ACIL ALLEN

30 November 2023

Report to The Clean Energy Regulator

Small scale technology certificate projections

2024-2028

About ACIL Allen

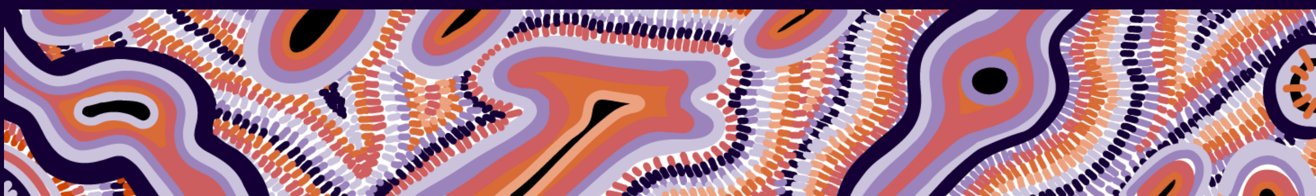
ACIL Allen is a leading independent economics, policy and strategy advisory firm, dedicated to helping clients solve complex issues.

Our purpose is to help clients make informed decisions about complex economic and public policy issues.

Our vision is to be Australia's most trusted economics, policy and strategy advisory firm. We are committed and passionate about providing rigorous independent advice that contributes to a better world.

Suggested citation for this report Small-scale technology certificate projections 2024-2028, ACIL Allen, November 2023

ACIL Allen acknowledges Aboriginal and Torres Strait Islander peoples as the Traditional Custodians of the land and its waters. We pay our respects to Elders, past and present, and to the youth, for the future. We extend this to all Aboriginal and Torres Strait Islander peoples reading this report.



Goomup, by Jarni McGuire

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Executive summary

ACIL Allen has been engaged by the Clean Energy Regulator (CER) to undertake annual small-scale technology certificate (STC) projections for the calendar years 2024 to 2028 for:

— small-scale solar PV
— eligible water heaters, which include solar water heaters (SWH) and air source heat pump (ASHP).

We use an econometric model to project the uptake of new small-scale solar PV installations (referred to in this report as solar PV). The projections are largely a function of the payback period of installations. The model uses historical data in the period January 2015 to March 2023 and for each state/territory and customer type separately. Although data is available for installations up to end of October 2023, installers have up to 12 months to register an installation with the CER. Our analysis suggests solar PV installers typically register an installation within around six months and hence we have omitted installations from April 2023 onwards to avoid partial installation count data. We have assumed 2024-2028 annual replacement[1] installations as a ratio of new installations is similar to the ratio observed to date.

For eligible water heater projections, we used a simpler approach compared to the approach to modelling solar PV installations. The projections of eligible water heaters consider recent historical installation trends and the relative cost of hot water technologies including government subsidies. We have assumed 2024-2028 annual new dwelling and replacement installations as a proportion of eligible dwellings are similar to the proportion in 2023 using historical data up to 31 October 2023.[2]

Solar PV

Figure ES 1 shows historical and projected annual solar PV installations in GW by region for the period 2016 to 2028.

Installations in 2023 and 2024 are projected to increase from 2022 levels due to lower payback periods compared with recent history. Lower payback periods in 2023 and 2024 are driven by higher electricity tariffs, higher solar feed-in-tariffs (FiT) and lower installation costs.

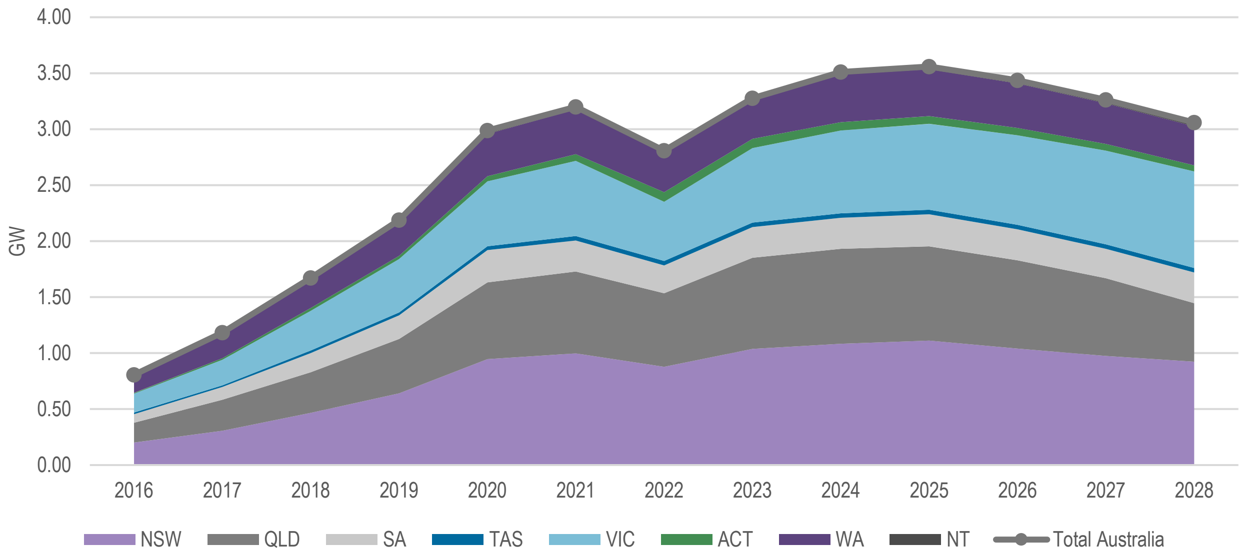
Despite slightly higher projected payback periods in 2025 due to declining retail tariffs, installations in GW terms, are projected to increase in 2025 due to higher average installation size of residential systems, which we assume continues to grow at recent historical rates.

[1] A projection of replacement installations is required in addition to new installations since replacement installations are eligible to create STCs.

[2] Eligible hot water installations rose sharply in the period from March 2023 to October 2023. We included all the data to 31 October to capture the impact of the recent increase in installations, which more than offsets any impact from partial installation count data.

From 2026 to 2028, projected installations decline, particularly in New South Wales and Queensland, due to higher payback periods because of lower projected retail electricity tariffs driven by the implementation of the New South Wales Electricity Infrastructure Roadmap and Queensland Energy and Jobs Plan encouraging a strong rollout in utility scale renewable energy and storage projects reducing wholesale electricity prices across these regions and interconnected regions. In effect, the rollout of the state-based schemes slightly shifts investment in generation from small scale to utility scale.

Figure ES 1 Historical and projected annual solar PV installations (GW) by region – 2016-2028



Note: Actual installations up to 31 March 2023; projected thereafter. Includes new and replacement installations. Includes residential and commercial installations.
Source: ACIL Allen analysis using CER data

Table ES 1 shows projected annual solar PV installations in GW by region for the period 2023 to 2028.

Table ES 1 Projected annual solar PV installations (GW) by region – 2023-2028

	2023	2024	2025	2026	2027	2028
NSW	1.04	1.08	1.11	1.04	0.97	0.92
QLD	0.81	0.85	0.84	0.79	0.69	0.52
SA	0.27	0.28	0.29	0.27	0.26	0.27
TAS	0.04	0.04	0.04	0.04	0.04	0.04
VIC	0.67	0.74	0.77	0.80	0.84	0.86
ACT	0.08	0.07	0.07	0.06	0.06	0.05
WA	0.35	0.43	0.42	0.40	0.36	0.35
NT	0.02	0.02	0.02	0.03	0.03	0.04
Total Australia	**3.28**	**3.51**	**3.56**	**3.44**	**3.26**	**3.06**

Note: Actual installations up to 31 March 2023; projected thereafter. Includes new and replacement installations. Includes residential and commercial installations.
Source: ACIL Allen analysis

Table ES 2 shows projected number of residential solar PV installations by region for the period 2023 to 2028. We have not projected the number of installations in the commercial market segment, instead our projections of commercial installations are expressed in kW terms and included together with residential installations in Table ES 1. In our model, eligible commercial roof space is characterised by kW available, due to the large range of roof size spaces available in this market.

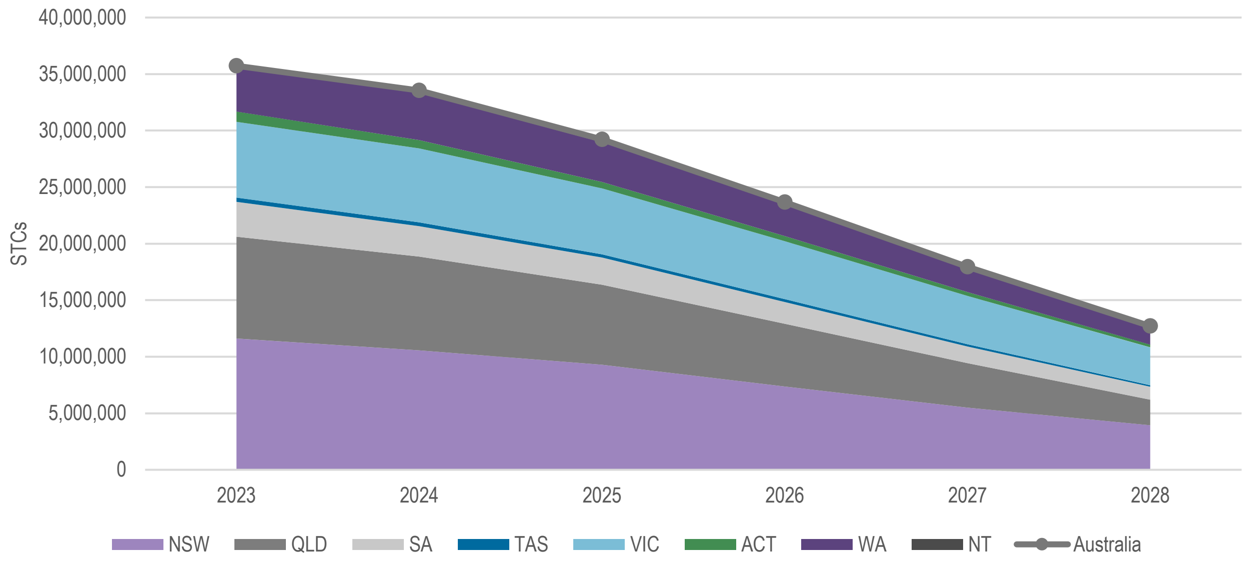
Table ES 2 Projected number of residential solar PV installations by region – 2023-2028

	2023	2024	2025	2026	2027	2028
NSW	100,550	96,597	94,916	84,693	75,726	68,065
QLD	77,564	73,201	66,538	56,001	44,061	31,953
SA	27,050	24,715	23,851	20,848	18,258	17,832
TAS	4,226	3,818	3,801	3,802	3,731	3,637
VIC	69,308	74,297	73,777	73,272	72,785	72,322
ACT	8,113	6,610	5,656	4,891	4,244	3,715
WA	43,939	48,639	46,674	44,914	41,368	38,354
NT	1,474	1,844	2,001	2,216	2,393	2,635
Total Australia	**332,224**	**329,720**	**317,213**	**290,636**	**262,565**	**238,512**

Note: Actual installations up to 31 March 2023; projected thereafter. Includes new and replacement installations.
Source: ACIL Allen analysis

Figure ES 2 shows projected STC creations from solar PV for the period 2023 to 2028. Projected annual STC creations from solar PV decline over the period due to the declining deeming periods.

