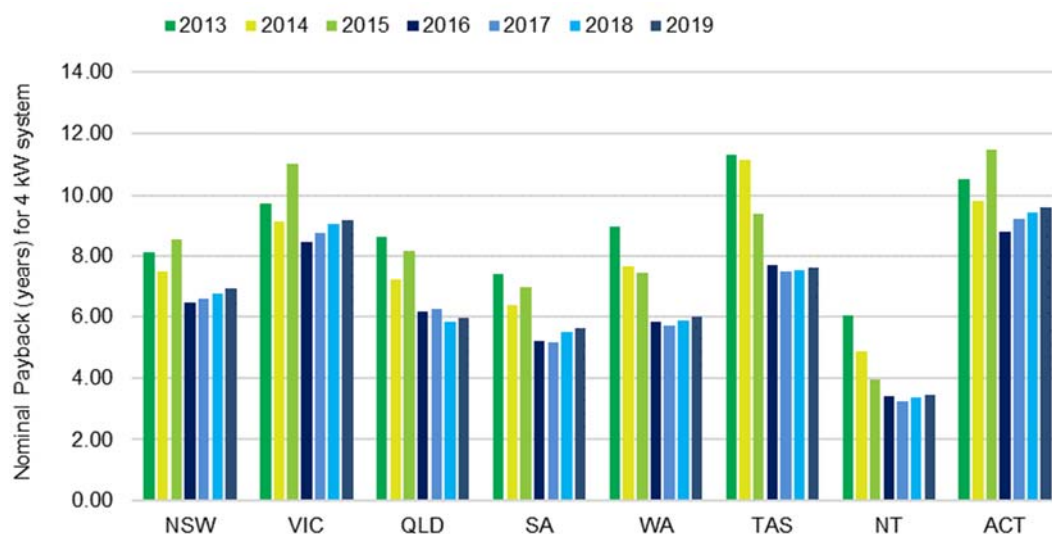
The installed cost and the contribution that STCs make is shown graphically in Figure 4.6 and Attachment 2.

Our electricity price projections have been based on the Australian Energy Market Commission (AEMC) 2015 Residential Electricity Price Trends (December 2015). Our variable pricing assumption (that can be avoided with solar PV) for 2015 is a combination of (i) the competitive pricing structure incorporated in each of the AEMC case studies for a typical four-person family using the “Energy Made Easy” tool and (ii) the standard power offering (refer to Figure 6.1).

For 2015 we assume an average of 50:50 split between competitive offering and standard offering with the trend towards more households moving to competitive offers over time (refer to Figure 6.2).

Figure 6.1 Avoidable electricity prices by state in 2015**Figure 6.2 Avoidable electricity price (variable cents per kWh component)**

Average system payback are generally expected to increase over the 2016 – 2019 period due to (i) a lower value for generated electricity as fixed electricity charges rise and variable charges reduce and (ii) reduced contribution from STCs as the deemed years reduces.

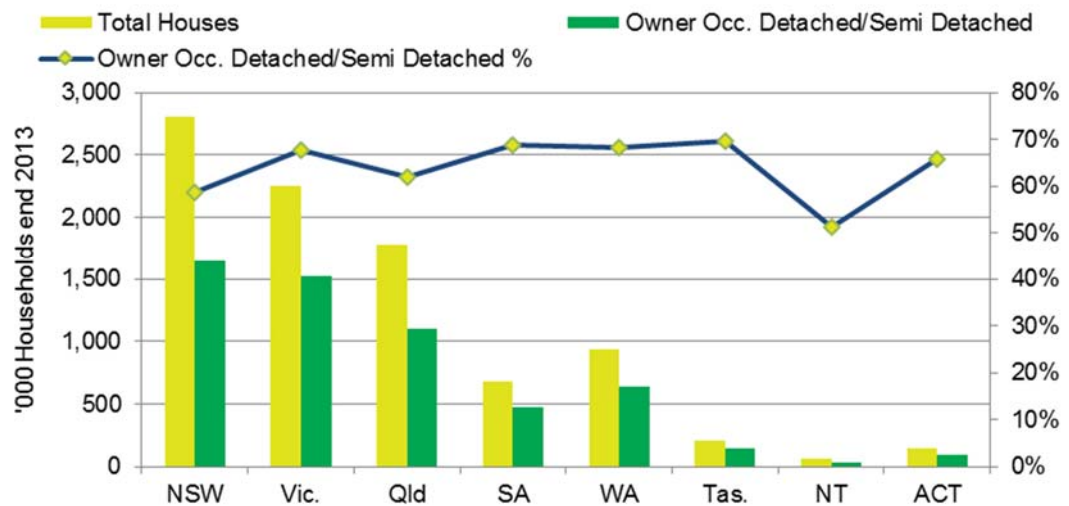
Figure 6.3 Simple Payback for residential PV system (4 kW)

Demand for solar PV

Solar PV is a discretionary purchase for most households so financial attractiveness will be the key determinant of the underlying demand. Like other discretionary purchases uptake will also be significantly impacted by the level of sales, marketing and promotion activity. In addition, concerns regarding the future economic outlook and the impact that any economic and budget contraction will have on discretionary household expenditure will constrain the near term outlook for solar PV. Offsetting this to some extent is the emergence of financing solutions that result in the customer not having to outlay any expenditure for a system.