Figure ES 2 Projected annual STCs from solar PV by region – 2024-2028



Source: ACIL Allen analysis

Eligible water heaters

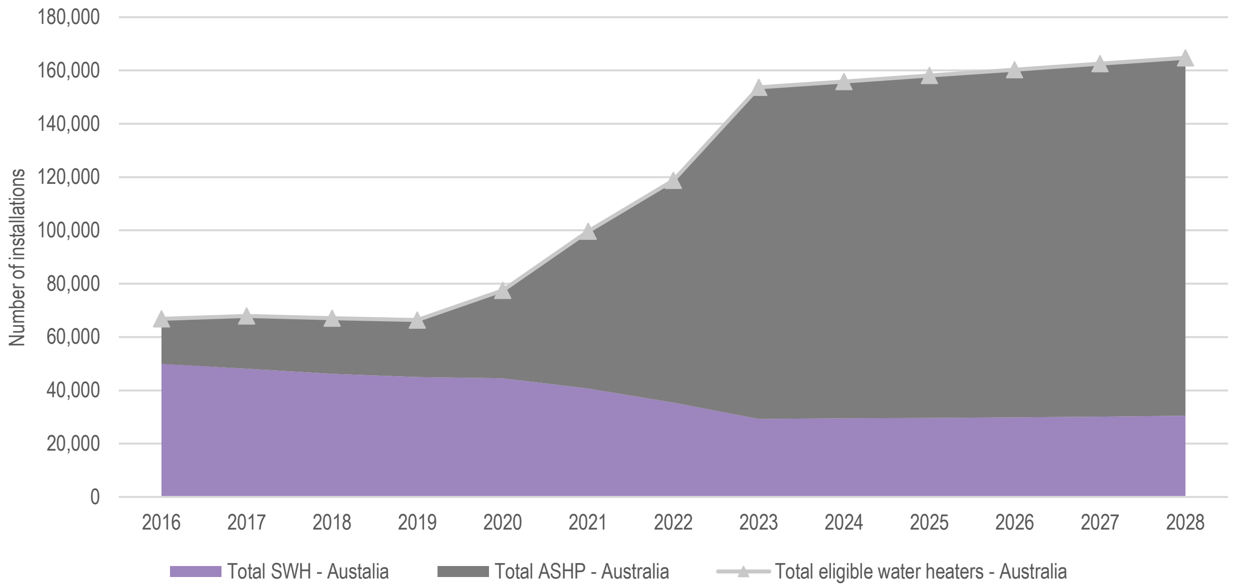
In this report, we refer to eligible water heaters, which covers both eligible hot water technologies under the scheme – solar water heater (SWH) and air source heat pump (ASHP).

Figure ES 3 shows the historical and projected annual installation of eligible water heaters, by technology type for the period 2016 to 2028.

SWH was the dominant installation technology type for both new and replacement categories until 2020, from which point ASHPs replacing electric water heaters increased noticeably in Victoria. The driver for the sharp increase in uptake of replacement ASHP appears to be the generous financial incentive under the Victorian Energy Upgrade (VEU) scheme. In late 2022 and continuing into 2023, a notable increase in ASHP replacing existing electric water heaters in New South Wales appears to be a response to financial incentives under the NSW Energy Efficiency Scheme (ESS) and higher retail electricity prices. For the period 2024-2028, we assume that installations as a percentage of eligible dwellings is similar to 2023 and that current financial incentives remain at a similar level over the projection period, which results in annual installation growth slowing in 2024-2028 compared to recent history.

Our analysis of payback periods (refer to Appendix) for eligible water heaters indicates a favourable payback period for ASHP compared to SWH from around 2022 due to higher energy efficiency of ASHP and lower installation costs.

Figure ES 3 Historical and projected annual eligible water heater installations by technology – 2016-2028

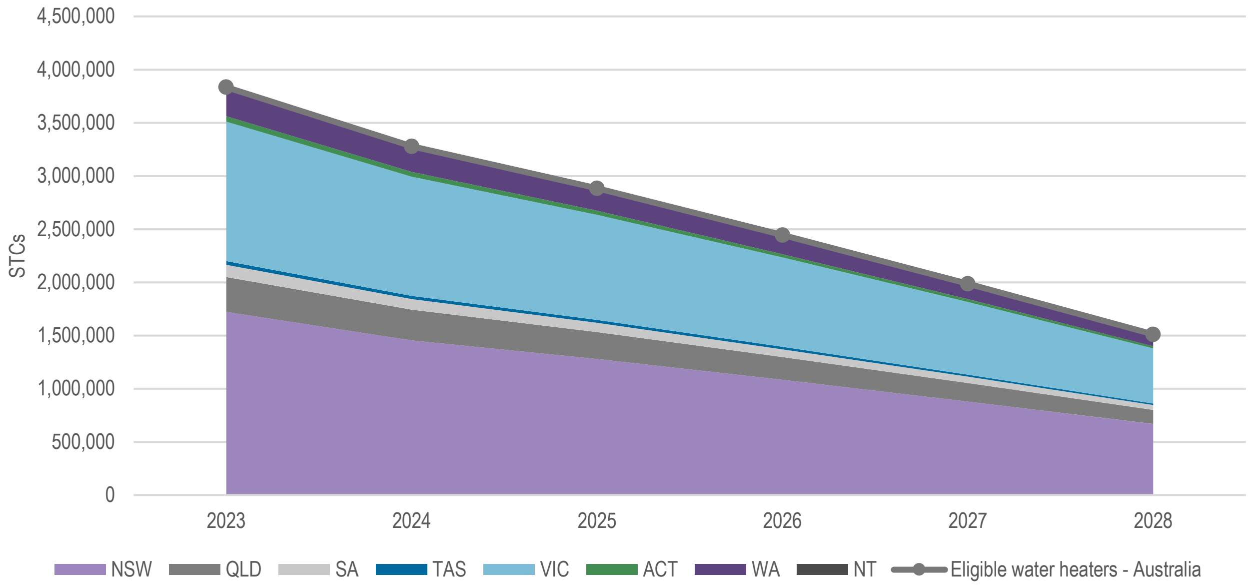


Note: Actual installations up to 31 October 2023; projected thereafter.
Source: ACIL Allen analysis

Figure ES 4 shows projected annual STC creations from eligible water heaters for the compliance years 2023 to 2028.

Projected annual STC creations from eligible water heater installations decrease over the period, due to the impact of the declining deeming periods.

Figure ES 4 Projected annual STCs from eligible water heaters by region – 2023-2028



Note: Actual data up to 31 October 2023; projected thereafter.
Source: ACIL Allen analysis

Total STCs

Table ES 1 shows projected total annual STC creations for the compliance years 2023 to 2028.

Table ES 2 Projected total annual STC creations - 2023 to 2028

	2023	2024	2025	2026	2027	2028
Solar PV	35,727,922	33,550,228	29,208,043	23,669,353	17,956,240	12,708,701
SHW/ASHP	3,834,722	3,278,795	2,884,425	2,445,658	1,988,180	1,511,247
Total STCs	**39,562,645**	**36,829,023**	**32,092,468**	**26,115,012**	**19,944,421**	**14,219,947**

Source: ACIL Allen analysis

Introduction 1

1.1 Background

The Clean Energy Regulator (CER) administers the Small-scale Renewable Energy Scheme (SRES) that creates financial incentives for investment in eligible small-scale renewable energy systems. Eligible small-scale renewable energy systems include solar photovoltaic (solar PV), solar water heater (SWH), air source heat pump (ASHP) and other small generation units (SGUs). SGUs are defined as those systems with capacity of no more than 100kW. The number of small-scale technology certificates (STCs) required to be surrendered by liable entities is set each year by the small-scale technology percentage (STP). In setting the STP, the CER, in the past, has considered inputs from qualified external consultants.

1.2 The brief

The CER has engaged ACIL Allen to undertake projections of:

— the number of small-scale installations (up to 100 kW)

— the capacity of small-scale installations (up to 100 kW)

— small-scale technology certificate (STC) creation.

The projections cover calendar years 2024 to 2028 and the following technology types:

— small-scale solar PV

— solar water heaters (SWHs)

— air source heat pump (ASHPs).

The projections are provided for commercial and residential installations for each state and territory in Australia.

In this report, ACIL Allen provides the assumptions, methodology and results of analysing and projecting the uptake of small-scale technology installations.

Methodology 2

Our approach to modelling the uptake of small-scale technology is outlined in the sections below, by technology type.

2.1 Our approach to modelling STC creation by solar PV

We have used our in-house econometric model of small-scale PV uptake to develop projections of STC creation by each state and territory for calendar years 2024 to 2028 for residential and commercial customers.

The projections of new[3] installations are largely a function of the payback period of installations. The model uses historical data in the period January 2015 to March 2023 and for each state/territory and customer type separately. Although data is available for installations up to end of October 2023, installers have up to 12 months to register an installation with the CER. Our analysis suggests installers typically register an installation within around six months and hence we have omitted installations from April 2023 onwards to avoid partial installation count data.

The model uses a logistic function to determine the probability of a new installation based on statistically significant factors drawn from a suite of potential factors such as payback period, interest rates, etc. For residential installations, these projected probabilities are then applied to remaining eligible dwellings to determine the number of new installations. For commercial installations, the projected probabilities are applied to remaining eligible commercial rooftop space in kW.[4]

For residential installations, the capacity of new residential installations is determined by applying an assumed capacity (kW) per installation to the projected number of installations produced by the model. The assumed capacity per installation in 2024 to 2028 is assumed to grow consistent with recent history with a limit of around 13 kW per installation. For commercial installations, we apply the projected probabilities directly to the available commercial roof space, expressed in kW terms, to find the projected new installations in kW terms.

We use population, residential and non-residential dwelling projections from the ABS. The uptake model also considers the recent demand and supply impacts of COVID-19, heavy rainfall, and flooding in parts of Australia, and supply chain bottlenecks, as well recent changes to interest rates and cost of living. The model also considers technical factors of small-scale solar panels like the impact of degradation on energy output.

[3] We model new installations and then assume a percentage uplift to the projected new installations to account for replacements based on the recent historical uplift.

[4] Eligible commercial roof space is characterized by kW available due to the large range of roof space sizes in this market segment.

Additional key inputs for the model consist of system size, system costs, system performance (output) by region, regional retail electricity prices and avoided retail tariffs, deeming period, regional daily consumption profiles and solar exports, government feed-in-tariffs, upfront subsidies, state and territory schemes, and an assumed lag between the timing of these factors and the decision by a household or business to install a system.

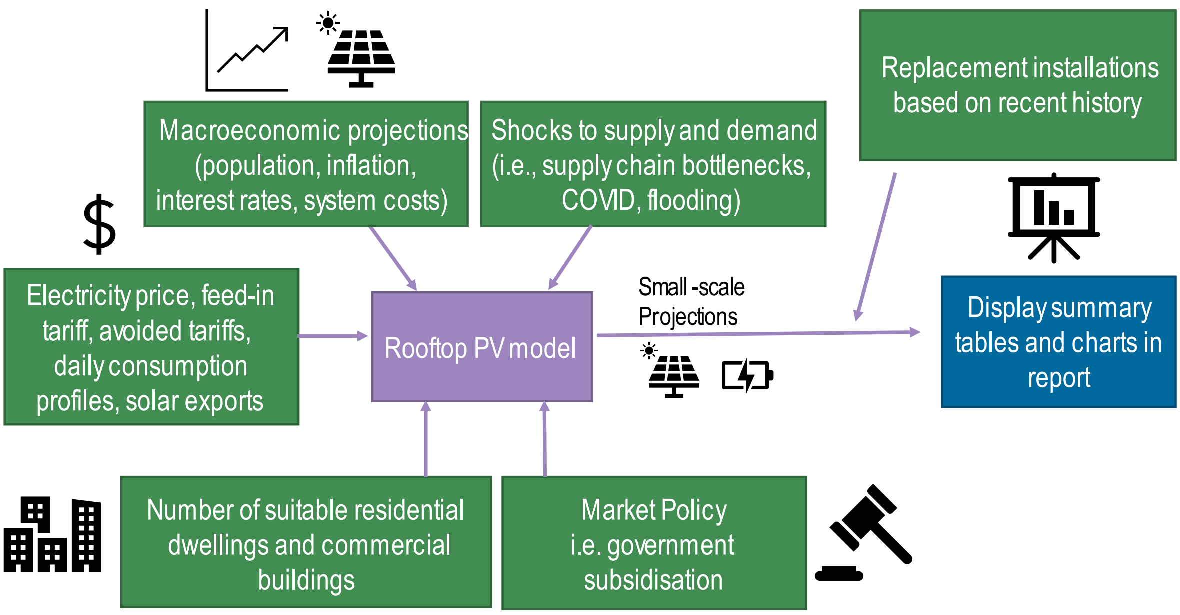
Retail electricity price projections are developed using our in-house retail price model, which includes as inputs, projected wholesale electricity prices from our PowerMark wholesale electricity market simulator which has been developed over the past 30 years in parallel with the development of the NEM and WEM, projected renewable energy policy costs, network costs, retailer operating and prudential costs, and retail margin. ACIL Allen uses its retail model extensively in simulations and sensitivity analyses conducted on behalf of industry and regulator clients. The retail model also considers tariff reform. As well as projected retail prices, two outputs from the retail model are the costs a household or small business avoids if installing rooftop PV, and the solar feed in tariff for surplus energy exported to the grid.

A detailed table of assumptions used in this analysis is presented in Appendix A.

Our small-scale PV uptake model provides projections of the number of installations, system size, their aggregate capacity and output.

Figure 2.1 presents a high-level diagram of the small-scale solar PV uptake model used in this analysis.

Figure 2.1 High-level diagram of small-scale solar PV model inputs and outputs



Source: ACIL Allen

The model translates the projected installations and capacity of small-scale PV systems into projected STC creations by applying a zonal production factor based on the location of the system (accounting for region and solar zone) and an assumed weighting by zone.

Table 2.1 Locational production factors, by state and territory

	Solar Zone 1	Solar Zone 2	Solar Zone 3	Solar Zone 4	Solar output values by state (MWh/kW)
Zone rating (MWh/kW)	1.622	1.536	1.382	1.185	
NSW	0%	2%	97%	1%	1.38
QLD	0%	2%	98%	0%	1.38
SA	0%	1%	99%	0%	1.38
TAS	0%	0%	0%	100%	1.19
VIC	0%	0%	32%	68%	1.25
ACT	0%	0%	100%	0%	1.38
WA	1%	3%	93%	2%	1.39
NT	13%	86%	1%	0%	1.55

Source: ACIL Allen analysis of CER data

The calculation of STC creation considers the declining deeming period, as well as any overhang or creation delays from previous periods, as well as an assumed creation lag based on analysis of recent creation lags (the difference between installation and creation date).

Table 2.2 STC deeming period (years) by year of installation

	2024	2025	2026	2027	2028
Deeming period (years)	7	6	5	4	3

Source: CER

2.1.1 Other SGUs

While STCs can be created by small-scale solar PV, wind or hydro systems, small-scale solar PV systems are historically the dominant technology and expected to remain so.

Other SGUs generating electricity and STCs from wind and hydro comprise only a small proportion of the total number of SGUs. The CER reports that as at 31 July 2023 only 445 installations out of a total of 3,551,111 SGUs were wind and hydro SGUs. In 2023 to date no new wind and hydro generation units have been installed. Given that this category comprises such a small proportion of total SGUs, we have excluded this category from the analysis.

2.2 Our approach to modelling STC creation by water heating systems

Solar water heater (SWH) and air source heat pump (ASHP) systems are generally installed when an existing water heater requires replacement or in conjunction with a new build dwelling.

Therefore, we adopt a simpler modelling approach for projecting eligible water heaters compared to the modelling approach for projecting small-scale solar PV. Our projections of SWH and ASHP are based on two key markets – new installations and replacements.

1. New installation projections of SWH and ASHP are based on the same projections of new residential dwellings and commercial buildings, by region as adopted in the projection of rooftop PV installations.
2. Replacement installation projections of SWH and ASHP are based on the following factors:

a) relative cost of replacement technology (e.g., SHW or ASHP), including the technology being replaced (e.g., gas hot water or less-efficient electric hot water)
b) government incentives/subsidies (e.g., state-based energy efficiency schemes and state-based policies for transitioning away from gas use).

To project the number of eligible water heater installations in new dwellings, we have analysed the percentage of new dwellings in each region where an eligible water heater was installed. Over the period 2024 to 2028, we have assumed the proportion of new dwellings where an eligible water heater was installed remain similar to observations in calendar year 2023 at a regional level. We have used ABS mid case dwelling projections to determine new dwelling growth over the projection period.

To project the number of replacement eligible water heaters, we have analysed the number of replacement installations as a percentage of residential dwellings, which shows an increase in almost all regions over the last 2-3 years. Likely drivers include the introduction of financial incentives under state-based energy efficiency schemes, government incentives to encourage households to replace old gas and electric water heaters, and an increase in retail electricity prices.

We have assumed 2024-2028 annual new dwelling and replacement installations as a proportion of eligible dwellings are similar to the proportion in calendar year 2023 using historical data up to 31 October 2023.[5]

We have assumed no changes to jurisdictional support mechanisms or regulations occur over the projection period.

2.3 Base case

We have modelled a Base case scenario which is consistent with the 2023 ESOO Central scenario narrative – that is, the ISP Step Change scenario.

[5] Eligible hot water installations rose sharply in the period from March 2023 to October 2023. We included all the data to 31 October to capture the impact of the recent increase in installations, which more than offsets any impact from partial installation count data.

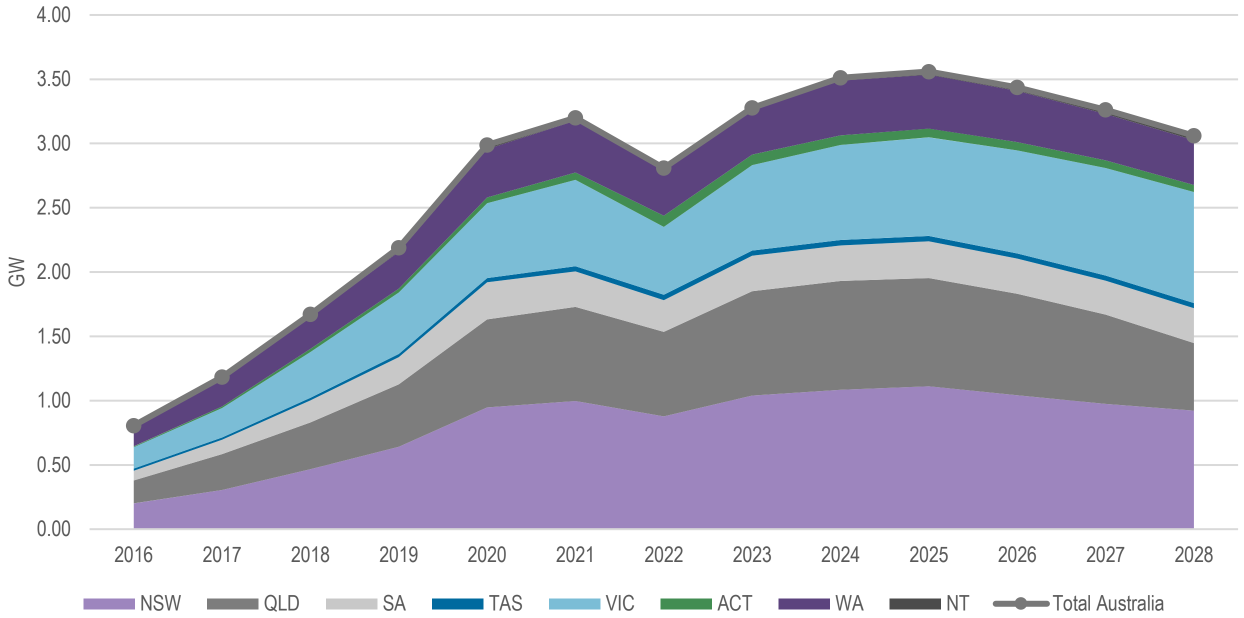
Results 3

This chapter presents historical and projected installations under the SRES scheme.

3.1 STC creation from solar PV SGUs

Figure 3.1 shows historical and projected annual solar PV installations by region. The values are presented on a calendar year basis.

Figure 3.1 Historical and projected annual solar PV installations (GW) by region – 2016-2028



Note: Historical data up to 31 March 2023; projected thereafter. Includes new and replacement installations. Includes residential and commercial installations.
Source: ACIL Allen analysis using CER data

Installations rose strongly during 2016 and 2017 on the back of rapidly falling PV system costs and continued to rise in 2018 and 2019 due to the lagged effect of higher retail prices which occurred after the unexpected closure of Hazelwood in 2016-17.

Despite payback periods rising in 2020 and 2021, installations rose to record levels in 2020 and 2021 due to the impact of COVID related restrictions which increased spending power and saw a widespread transition of centralised to remote working and learning. Installations declined in 2022 due to rising installation costs.

Installations in 2023 and 2024 are projected to increase from 2022 levels due to lower payback periods compared with recent history. Lower payback periods in 2023 and 2024 are driven by higher electricity tariffs, higher solar feed-in-tariffs (FiT) and lower installation costs.

Despite slightly higher projected payback periods in 2025 due to declining retail tariffs, installations in GW terms, are projected to increase in 2025 due to higher average installation size of residential systems, which we assume continues to grow at recent historical rates.

From 2026 to 2028, projected installations decline, particularly in New South Wales and Queensland, due to higher payback periods because of lower projected retail electricity tariffs driven by the implementation of the New South Wales Electricity Infrastructure Roadmap and Queensland Energy and Jobs Plan encouraging a strong rollout in utility scale renewable energy and storage projects reducing wholesale electricity prices across these regions and interconnected regions. In effect, the rollout of the state-based schemes slightly shifts investment in generation from small scale to utility scale. Australia level weighted average payback periods for small-scale solar PV are shown in Appendix A.1.3.

Table 3.1 shows projected annual solar PV installations in GW by region for the period 2023 to 2028.

Table 3.1 Projected annual solar PV installations (GW) by region – 2023-2028

	2023	2024	2025	2026	2027	2028
NSW	1.04	1.08	1.11	1.04	0.97	0.92
QLD	0.81	0.85	0.84	0.79	0.69	0.52
SA	0.27	0.28	0.29	0.27	0.26	0.27
TAS	0.04	0.04	0.04	0.04	0.04	0.04
VIC	0.67	0.74	0.77	0.80	0.84	0.86
ACT	0.08	0.07	0.07	0.06	0.06	0.05
WA	0.35	0.43	0.42	0.40	0.36	0.35
NT	0.02	0.02	0.02	0.03	0.03	0.04
Total Australia	**3.28**	**3.51**	**3.56**	**3.44**	**3.26**	**3.06**

Note: Actual installations up to 31 March 2023; projected thereafter. Includes new and replacement installations. Includes residential and commercial installations.

Source: ACIL Allen analysis

Table 3.2 shows projected number of residential solar PV installations by region for the period 2023 to 2028. We have not projected the number of installations in the commercial market segment, instead our projections of commercial installations are expressed in kW terms and included together with residential installations in Table ES 1. This is because eligible commercial roof space is characterised by kW available, due to the large range of roof size spaces available in this market.