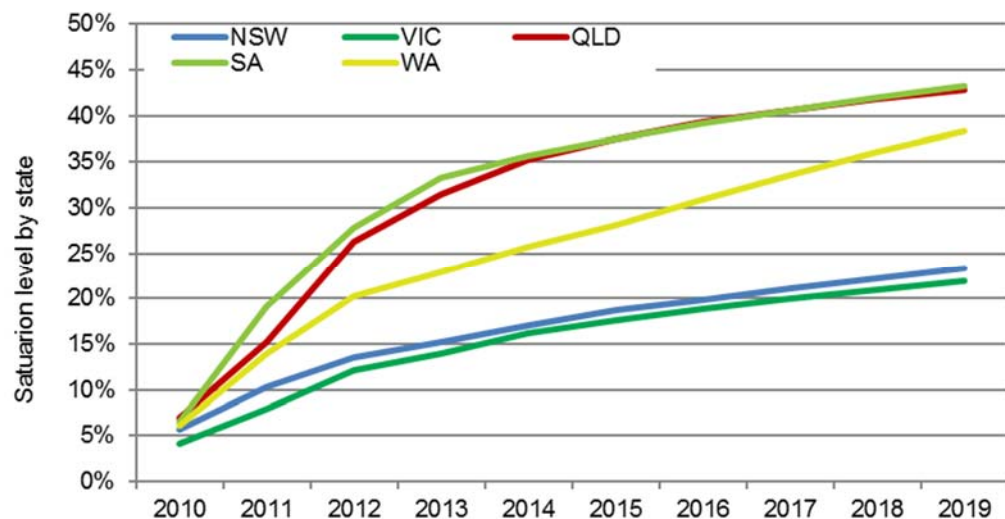
There are several financiers that have been providing finance solutions to the residential market. We understand that this is still a relatively small proportion of total systems. Industry feedback suggests that greater headway is being made in the commercial market where larger installations can justify the higher transactions costs.

Demand curves have been developed on a state basis based on historical residential system installations. Demand curves are represented as a proportion of owner occupied relevant dwellings (separate and semi-detached houses) for that state (expressed as the average number of systems per month) for a given simple payback level. Based on ABS data we estimate that there were 8.7 million occupied dwellings in Australia at the end of 2013 of which 63.7 per cent (5.6 million) were owner occupied detached or semi-detached (refer to Figure 6.4).

Figure 6.4 Dwellings by state (source: ABS)

Demand curves have been further refined to take into account the level of marketing and promotion activity, and the relative attractiveness of the state (that is not picked up through the factors incorporated in the payback model) and covers factors such as state economic conditions, relevant level of retirees and income levels.

The demand curves are then further scaled based on the level of saturation in each state. Over the three years to 2018 the cumulative PV systems installed in each state grows considerably with very high saturation rates achieved in Queensland and South Australia, reaching over 39 per cent by 2016.

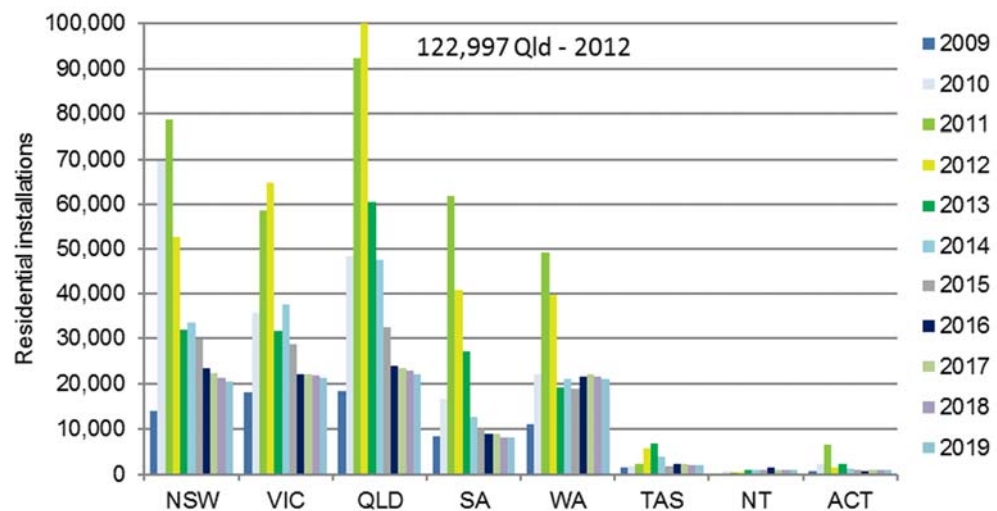
Figure 6.5 Saturation level by state

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

Projected system installations and saturation levels for each state is included in Attachment 3. The data is shown diagrammatically as Figure 6.6. The level of residential system installations across all states has reduced markedly from the peak in 2011. Solar PV installations across most states and territories were not receiving any additional support (other than through STCs) in 2014. As a result, the level of installations in 2014 represents a reasonable base level for forecasting future years.

Queensland had been the leading state for the number of residential installations over the last 6 years. Into the foreseeable, NSW, Victoria and Western Australia are expected to achieve a similar level of installations.