Table 3.2 Projected number of residential solar PV installations by region – 2023-2028

	2023	2024	2025	2026	2027	2028
NSW	100,550	96,597	94,916	84,693	75,726	68,065
QLD	77,564	73,201	66,538	56,001	44,061	31,953
SA	27,050	24,715	23,851	20,848	18,258	17,832
TAS	4,226	3,818	3,801	3,802	3,731	3,637
VIC	69,308	74,297	73,777	73,272	72,785	72,322
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WA	43,939	48,639	46,674	44,914	41,368	38,354
NT	1,474	1,844	2,001	2,216	2,393	2,635
Total Australia	**332,224**	**329,720**	**317,213**	**290,636**	**262,565**	**238,512**

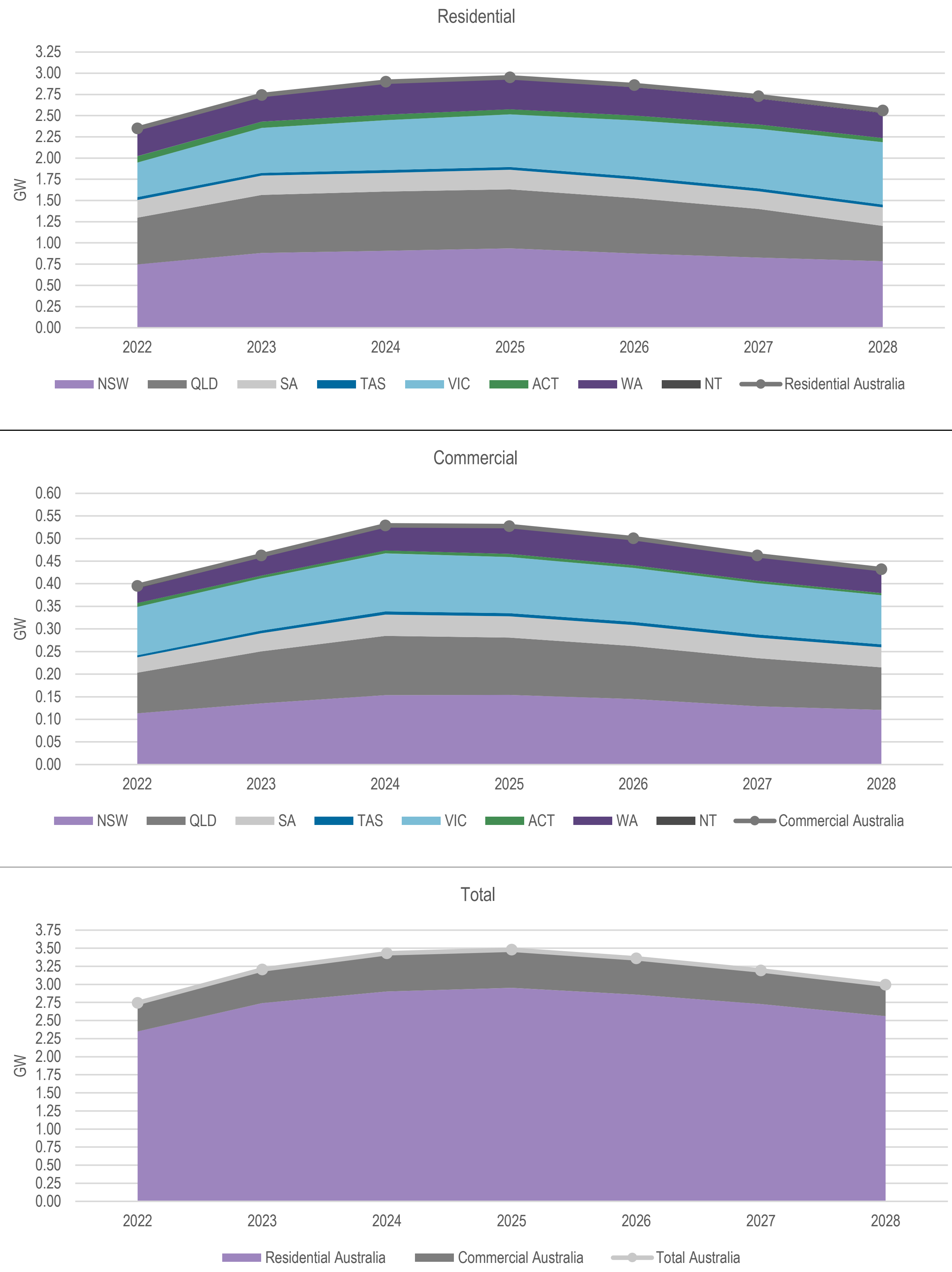
Note: Actual installations up to 31 March 2023; projected thereafter. Includes new and replacement installations.
Source: ACIL Allen analysis

Figure 3.2 shows projected annual solar PV installations in GW by market segment (residential or commercial) and by region.

Residential installations in GW terms are projected to increase in 2023 and 2024 due to lower payback periods and higher average installation size. Installations in GW continue to increase in 2025 but at a slower rate due to higher average installation size, which offsets the impact of higher payback periods in this year. Residential installations are projected to decline in 2026-2028 due to higher payback periods driven by higher electricity retail tariffs.

Commercial installations in GW are projected to increase in 2023-2024 due to lower payback periods. Installations are projected to decline in 2025-2028 due to higher payback periods. This market segment has a higher sensitivity than the residential sector to payback periods. This is likely due to commercial customers being more actively engaged in consideration of future electricity tariffs. Interest rate levels were considered in this analysis but were not a significant driver. Other factors that may drive commercial installations in the future, such as ESG pressures, have been considered but not included in this analysis due to limited or unavailable historical data.

Figure 3.2 Historical and projected annual solar PV installations (GW) – 2023-2028



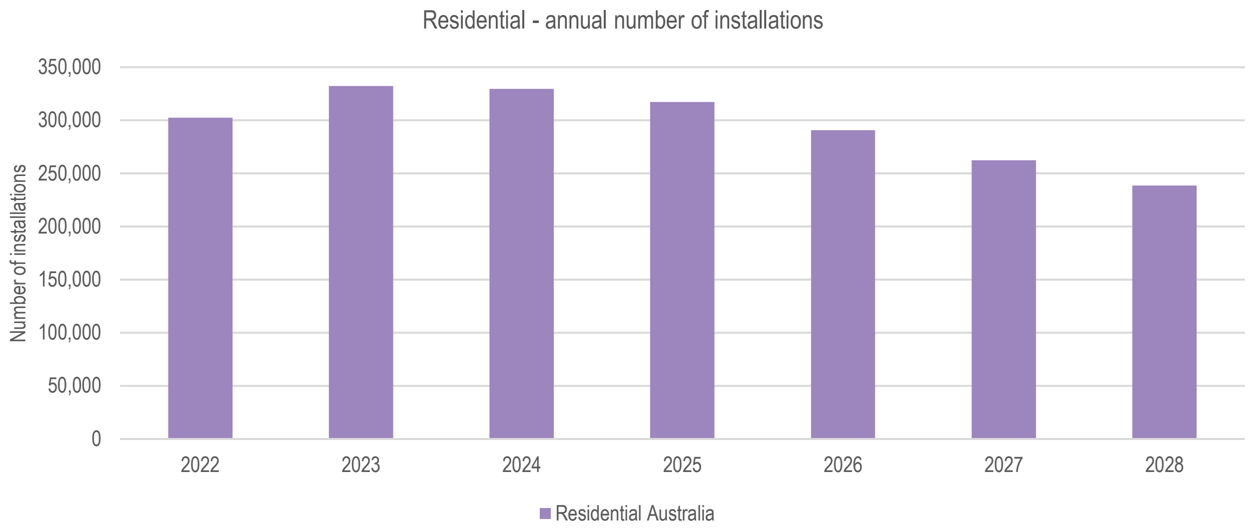
Note: Historical data up to 31 March 2023; projected thereafter. Includes new and replacement installations.
Source: ACIL Allen analysis

Figure 3.3 shows the historical and projected number of installations and the average size of installations for the residential segment.

Projected installations from the model are multiplied by the assumed regional average installation size to arrive at installation capacity in kW terms.

Australia level weighted-average residential installation size is assumed to continue to increase from approximately 8.2 kW in 2023 to 11.1 kW by 2028.

Figure 3.3 Historical and projected number of residential installations (top panel) and average installation size (lower panel) – Australia

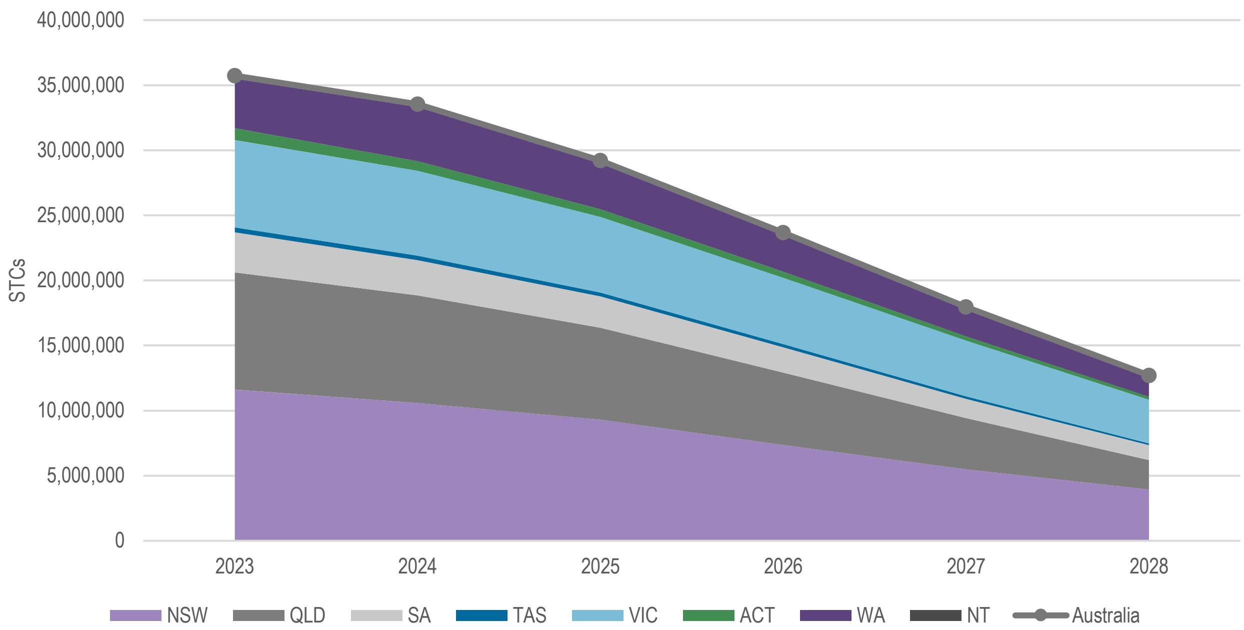


Note: Historical data up to 31 March 2023; projected thereafter. Includes new and replacement installations.
Source: ACIL Allen analysis

Figure 3.4 and Table 3.3 show the projected annual STC creations from solar PV for the 2023 to 2028 compliance years.

Projected STC creations are the product of the projected solar PV system size in kW from Figure 3.1, the postcode zone rating in Table 2.1, and the deeming period in Table 2.2.

Figure 3.4 Projected annual STCs from solar PV by region – 2023-2028



Note: Includes residential and commercial STC creations.
Source: ACIL Allen analysis

Total STC creations from solar PV are projected to decline across the projection period due to the combination of the drivers of declining installations described earlier and the falling deeming period.

Table 3.3 Projected annual STCs from solar PV – 2023-2028

	2023	2024	2025	2026	2027	2028
NSW	11,608,627	10,570,685	9,300,075	7,368,804	5,484,328	3,936,843
QLD	9,007,338	8,283,164	7,071,377	5,542,937	3,941,706	2,254,990
SA	3,081,593	2,697,925	2,397,457	1,940,174	1,476,678	1,151,947
TAS	380,791	340,770	294,553	246,253	194,412	147,341
VIC	6,698,864	6,539,873	5,813,245	5,107,349	4,272,837	3,339,100
ACT	914,969	738,100	583,044	455,796	338,526	234,413
WA	3,808,675	4,140,754	3,516,808	2,789,790	2,050,566	1,479,021
NT	227,066	238,957	231,484	218,250	197,185	165,045
Australia	**35,727,922**	**33,550,228**	**29,208,043**	**23,669,353**	**17,956,240**	**12,708,701**

Note: Includes residential and commercial STC creations.
Source: ACIL Allen analysis

3.2 STC creation from eligible water heaters

Figure 3.5 shows the historical and projected annual eligible water heater installations by installation reason and technology type.

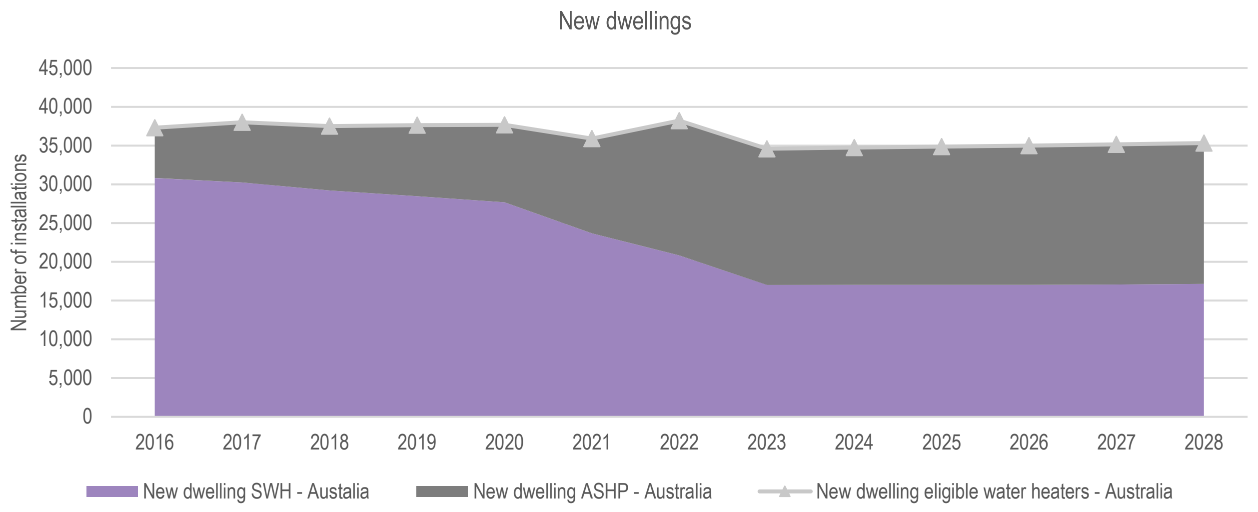
New dwelling installations have historically tracked along at a consistent annual level, with ASHP growing in market share. We project new dwelling installations of eligible water heaters based on recent installation rates as a percentage of new dwellings.

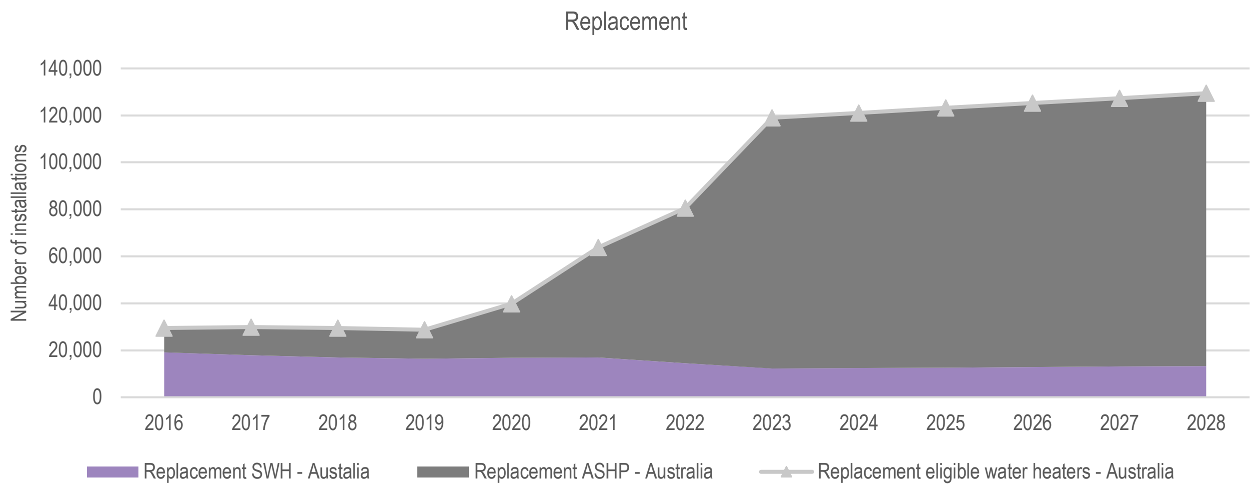
ASHP replacement installations have increased significantly between 2020 and 2023, with the majority of ASHP installations replacing existing electric water heaters. Likely drivers include the introduction of financial incentives under state-based energy efficiency schemes, government incentives to encourage households to replace inefficient water heaters, and an increase in retail electricity prices.

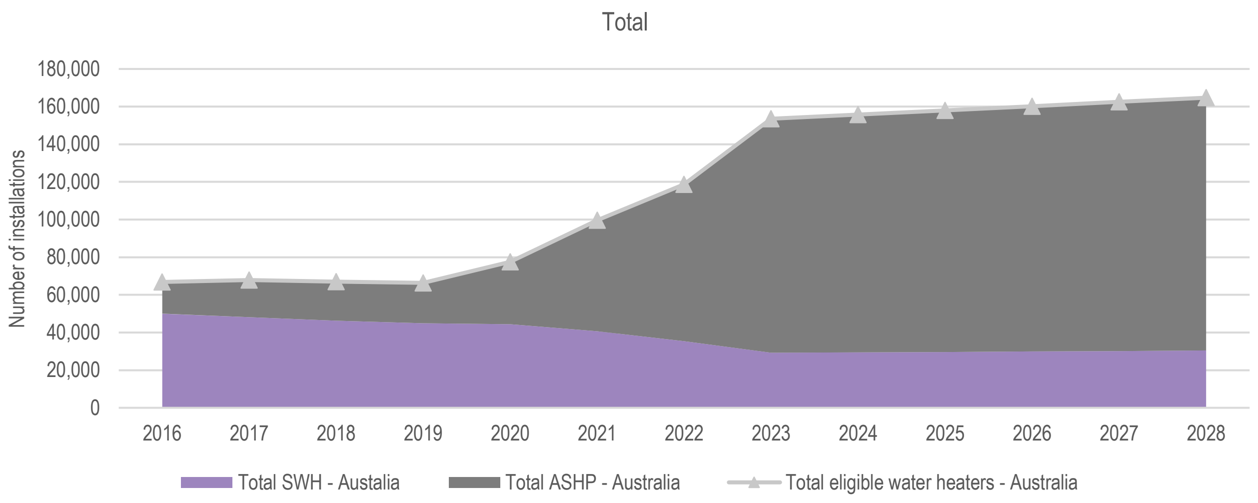
For the period 2024-2028, we assume that installations as a percentage of eligible dwellings is similar to 2023 and that current financial incentives remain at a similar level over the projection period, which results in installation growth slowing in 2024-2028 compared to recent history.

Our analysis of payback periods for eligible water heaters indicates a favourable payback period for ASHP compared to SWH since around 2021, due to higher energy efficiency and lower installation costs (including subsidies), which is why our projections reflect a higher proportion of ASHP installations. This assumes that the government incentives under these schemes remain in place across the projection period. More detailed information on regional subsidies for eligible water heaters are provided in the Appendix.

Figure 3.5 Historical and projected annual eligible water heater installations, by installation reason and technology type – 2016-2028



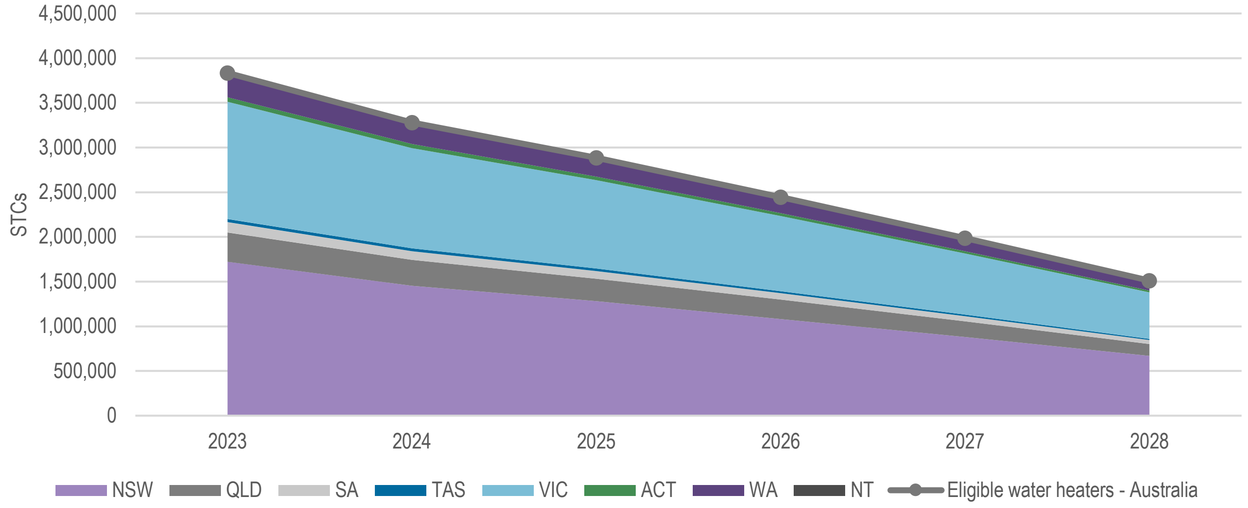




Note: Historical data up to 31 October 2023; projected thereafter.
Source: ACIL Allen analysis using CER data

Figure 3.6 and Table 3.4 show the projected annual STC creations from eligible water heater installations for the 2023 to 2028 compliance years. Projected STCs decline due to the declining deeming period.

Figure 3.6 Projected annual STCs from eligible water heater installations, by region – 2023-2028



Source: ACIL Allen analysis

Table 3.4 Projected annual STCs from eligible water heater installations – 2023-2028

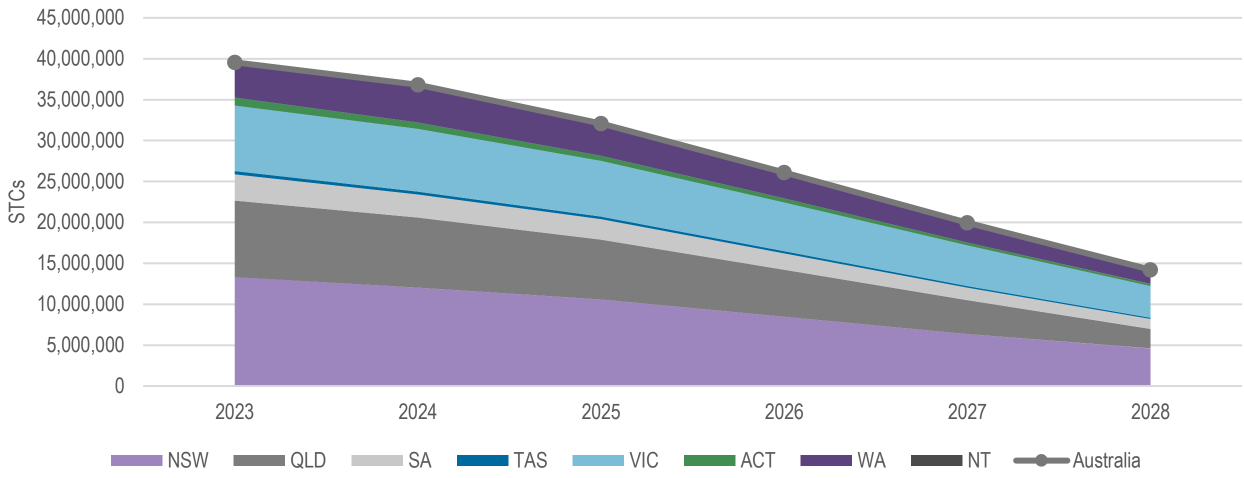
	2023	2024	2025	2026	2027	2028
NSW	1,722,564	1,453,836	1,279,550	1,082,415	878,804	668,804
QLD	326,875	289,849	254,000	216,097	175,537	133,129
SA	114,992	97,793	85,782	72,607	58,846	44,490
TAS	35,464	31,524	27,045	22,719	18,207	13,683
VIC	1,311,964	1,121,289	988,355	838,816	682,918	518,712
ACT	50,581	43,975	38,553	32,757	26,788	20,435
WA	254,993	226,622	198,534	169,373	138,141	105,155
NT	17,290	13,907	12,607	10,874	8,940	6,840
Australia	**3,834,722**	**3,278,795**	**2,884,425**	**2,445,658**	**1,988,180**	**1,511,247**

Source: ACIL Allen analysis

3.3 Total STC creation

Figure 3.7, Table 3.5 and Table 3.6 provide projected total STC creations for the 2023 to 2028 compliance years, which are the sum of projected STCs from solar PV and eligible water heater installations.