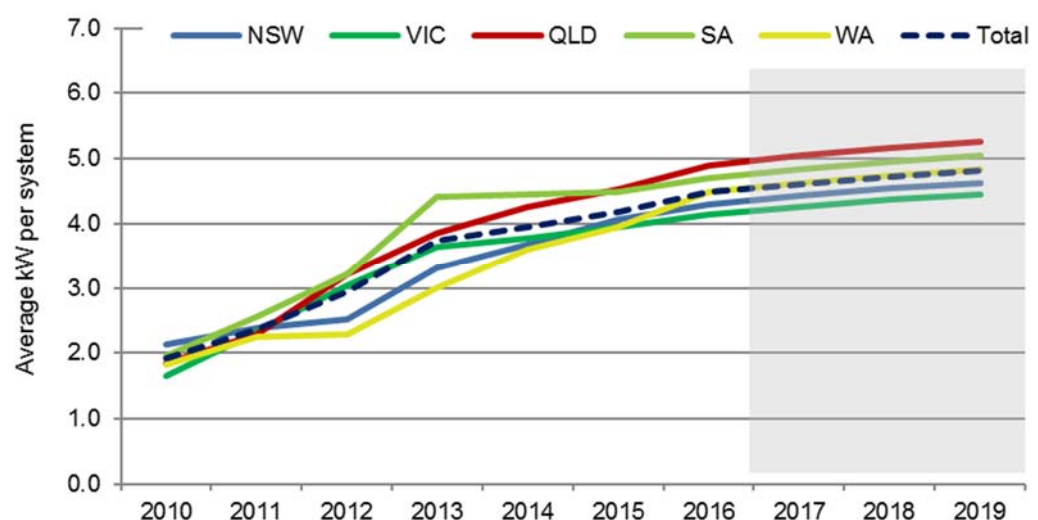
Figure 6.6 Residential PV systems installed by state



Determining the level of certificate creation

The average residential system size installed has continued to increase over the last seven years reaching 4.5 kW per system in 2016 (refer to Attachment 4 for details). All states have seen an increase in system size through 2016 (refer to Figure 6.7). Queensland and South Australia have continued to maintain the largest system sizes even though their attractive feed-in tariffs have been removed.

Figure 6.7 Average system size installed for NSW, Qld, SA, Vic and WA



We forecast that the average system size will continue to increase, but at a slower rate than experienced over the last few years. Improved panel performance will result in increased generation capacity for a given area. We have assumed that the overall

average system size progressively increases from 4.5 kW per system in 2016 to 4.81 kW per system in 2019.

The total number of systems installed and associated certificates created for new residential systems is detailed in Attachment 4 and summarised in Table 6.1.

Table 6.1 Number of New Residential Systems and Certificate Creation

Year of installation	2013	2014	Estimate 2015	Estimate 2016	Forecast 2017	Forecast 2018	Forecast 2019
Number of Systems Installed	182,786	159,997	125,524	113,261	106,876	104,035	100,943
Avg kW/system	3.73	3.96	4.19	4.50	4.60	4.72	4.81
Avg Certificates/kW	20.6	19.9	20.0	20.1	18.7	17.3	16.0
MW Installed	681.4	632.9	525.5	509.3	492.1	490.9	485.9
Eligible Certificates ('000)	14,025	12,598	10,493	10,212	9,186	8,503	7,768

7. Solar PV Projections – Non-residential (Commercial)

The commercial or non-residential sector has become a significant market as high saturation rates are achieved in the residential market. We have generally segmented the commercial market into those systems where the installed capacity of the system is greater than 10 kW. This is a proxy for commercial systems and while in some ways is an arbitrary delineation; it does generally reflect industry convention.

Installed capacity for 2016 is estimated to be 180 MW which is a 21 per cent increase on 2015 levels. The commercial sector accounted for 25 per cent of total installed small-scale solar PV in 2016 compared to 21 per cent in 2015.

We have analysed the level of installations by size range to achieve a better understanding of the underlying level of activity in each state (Table 7.1).

Table 7.1 Commercial PV systems by sub-segment

	2011	2012	2013	2014	2015	2016
Number of Systems						
>10 to 30 kW	1,764	1,822	2,802	3,633	4,266	5,489
>30 to 50 kW	164	188	283	509	613	869
>50 to 100 kW	47	46	226	498	591	714
Total	1,975	2,056	3,311	4,640	5,470	7,072
Installed Capacity (kW)						
>10 to 30 kW	24,549	28,550	50,781	68,429	75,553	88,687
>30 to 50 kW	5,617	6,610	10,456	19,758	23,587	31,644
>50 to 100 kW	3,262	3,455	18,723	41,471	49,923	59,851
Total	33,428	38,615	79,960	129,657	149,064	180,182
Average System Size (kW)						
>10 to 30 kW	13.9	15.7	18.1	18.8	17.7	16.2
>30 to 50 kW	34.3	35.2	36.9	38.8	38.5	36.4
>50 to 100 kW	69.4	75.1	82.8	83.3	84.5	83.8
Total	16.9	18.8	24.1	27.9	27.3	25.5

Potential Demand

There have been more than 25,000 commercial sized systems installed across Australia to 2016. This is still only a very small proportion of potential sites and there remains considerable scope for this sector to continue to expand.

It is difficult to obtain data on the potential size of the market as we need to consider:

- Those businesses that own their own facilities, or at least have considerable time remaining on their lease;
- Business sites that have appropriate roof space available to accommodate a large number of solar panels; and
- Business sites that consume a reasonable amount of electricity so that not too much of the electricity produced is exported.