Figure 3.7 Total projected annual STCs, by region – 2023-2028



Source: ACIL Allen analysis

Table 3.5 Projected total annual STCs by region – 2023-2028

	2023	2024	2025	2026	2027	2028
NSW	13,331,191	12,024,522	10,579,625	8,451,219	6,363,132	4,605,647
QLD	9,334,213	8,573,013	7,325,377	5,759,034	4,117,242	2,388,119
SA	3,196,585	2,795,719	2,483,240	2,012,782	1,535,525	1,196,437
TAS	416,255	372,294	321,598	268,971	212,619	161,024
VIC	8,010,827	7,661,162	6,801,599	5,946,165	4,955,755	3,857,811
ACT	965,550	782,075	621,597	488,553	365,314	254,848
WA	4,063,668	4,367,376	3,715,342	2,959,163	2,188,707	1,584,176
NT	244,356	252,864	244,091	229,125	206,125	171,885
Australia	**39,562,645**	**36,829,023**	**32,092,468**	**26,115,012**	**19,944,421**	**14,219,947**

Source: ACIL Allen analysis

Table 3.6 Projected total annual STCs, by type – 2023-2028

	2023	2024	2025	2026	2027	2028
Solar PV	35,727,922	33,550,228	29,208,043	23,669,353	17,956,240	12,708,701
SHW/ASHP	3,834,722	3,278,795	2,884,425	2,445,658	1,988,180	1,511,247
Total STCs	**39,562,645**	**36,829,023**	**32,092,468**	**26,115,012**	**19,944,421**	**14,219,947**

Source: ACIL Allen analysis

Appendices

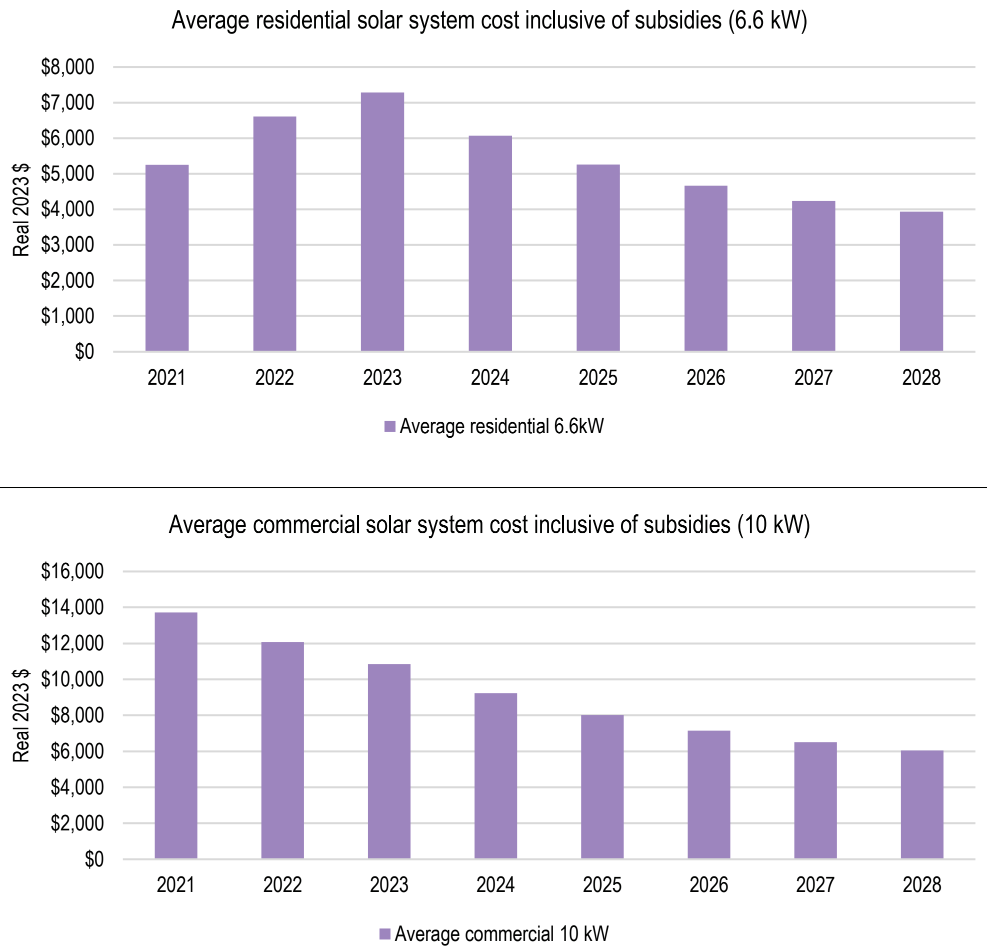
A Assumptions

The key assumptions underpinning the projections are outlined in this Appendix.

A.1.1 Installation costs

Historical solar PV installation costs are sourced from Solar Choice, are inclusive of subsidies, and are used as a starting point for the projections. We assume installation costs experience a decline due to technology improvements, outweighing the decrease in revenue from the declining deeming period.

Figure A.1 Average solar system cost inclusive of subsidies (Real 2023 $)

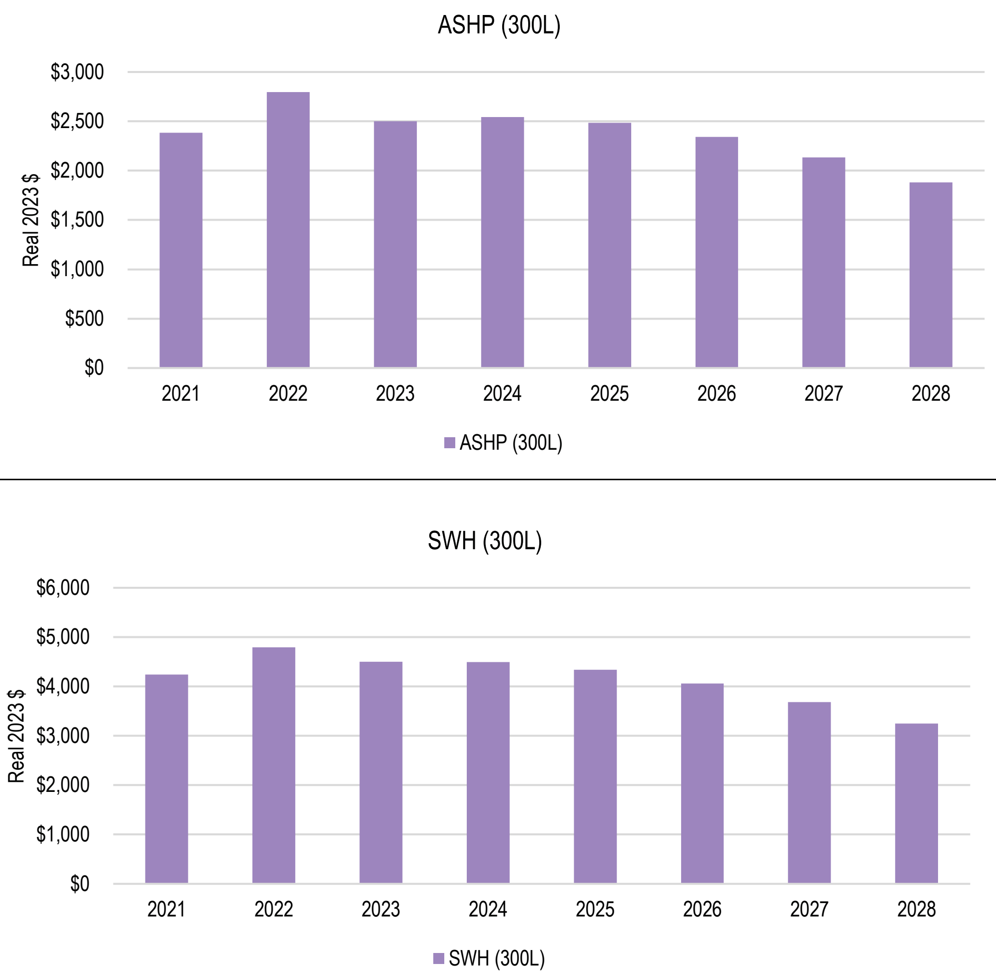


Source: ACIL Allen analysis of Solar Choice data

Figure A.2 shows assumed subsidised installation costs of eligible water heaters. Costs in 2023 are sourced from manufacturer websites, with adjustments made for STC subsidies, state-based subsidies, and the appliance price index (to adjust to pre-2023).

The higher cost in 2022 is because of an increase in the unsubsidised price of systems and a reduction in the STC subsidy due to declining deeming period. The reduction in 2023 is due to several state-based subsidies. The decline in unsubsidised costs in the period 2024 to 2028 outstrips the impact of the declining STC subsidy.

Figure A.2 Average eligible water heater cost inclusive of subsidies (Real 2023 $)



Source: ACIL Allen analysis of Solar Choice data

A.1.2 Electricity prices

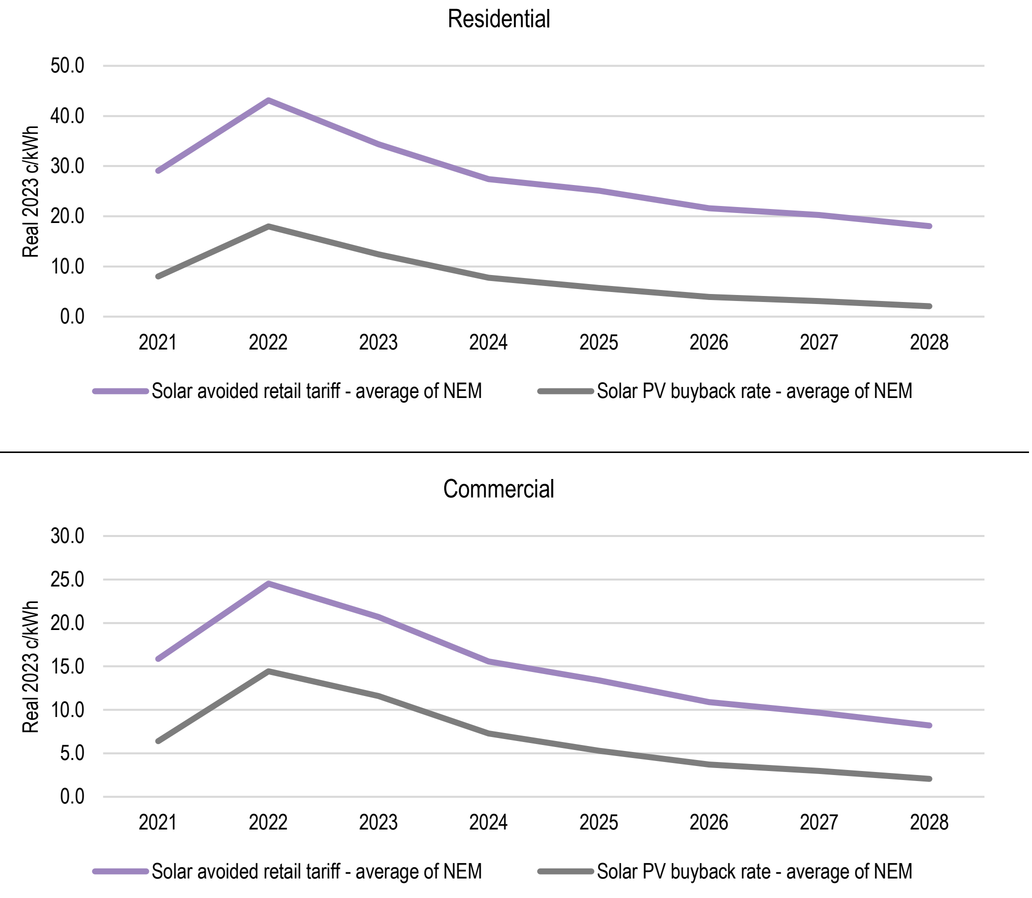
Retail tariffs include wholesale, network, environmental, and retailing costs. Wholesale electricity costs are modelled using our in-house PowerMark market simulator.