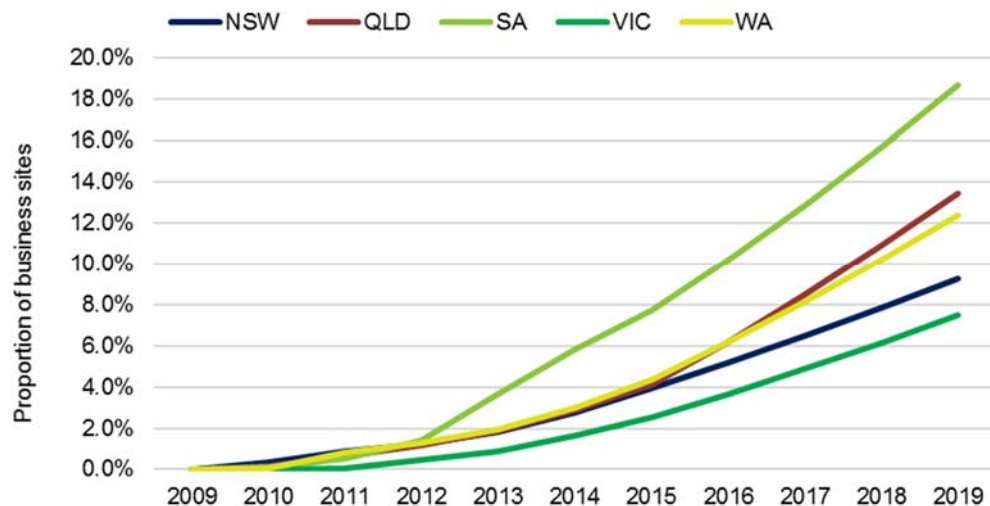
Data is not available by state that represents the above characteristics and we have developed a proxy to assist in assessing market prospects and growth over time. The ABS publishes data on the number of registered businesses (by number of employees) and the Energy Supply Association of Australia (ESAA) publishes data by state on the number of business connections. This information is summarised by state in Table 7.3.

Table 7.3 Number of Businesses and Electricity Connections (2013)

	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	Total
Business Connections (ESAA)	371,874	319,840	221,300	98,783	128,942	44,777	15,104	15,495	1,216,115
Total Businesses (ABS)	688,766	538,767	414,423	143,300	215,938	37,529	14,244	25,298	2,078,265
Businesses >1 employee (ABS)	282,421	210,315	159,015	50,604	81,425	15,100	5,691	10,729	815,300
Proportion >1 employee	41.0%	39.0%	38.4%	35.3%	37.7%	40.2%	40.0%	42.4%	39.2%

According to the ESAA there were 1.2 million business connections in Australia in 2013. The ABS estimates that 39 per cent of businesses employ more than one person and we have scaled the ESAA connection data by this ratio to arrive at a proxy for the number of potential sites. Many of these sites will not be suitable for PV due to being rented or not having sufficient roof space.

We have analysed the proportion of businesses that have installed solar by state and this is summarised in Figure 8.1. NSW, Queensland and WA have achieved more than 5 per cent market saturation in 2016. Victoria has quite a bit lower saturation rate with South Australia having 10 per cent.

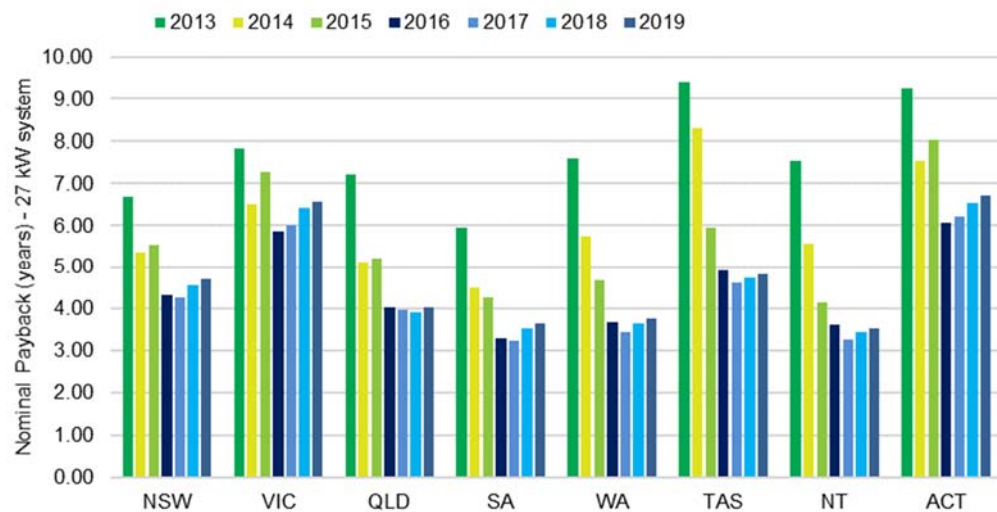
Figure 7.1 Estimated Proportion of Business Sites with Solar PV (larger states)

The availability of roof space and owning the site are key requirements for solar PV to be considered by a business customer. It would appear that sites that are outside of the major metropolitan areas of capital cities are more likely to have these characteristics and therefore more likely to be attractive for solar PV.

Financial attractiveness

Most business sites consume less than 160 MWh of electricity per annum and pay electricity tariffs that are broadly similar to residential customers. To the extent that these businesses can mainly offset their on-site power use (and avoid exporting significant levels of power) then an investment in PV can be quite attractive. The simple payback for a commercial system of average size (27kW) is shown diagrammatically in Figure 7.2.

Paybacks are assumed to increase across all states over the forecast period as the level of non-avoidable electricity charges increase and the value of STCs reduce due to lower levels of deeming. System paybacks typically range from less than 4 years to nearly 7 years over the projection period. This amounts to an internal rate of return of 13 to 25 per cent.

Figure 7.2 Simple payback for a 27 kW Solar PV System

Assumptions used in the payback analysis are consistent with the assumptions used for residential systems only with a lower export proportion (20 per cent of power is assumed to be exported) and the value of the electricity exported is assumed to be zero.

In assessing the potential market for solar PV, a relative attractive investment may not get implemented as high up-front cost activities such as PV suffer a number of barriers, these include:

- The split incentive: most small-to-medium businesses lease their premises. Payback may take longer than the lease term, and the building owner does not pay the electricity bill;
- Businesses' preference to invest in their own operations rather than in non-core activities;
- The frequency of non-working periods (eg weekends) for such businesses, which leads to power export and a consequent reduction in attractiveness; and
- Electricity represents a relatively small proportion of a business's costs and as such gets little attention from business owners.

In developing projections for 2017 to 2019 we have considered the following factors:

- With the fall in electricity demand there is a movement by network business and retailers to restructure electricity charges so that they are less avoidable by the customer. This means higher standing charges and demand based charges resulting in lower variable (cents per kWh) charges;
- Selling PV to commercial customers is a more complex and more involved sales process; and
- Economic uncertainty still prevails with concerns of a stagnant economy reducing the inclination of many businesses to invest.

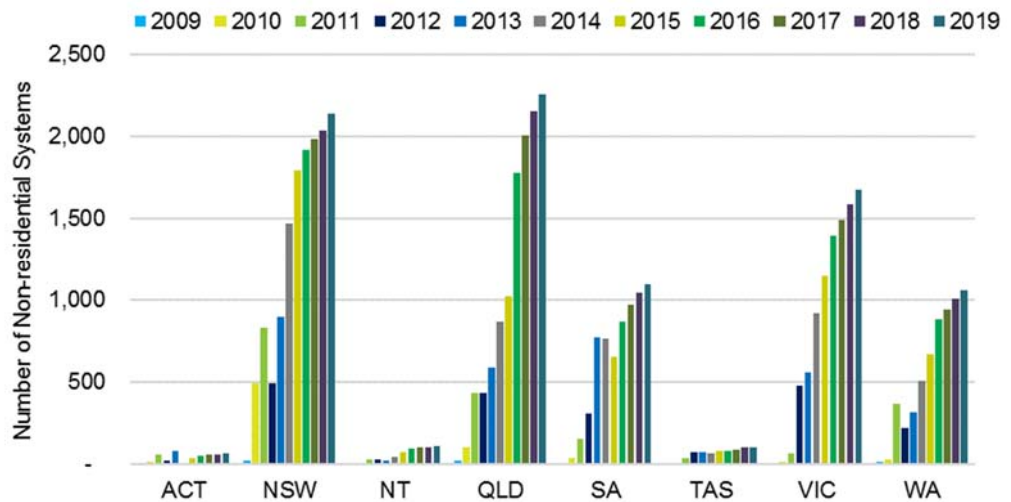
Countering the above negative factors are:

- PV retailers' increasing need to sell commercial PV to offset a contracting market for residential systems;
- Increasing experience and competence of the solar industry in delivering commercial PV with businesses starting to build a pipeline of potential projects; and
- Financing solutions are progressively being made available to customers to assist with up-front capital cost.

- Rising wholesale costs of electricity in as number of states (South Australia and Queensland in particular) due to higher gas prices (for use in power generation) and closure of coal fired generators

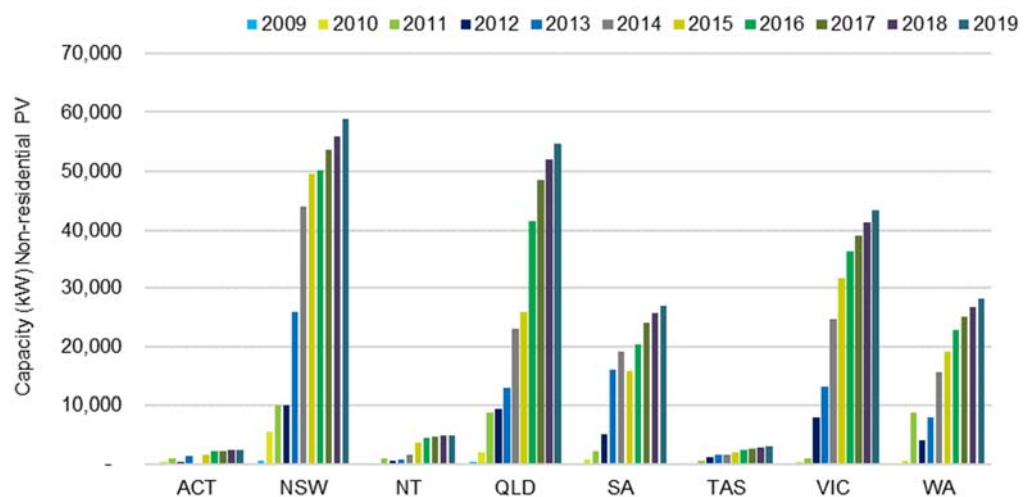
The level of commercial PV installations is forecast to continue to increase but at a lower rate of growth than experienced in the past. We assume that the number of systems installed increases by 8.1 per cent in 2017, 5.8 per cent in 2018 and 5.1 per cent in 2019.

Figure 7.3 Number of Non-residential PV Systems installed by state



For the forecast period we have assumed that the average system size in each state over the 2015 and 2016 period applies.

Figure 7.4 Installed Non-residential PV Capacity by State



The total number of systems installed and associated certificates created for the non-residential PV market is detailed in Attachment 5 and summarised in Table 7.5.