Network, environmental and retailing costs are based on data from publicly available sources such as the AER determinations regulator determinations and AEMO.

Projected prices decline over the period because of assumed build out of significant renewable and storage capacity, incentivised by state-based schemes such as the NSW Roadmap and the Queensland Energy and Jobs Plan. Solar avoided tariffs (or retail tariffs) include the variable network component only.

Solar buyback rate (or the solar feed-in tariff) reflects the projected generation-weighted price of solar PV.

Figure A.3 Solar avoided retail tariffs and solar buyback rate in the NEM (real 2023 c/kWh)

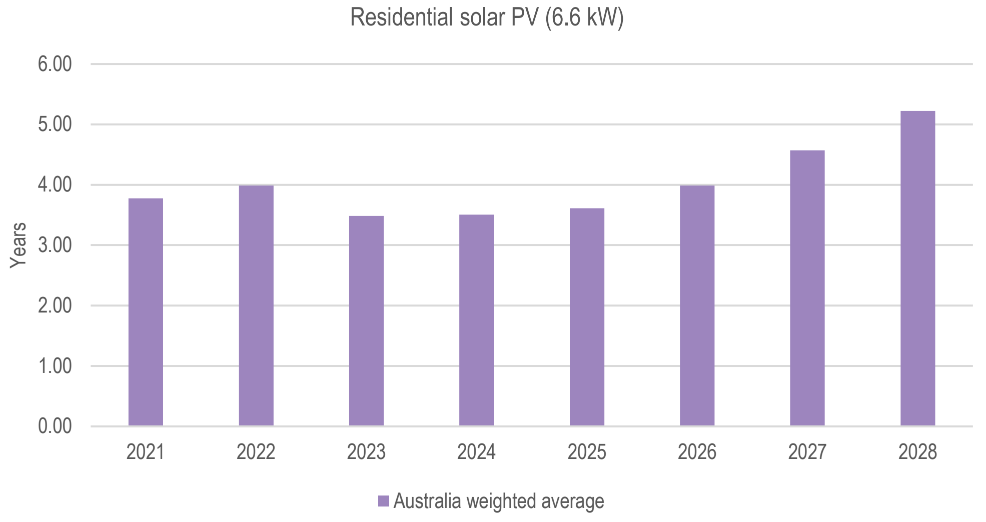


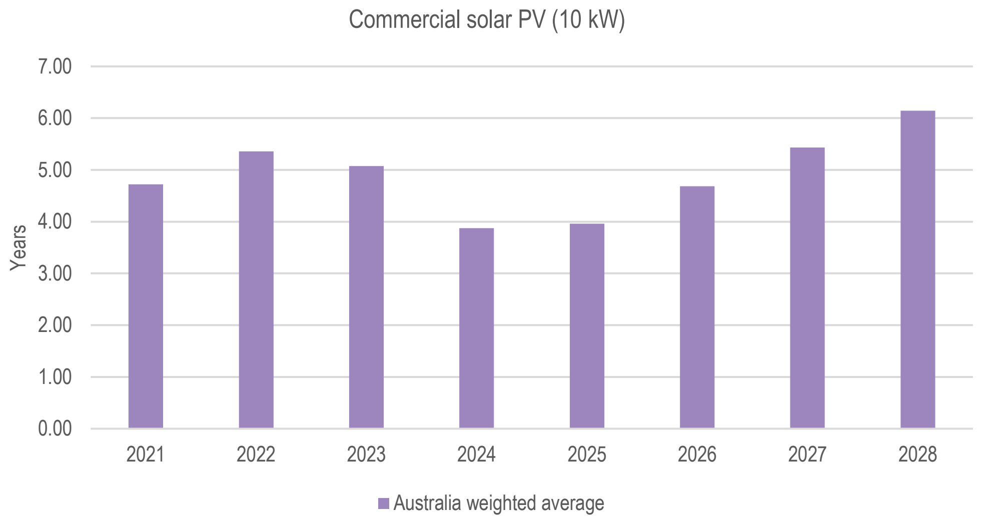
Source: ACIL Allen analysis

A.1.3 Payback periods

Average payback periods for small-scale solar installations (Figure A.4) are a function of the upfront installation cost, and the future value of avoided electricity expenditure and the revenue received from PV exports. The model takes account a lagged impact of electricity prices on installation rates and is already considered in the payback periods shown below. The projected increase in payback periods after 2025 is driven by the projected decline in retail electricity tariffs and solar feed-in-tariffs, which offsets the impact of declining installation costs.

Figure A.4 Average payback periods for solar PV





Source: ACIL Allen analysis

Average payback periods for eligible hot water systems (Figure A.5) are a function of the upfront installation cost, and the future value of avoided electricity expenditure. There is no lag assumption for the impact of electricity prices in the payback periods for eligible hot water systems. This reflects that replacement decisions generally occur soon after the failure of an existing hot water system or are tied to the timing of construction of a new dwelling. From 2022, ASHP payback periods are lower than SWH, which reflects higher energy efficiency and lower installation cost of ASHP.

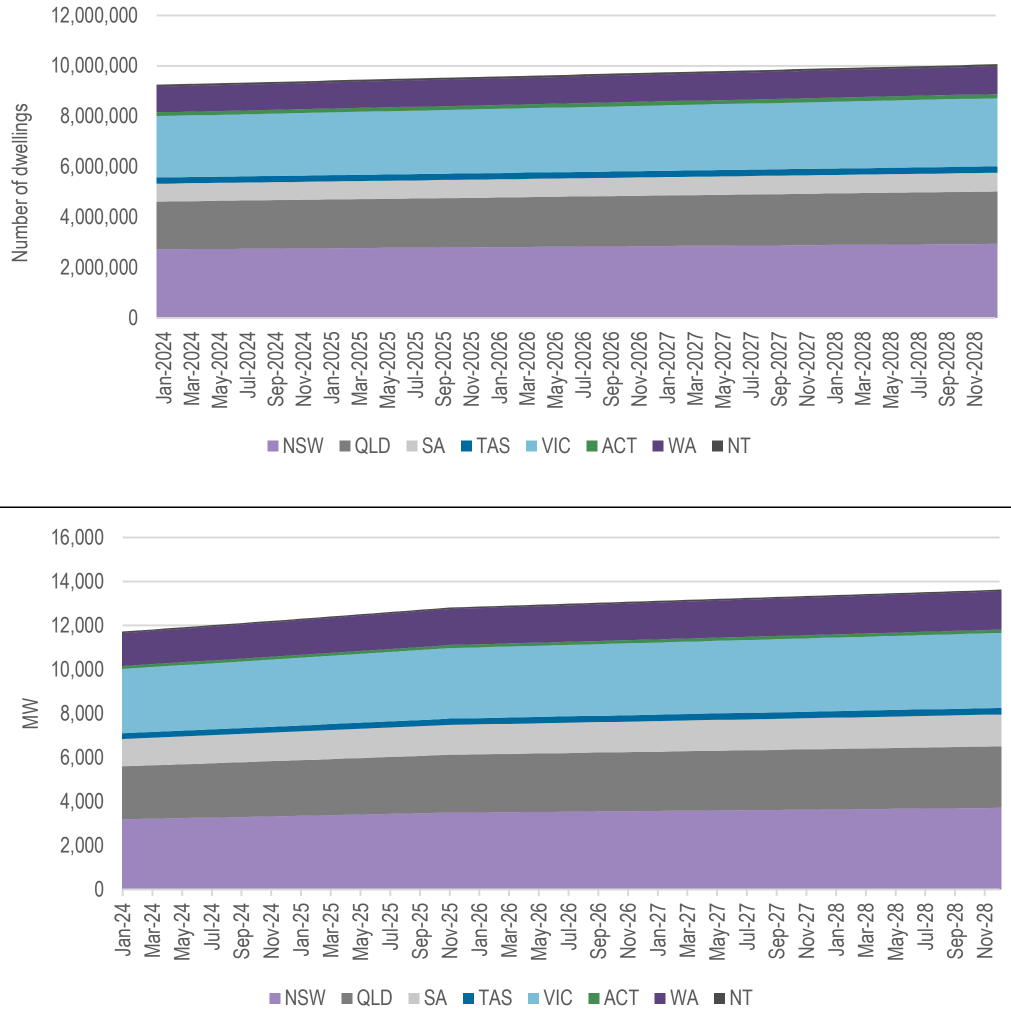
Figure A.5 Average payback periods for eligible water heaters

Source: ACIL Allen analysis

A.1.4 New dwellings and commercial roof space

Figure A.6 shows assumed eligible dwellings (for residential installations) and commercial roof space for (commercial installations). Commercial roof space is characterised in MW terms rather than numbers of buildings because of the large roof size range in this market segment.

Figure A.6 Eligible dwellings projection (top panel) and eligible commercial roof space MW (lower panel)

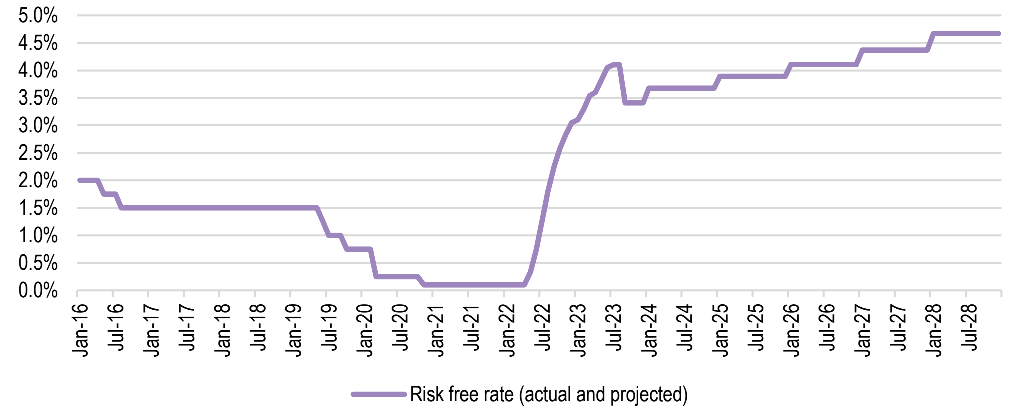


Source: ACIL Allen analysis of ABS and Institute for Sustainable Futures data

A.1.5 Interest rates

ACIL Allen has used 10-year government bond data from the RBA to represent the risk-free rate. We assume projected rates continue at current levels, increasing slightly to converge to a long-term view of 5.5%.

Figure 3.8 Historical and projected risk-free rate



Source: ACIL Allen of RBA data

A.1.6 Government subsidies

Current government rebates and energy efficiency schemes are assumed to remain at similar levels throughout the projection period. Assumed subsidies are detailed in Table A.1.