Table 7.5 Commercial System Installations and Certificates (all states)

Year of installation	2013	2014	Estimate 2015	Estimate 2016	Forecast 2017	Forecast 2018	Forecast 2019
Number of Systems Installed	3,311	4,640	5,470	7,072	7,643	8,089	8,500
Avge kW/system	24.15	27.94	27.25	25.48	26.17	26.18	26.17
Avge Certificates/kW	20.3	20.3	20.2	20.3	19.0	17.6	16.2
MW Installed	80.0	129.7	149.1	180.2	200.0	211.8	222.5
Eligible Certificates ('000)	1,624	2,627	3,017	3,658	3,792	3,728	3,615

8. Solar PV Projections – Upgrades

As the solar PV market matures, and with rising saturation rates in the new residential market solar resellers and installers are increasingly targeting their existing customers to upgrade their systems. This market can best be characterised as consumers that may have installed a smaller system than their available roof space and electricity demand might otherwise support. This is likely to have been done due to initial up-front cost considerations. As system prices have fallen and power prices have continued to rise, it has become more attractive for consumers to upgrade their system.

The average size of system installed has trebled over the last four years from 1.3 kW per system in 2009 to 4.5 kW per system in 2016 (refer to Attachment 9). The \$8000 rebate for 1 kW systems applying in 2009 and the initial 5 times solar credits multiplier applying up to 1.5kW have acted to keep systems smaller up to mid-2011. As a result, there are many smaller systems that have been installed that are capable of being significantly upgraded.

A number of solar retailers have also been selling systems with larger inverters that are capable of being upgraded. Whilst historically this sector has been relatively small (3.7 per cent of capacity in 2013) we expect that this market will continue to grow over time. There is however a constraining factor, with some customers unlikely to expand if they were on an attractive feed-in tariff that they might lose. As customers come off attractive feed-in tariffs (particularly in NSW) we expect to see many more consider system expansion. The emergence of more cost effective battery solutions provides an added incentive for customers to upgrade.

The number of system upgrades increased by 6 per cent in 2016 and we expect an 11 per cent increase in 2017 largely supported by a strong NSW market.

The total number of systems installed and associated certificates created for the upgrade PV market is detailed in Attachment 6 and summarised in Table 8.1.

Table 8.1 Residential upgrade systems and certificates

Year of installation	2013	2014	Estimate 2015	Estimate 2016	Forecast 2017	Forecast 2018	Forecast 2019
Number of Systems Installed	14,471	15,670	10,521	11,124	12,305	13,410	14,622
Avg kW/system	2.17	2.42	3.00	3.39	3.38	3.38	3.38
Avg Certificates/kW	20.4	20.5	20.8	20.9	19.6	18.2	16.8
MW Installed	31.5	37.9	31.5	37.7	41.6	45.3	49.4
Eligible Certificates ('000)	641	779	656	790	814	823	827

9. SWH and Air Sourced Heat Pump Projections

Overview

We estimate that 60,623 SWH systems will be installed in 2016 that will create STCs which amounts to a 3.2 per cent increase on 2015 levels. We expect to see a modest increase (1.7 per cent) in 2017 with both the replacement and new home market increasing. From 2018 onwards we see a contraction in the number of installations due primarily to a reduction in the new home market reflecting a contraction in the number of new homes built.

Overall Solar Water Heater market drivers

Water heaters can be characterised as essential appliances and may subject to regulations which will possibly limit consumer choices. As such, solar water heaters are subject to very different drivers than solar PV systems.

The market for water heater systems can be segmented into three distinct sub-markets:

- installations of water heater systems at new dwellings
- replacement of water heater systems at existing dwellings
- installation of water heater systems of commercial size (both at new buildings and replacement at existing buildings)

For the purposes of our analysis, we have combined Solar Water Heaters (SWH) with Air-Sourced Heat Pumps (ASHP) into one category. We refer to this category simply as Solar Water Heaters (SWH). ASHPs have accounted for approximately 15 per cent of total hot water STCs over the last two years.

ASHPs with capacity greater than 425L have not been eligible to create certificates since June 2010. Most systems with a capacity of more than 425L will be commercial systems, and since this system size is no longer able to create certificates, the quantity of commercial sized SWH systems has declined markedly. The number of commercial sized SWH systems that have created STCs over the last three years has been negligible. At this stage we envisage that the sector will remain a relatively insignificant component of the broader SWH market, therefore we have not forecast this market separately.

The most important drivers influencing choice of water heaters – electric, gas (storage or instantaneous) or solar (including heat pumps), include:

- building regulations
- comparative capital costs of the technologies
- access to reticulated gas
- financial incentives – rebates and REC/STCs
- consumer perceptions of energy prices i.e. electricity, natural gas and LPG

The drivers above play out differently in each of the two market segments. For example, the most important driver influencing the choice of water heating system in the replacement market is the type of water that is currently in place.

SWH systems are a mature technology with well-established sales and distribution channels. SWH system costs are forecast to remain relatively stable over the next 3 years. There is little upside to the STC price over and above the current price, therefore the installed cost (net cost to the customer) is expected to remain steady in the short-term.

New building market

The number of systems installed by state in the new building market has been reasonably stable on a year to year basis across nearly all states (refer to Figure 5.1 and Attachment 10). This is in sharp contrast to the replacement market.

The primary drivers behind purchase behaviour in this segment include:

- The number of new dwellings
- Building regulations
- The availability of gas to the new development
- Other factors — such as builder influence, environmental performance and industry marketing, as well as capital and operating costs

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

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

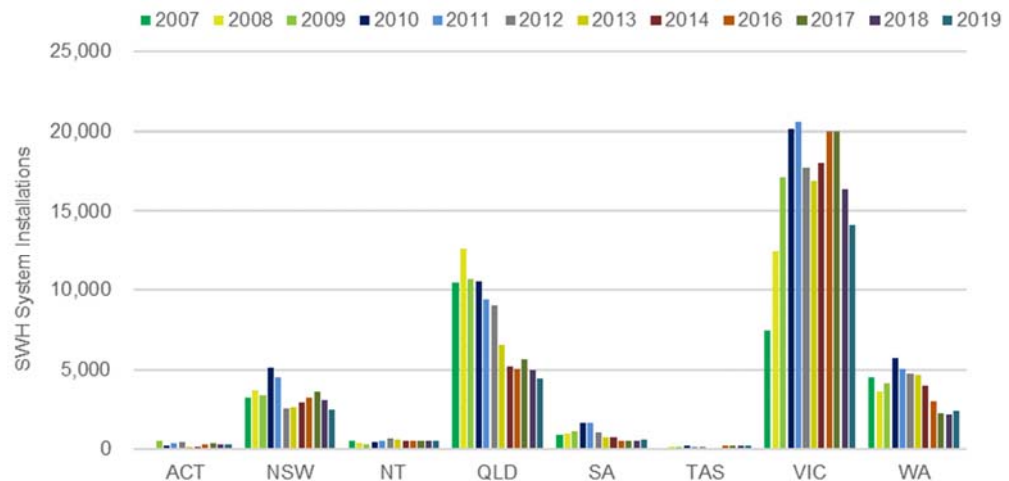
The level of new home starts is expected to increase by 1 per cent in 2017 and then fall dramatically in 2018 and 2019 according to the Housing Industry Association (HIA) Economics Group (Table 9.1).

Table 9.1 Housing Industry Association – New Home starts (Aug 2016)

	2012	2013	2014	2015	2016	2017	2018	2019
ACT	4.1%	-17.9%	9.5%	-8.4%	7.8%	11.3%	-20.4%	2.5%
NSW	-7.2%	0.9%	34.0%	13.3%	21.1%	10.4%	-17.4%	-21.7%
NT	6.5%	22.3%	3.8%	-2.3%	-23.8%	0.6%	-7.5%	2.0%
QLD	-19.2%	1.4%	16.5%	19.3%	18.9%	9.1%	-14.5%	-13.5%
SA	-18.3%	-16.5%	14.8%	16.7%	-11.5%	8.4%	-5.5%	4.2%
TAS	-17.3%	-23.1%	-12.3%	33.5%	17.2%	-19.6%	-2.7%	5.9%
VIC	-9.3%	-4.8%	-9.9%	25.5%	17.1%	-2.6%	-20.7%	-16.1%
WA	-20.6%	1.8%	31.1%	22.7%	-11.5%	-27.6%	-4.2%	7.3%
Total	-12.7%	-2.8%	12.4%	18.9%	11.7%	0.8%	-15.8%	-12.9%

We have used the HIA forecast of new home starts as a guide and have adjusted these rates for other market factors. The number of SWH systems installed in new buildings is expected to experience a slightly increase in 2017 and then reduce in 2018 and 2019.

The level of SWH systems creating certificates is summarised in Figure 9.1. Victoria which has the most progressive new building regulations accounted for more than half of SWH certificates created from new homes over the 2014 to 2016 period.

Figure 9.1 SWH Systems installed claiming certificates for New Homes by state

Replacement submarket

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

There have been a range of state-based schemes, incentives and/or regulations, particularly for the replacement of electric resistance water heaters (EWH). We have assumed that the previously announced phase-out of EWH does not proceed and has no impact over the forecast period. The exception being South Australia where regulations are in place for some building types and where gas is available.

The only material rebates that are currently available are in Victoria through the Energy Savings Scheme which includes SWH as an eligible activity. For example, a EWH system replaced by a SWH system can generate between 30 to 50 Victorian Energy Efficiency Certificates (VEECs). VEECs provide an added financial incentive of \$400 to \$1200 that helps drive extra SWH system installations in Victoria.

There are three sub-sectors to consider with regard to the replacement market. These are:

- Replace Gas Water Heater
- Replaced Electric Heater
- Replaced Solar Water Heater

A breakdown by state of the sources for heating water by household in 2011 is summarised in Table 9.2 below.

Table 9.2 Sources of energy for heating water, 2011 (per cent of total households)

	NSW	Vic.	Qld	SA	WA	Tas.	NT	ACT	Aust.
Mains Electricity	64.0%	28.2%	74.9%	45.0%	26.3%	92.2%	54.3%	52.3%	52.3%
Mains gas	26.4%	66.0%	7.3%	48.6%	50.7%	0.0%	0.0%	42.5%	36.1%
LPG/bottled gas	2.8%	1.8%	8.1%	3.0%	6.4%	2.1%	0.0%	0.0%	4.0%
Solar	6.8%	3.8%	10.5%	6.6%	20.8%	2.6%	45.8%	5.5%	8.5%
Other	2.3%	3.2%	1.7%	1.0%	2.3%	0.0%	1.8%	0.0%	2.3%

Source: ABS, Environmental Issues: Energy Use and Conservation, Mar 2011

The replacement SWH market has been driven by the replacement of electric resistance water heaters. In a situation where an electric resistance water heater is due to be replaced, whether the property has access to reticulated gas has traditionally influenced the type of water heater system chosen as a replacement. Therefore, access to reticulated gas is a good predictor of the potential size of a SWH market. In Table 9.3 below we show the share of houses with access to reticulated gas. Residents in New South Wales and Queensland have limited access to reticulated gas; therefore, we can expect larger growth of SWH installations in these states.