Table A.1 Government subsidies for ASHP and SWH

States	Rebate programs	SWH or ASHP	Details	Conditions	Residential/ Business	Source
VIC	Solar homes program	Both	Households: 50% on SWH or ASHP or up to $1,000. In combination with rebate on solar panel possible.	The hot water system to be replaced is at least three years old from the date of purchase	Residential and small business	Households: https://www.solar.vic.gov.au/hot-water-rebate
VIC	Victorian Energy Upgrades	Both	Households and business can receive Victorian certificates for energy efficiency upgrades. Households: Replacing electric hot water for heat pump ($1,050) and replacing gas water heater for heat pump or solar hot water ($490) Business: Replacing electric hot water for heat pump or solar hot water ($900) and replacing gas water heater for heat pump ($420)	Replacing an inefficient electric or gas hot water system (Households) replacing an electric or gas hot water system for a more efficient system (Business)	Residential and small business	Households: https://www.energy.vic.gov.au/for-households/victorian-energy-upgrades-for-households/hot-water-systems Business: https://www.energy.vic.gov.au/for-businesses/victorian-energy-upgrades-businesses/hot-water-systems
NSW	Energy Savings Scheme Rebate	Both	Cost of $33 to join the program. This program does not provide a rebate but allows you to benefit from the creation of energy savings certificates. The installer of the hot water heater needs to be an Accredited Certificate Provider and can	Replacement of existing electrical or gas hot water heater to solar water heater or heat pump	Residential and small business	Households https://www.energy.nsw.gov.au/households/rebates-grants-and-schemes/household-energy-saving-upgrades/upgrade-your-hot-water Business

States	Rebate programs	SWH or ASHP	Details	Conditions	Residential/ Business	Source
			create certificates based on the expected reductions.			https://www.energy.nsw.gov.au/business-and-industry/programs-grants-and-schemes/business-equipment/hot-water
QLD	Climate smart energy savers rebate	Both	Standard rebate for ASHP and SWH is $800, low-income rebate is $1,000.	Must replace another appliance	Residential	https://www.qld.gov.au/housing/home-modifications-energy-savings/climate-smart-energy-savers/about
SA	-Retailer Energy Productivity Scheme -Adelaide City	Both	REPS: Amounts vary depending on models ($348 on YESS, $847 on Adelaide heat pumps) Adelaide City: All residential properties can replace a hot water system with a 50% rebate up to $1,000. Commercial replacement of hot water system can receive a rebate of 50% up to $5,000. Adelaide City: For residential tenants and concession card holders, a top up on the REPS from Adelaide city of 25% or up to $500	Replacement existing water heaters. There are no conditions that state that the REPS and Adelaide city rebate can't be used together. Household can only apply to one type of REPS rebate, so if a household has already used it for another energy efficiency system it can't access this. Residents of Adelaide can also apply for the Adelaide City top up.	Residential and small business	https://www.escosa.sa.gov.au/industry/reps/faqs/households-businesses https://www.cityofadelaide.com.au/about-council/grants-sponsorship-incentives/incentives-for-sustainability/#Incentives_5831394
ACT	Energy efficiency improvement scheme Home energy support rebate for concession holders ACT Government's Business Energy and Water Program	Both	The scheme is enacted by different retailers like the Energy-efficient electric water heater upgrade from ActewAGL. ActewAGL provides a rebate of $500 of the purchase price of a new hot water heat pump for ACT Residents (only for ActewAGL customers). Concession holders can also get a 50% rebate up to $2,500 for a hot water heat pump. For business that want to increase energy efficiency by installing a new hot water system, they can get a rebate up to $5,000 on a 50/50 contribution basis.	Only for replacement of gas or electric hot water heater.	Residential	https://www.climatechoices.act.gov.au/policy-programs/energy-efficiency-improvement-scheme https://www.climatechoices.act.gov.au/policy-programs/home-energy-support-rebates-for-homeowners
TAS			No rebates available.			
NT			No rebates available			
WA			No rebates available			

Source: Various government websites

A.1.7 Data sources

Table A.2 summarises the key input assumptions and data sources used in this analysis.

Table A.2 Key assumptions and data sources

Key input assumption	Data source
Population, residential dwelling projections, inflation	ABS 'mid' case projections
Commercial roof space	Institute for Sustainable Futures report on available roof space for solar PV in Australia assessed at: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://apvi.org.au/wp-content/uploads/2019/06/isf-rooftop-solar-potential-report-final_.pdf
Interest rates	RBA
Retail electricity prices	Wholesale energy costs from ACIL Allen Reference case projection, renewable energy costs from the CER, retailing costs from regulatory reports, network costs from regulatory determinations
PV system costs	Historical costs from Solar Choice; projected based on latest ISP Step Change scenario
Hot water system costs and energy efficiency ratings	Current costs from Choice and various hot water system manufacturer websites; projected based on similar decline rate of solar PV system costs.
Historical SRES installations	CER
Deeming periods	CER
Locational production factors	CER
Government incentives/subsidies/schemes	Various State Government and Regulator websites
Uplift factor to account for replacement installations relative to new installations	ACIL Allen analysis of CER data
Lag between installation and STC creation	ACIL Allen analysis of CER data

A.1.8 PowerMark wholesale electricity market modelling assumptions

ACIL Allen maintains a Reference case projection of the National Electricity Market (NEM), which it updates each quarter in response to supply changes announced in the market in terms of new investment, retirements, fuel costs, and plant availability.

Projected electricity prices used in this analysis are based on our September quarter 2023 Reference case projection settings which, in the short term, are closely aligned with AEMO's Integrated System Plan (ISP) and ESOO. Table A.3 summarises the key assumptions adopted in the Reference case that are pertinent to the period to 2028.

Table A.3 Overview of National Electricity Market Reference case assumptions

<table>
<tr><th>Assumptions</th><th colspan="4">Details</th></tr>
<tr><td>Macro-economic variables</td><td colspan="4">– Exchange rate of AUD to USD converging to 0.75 AUD/USD.
– Inflation of 2.5 per cent per annum in the long-run.
– The brent crude oil price is assumed to converge from current levels to USD65/barrel by the mid-2020s.
– International thermal coal prices are assumed to converge from current elevated levels of about USD$150/t to USD$80/t in the mid term.</td></tr>
<tr><td>Electricity demand</td><td colspan="4">The demand forecast used in the wholesale electricity market modelling is based on the AEMO 2022 ISP Strong Electrification scenario for underlying energy and POE50 peak demand. ACIL Allen chooses the Strong Electrification scenario over the Step Change scenario as the basis for the demand projection as the electrification load in the Step Change scenario is insufficient to decarbonise the stationary energy and gas sectors outside of NEM generation.
Projected uptake of rooftop solar PV, home battery systems and electric vehicles are based on outputs from ACIL Allen's modelling.</td></tr>
<tr><td>Federal greenhouse gas emission policies</td><td colspan="4">Economy-wide 43 per cent reduction in GHG emissions below 2005 levels by 2030 and a net zero emissions target by 2050.</td></tr>
<tr><td rowspan="3">State based schemes</td><td>NSW
NSW Roadmap capacity of:
– 12 GW renewables by 2032 within designated Renewable Energy Zone (REZ)
– 2 GW long-duration storage by 2030</td><td>QLD
Powering Queensland Plan:
– CleanCo has been mandated to contract for a total capacity of 1 GW
Queensland Energy and Jobs Plan (QEJP):
– QRET target of 50 per cent renewable energy generation by 2030
–</td><td>TAS
TRET target of 15,750 GWh (150 per cent) of renewable energy by 2030</td><td>VIC
VRET targets of 40 per cent by 2025, 50 per cent by 2030.
Victoria energy storage targets:
– At least 2.6 GW storage capacity by 2030
Offshore wind capacity target:
– 2 GW of offshore wind capacity by 2032</td></tr>
<tr><td colspan="4">SA
The government has indicated a 100 per cent net renewable energy ambition by 2030. The SA government announced its Hydrogen Jobs plan in December 2022. It includes the development of a 250 MW electrolyser, a 200MW hydrogen-fuelled power generator and a hydrogen storage facility by the end of 2025.</td></tr>
<tr><td colspan="4">All NEM states: Economy-wide net zero emissions by 2050; interim targets of 50 per cent reductions by 2030.</td></tr>
</table>

<table>
<tr><th>Assumptions</th><th colspan="3">Details</th></tr>
<tr><td>Electricity supply (beyond new supply driven by state-based schemes)</td>
<td>Committed projects
– Named new entrant projects are included in the modelling where there is a high degree of certainty that these will go ahead (i.e., project has reached financial close)
– Includes the Federal Government's Snowy 2.0 by 2030.</td>
<td>Assumed new entry and closures
– 400 MW of corporate PPAs across New South Wales and Victoria entering from mid-2024 to reflect the continued appetite by larger corporates to demonstrate their green credentials as well as reduce electricity costs ahead of the rollout of the various state-based schemes
– Committed or likely committed generator closures included where the closure has been announced by the participant (Liddell in 2023, Torrens Island B in 2026, Yallourn in 2028, Eraring in 2029, Bayswater and Stanwell in 2033, Tarong and Tarong North in 2034, Loy Yang A and Kogan Creek by 2035).</td>
<td>Projected new entry and closures
– Beyond committed and assumed projects, only commercial generic new entrants are introduced within the modelling.
– Closure of existing generators where the generator is projected to be unprofitable over an extended period of time or the generator's expected closure year as indicated to AEMO – whichever is earlier.</td></tr>
<tr><td>Gas prices into gas-fired power stations</td>
<td colspan="3">– The Eastern Australian gas market is modelled in ACIL Allen's GasMark model.
– Gas prices for CCGTs are assumed to:
  – commence the projection at $14/GJ in 2023
  – gradually decline to about $12/GJ by the mid-2030s
  – However, between 2023 and 2025, gas prices are capped at $12/GJ for existing CCGTs as part of the Government's response to high electricity prices
— Gas prices for OCGTs are assumed to commence the projection at $25/GJ in 2023 and gradually decline to about $18/GJ by the mid-2030s.</td></tr>
<tr><td rowspan="2">Coal prices into coal-fired power stations</td>
<td colspan="3">ACIL Allen's in-house understanding of the cost of thermal coal to the NEM's coal-fired power stations, based on existing contracts with domestic mines and the plant's exposure to the international export market. However, between 2023 and 2027, export coal prices are capped at AUD$125/t as part of the Government's response to high electricity prices.</td></tr>
<tr><td>New South Wales
The delivered marginal coal prices in NSW are assumed to be linked to export parity and therefore follow the assumed movement in export coal prices. However, from FY24 coal prices are capped at AUD$125/t.
Marginal coal prices decline from $8.90 in 2023 to $4.20/GJ by 2025 under the coal price cap.</td>
<td>Queensland
There are four types of coal supply arrangements across the Queensland fleet, with most generator's fuel supply not linked to export pricing.
Marginal coal prices range from $1.10 to $3.70/GJ for the entire projection period.</td>
<td>Victoria
Coal mined for power generation in Victoria is unsuitable for export and hence not affected by fluctuations in export prices.
Marginal coal prices range from $0.28 to $0.78/GJ, representing marginal mining costs.</td></tr>
</table>

Assumptions	Details
Coal & gas price caps	A gas price cap of AUD$12/GJ and a coal price cap of AUD$125/t have been introduced. This Reference case applies the gas and coal price caps starting from 2023. The caps are expected to end when market prices for export coal and gas fall below cap levels. Based on our assumptions, the coal price cap is in place until 2027, whereas the gas price cap is binding until mid-2025.
Interconnectors	**Existing interconnection** Assumed transfer capabilities updated to reflect recent history and known constraints (e.g., related to planned outages as part of upgrade works). **ISP committed and actionable projects included:** – QNI minor (July 2023); QNI connect (Jul 2029) – EnergyConnect (Jul 2026) – Heywood upgrade (Jul 2026) – VNI Minor (Sep 2022) – VNI West (Jul 2031) – Marinus Link (750 MW) (Jul 2030)
Marginal loss factors	ACIL Allen's projections of average annual marginal loss factors (MLF) by generator DUID, developed using commercial power flow software. Our latest calibration with AEMO's forecast has shown over 95 per cent of connection point values deviating by no more than 0.02 from the latest AEMO values for 2023-24.
Constraints	– Thermal constraints which impact renewable energy zones in **Western Victoria, South West New South Wales** and **Central New South Wales** and result in generator curtailment greater than five 5 per cent are included in the Reference case modelling. Stability limit constraints which have a material impact on **QLD-NSW and VIC-NSW** flows and regional prices during peak periods are also included. – Certain constraints are disabled once upgrades are installed. .

[a] ACIL Allen's modelling considers battery storage technologies of varying duration – the eight-hour batteries are the most prevalent duration option in our modelling results.

Note: Unless stated otherwise, all dollar values in this table are presented in real 2023 AUD.

Source: ACIL Allen

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