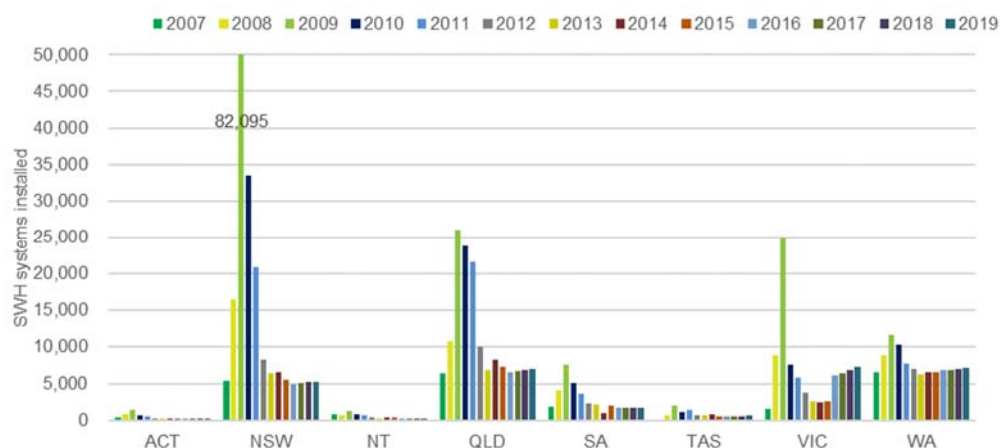
Table 9.3 Per cent of households with mains gas

	NSW	Vic.	Qld	SA	WA	Tas.	NT	ACT	Aust.
Capital City	47.7	91.0	18.6	75.2	83.9	6.2			62.6
Balance of State	25.3	57.5	5.0	13.7	24.5	3.1			23.4
Overall	38.9	81.6	10.9	58.4	68.3	4.4	2.9	74.6	47.9

Source: ABS, Environmental Issues: Energy Use and Conservation, Mar 2011

We expect the replacement market for SWH to continue to recover through 2017 and beyond, this recovery will be driven by a fast rising gas price and a slowdown in PV sales reducing competition to SWH for discretionary household expenditure. Recovery will be hindered somewhat due to uncertainty over the future economic outlook.

We expect the number of SWH systems installed in existing homes in 2017 to increase by 2.6 per cent to 28,456 systems. We expect to see further growth in replacement SWH system installations in 2018 and 2019 of 2.7 per cent per annum.

Figure 9.2 Replacement SWH Systems installed claiming certificates by state

Certificates created from the installation of water heater systems

We have assumed that the average certificates per system (on a state basis) for the 2017 to 2019 forecast period will be similar to the average levels achieved over the 2015 to 2016 period.

We forecast the total number of certificates created by SWH systems to be installed in 2016 at 1.85 million. We forecast this to increase by 1.7 per cent in 2017 to 1.88 million and then to reduce in line with forecast slowdown in residential construction.

Table 9.4 Certificate creation from SWH

Year of installation	2013	2014	Estimate 2015	Estimate 2016	Forecast 2017	Forecast 2018	Forecast 2019
New Buildings							
Number of Systems Installed	32,316	31,795	33,265	32,889	33,188	28,192	25,135
Avg Certificate/System	29.0	30.2	30.4	30.5	30.4	30.5	30.6
Eligible Certificates ('000)	938	961	1,013	1,004	1,009	860	770
Replacement							
Number of Systems Installed	25,983	26,933	25,448	27,733	28,456	29,210	29,996
Avg Certificate/System	31.0	30.7	30.8	30.4	30.7	30.7	30.7
Eligible Certificates ('000)	804	827	784	843	873	897	921
Total							
Number of Systems Installed	58,299	58,728	58,713	60,623	61,645	57,402	55,131
Avg Certificate/System	30	30	31	30	31	31	31
Eligible Certificates ('000)	1,743	1,788	1,797	1,847	1,883	1,757	1,691

10. Other small generating units

Wind and Hydro SGUs remain an extremely small part of STC creation.

We do not expect certificate creation will be material over the forecast period for these fuel sources and as a result we have excluded them from this analysis.

11. Resources

Resources utilised in our modelling have included:

- Clean Energy Regulator data
- ABS publications including:
 - 81650 Counts of Australian Businesses
 - 8752.0 Building Activity;
 - 41300 State and Territory Data;
 - 3236 Household and Family Projections;
 - 3101.0 Australian Demographic Statistics
 - 4602.0 Environmental Issues (for water heater system and gas usage data)
- GEM solar water heater and solar PV installation models
- GEM solar PV payback model
- Australian PV Institute
- State and territory government information on feed-in tariffs, SWH rebates and other programs such as the Victorian Energy Efficiency Target
- PV industry analyst module and inverter price forecasts
- REC Agents Association, Research Notes and Media Releases
- Housing Industry Association, Housing Forecasts – July 2016
- ESAA, Electricity Gas Australia 2014
- Australian Energy Market Commission, Residential Electricity Price Trends report, December 2015