Technology Collaboration Programme
by IEA

International Energy Agency
Photovoltaic Power Systems Programme

Task 1 Analysis & Outreach

PVPS

National Survey Report of PV Power Applications in Australia

2024

ACAP

ARENA

Australian Government
Australian Renewable Energy Agency

AUSTRALIAN PV INSTITUTE

What is IEA PVPS TCP?

The International Energy Agency (IEA), founded in 1974, is an autonomous body within the framework of the Organization for Economic Cooperation and Development (OECD). The Technology Collaboration Programme (TCP) was created with a belief that the future of energy security and sustainability starts with global collaboration. The programme is made up of 6.000 experts across government, academia, and industry dedicated to advancing common research and the application of specific energy technologies.

The IEA Photovoltaic Power Systems Programme (IEA PVPS) is one of the TCP's within the IEA and was established in 1993. The mission of the programme is to "enhance the international collaborative efforts which facilitate the role of photovoltaic solar energy as a cornerstone in the transition to sustainable energy systems." In order to achieve this, the Programme's participants have undertaken a variety of joint research projects in PV power systems applications. The overall programme is headed by an Executive Committee, comprised of one delegate from each country or organisation member, which designates distinct 'Tasks,' that may be research projects or activity areas.

The 28 IEA PVPS participating countries are Australia, Austria, Belgium, Canada, China, Denmark, Finland, France, Germany, India, Israel, Italy, Japan, Korea, Lithuania, Malaysia, Morocco, the Netherlands, Norway, Portugal, South Africa, Spain, Sweden, Switzerland, Thailand, Turkiye, the United Kingdom and the United States of America. The European Commission, Solar Power Europe and the Solar Energy Research Institute of Singapore are also members.

Visit us at: www.iea-pvps.org

What is IEA PVPS Task 1?

The objective of Task 1 of the IEA Photovoltaic Power Systems Programme is to promote and facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of PV power systems. Task 1 activities support the broader PVPS objectives: to contribute to cost reduction of PV power applications, to increase awareness of the potential and value of PV power systems, to foster the removal of both technical and non-technical barriers and to enhance technology co-operation. An important deliverable of Task 1 is the annual "Trends in photovoltaic applications" report. In parallel, National Survey Reports are produced annually by each Task 1 participant. This document is the country National Survey Report for the year 2024. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

Authors

- **Main Content: RJ Egan**
- **Data:** Australian PV Institute (APVI) R Passey, L Ashby, A Bruce (UNSW)
- **Analysis: RJ Egan**
- **Editor: L Koschier**

SUGGESTED CITATION

Egan R., Koschier L. (2025) National Survey Report of PV Power Applications in Australia 2024. IEA PVPS Task 1. https://iea-pvps.org/national_survey/nsr-australia-2024/

COVER PICTURE

10kW Residential Solar in Regional Australia representing 10kW average rooftop installation size [Source: APVI]

INTERNATIONAL ENERGY AGENCY
PHOTOVOLTAIC POWER SYSTEMS PROGRAMME

National Survey Report of PV Power Applications in Australia 2024

IEA PVPS
Task 1
Strategic PV Analysis and Outreach

November – 2025

DOI: https://doi.org/10.69766/HLWO1975

AUTHORS

Main Authors

Renate Egan, Australian Centre for Advanced Photovoltaics, Australia

Editors

Linda Koschier, University of New South Wales, Australia

TABLE OF CONTENTS

Acknowledgements 5
EXECUTIVE SUMMARY 6
1 Installation Data 11
1.1 Applications for photovoltaics 11
1.2 Total photovoltaic power installed 11
1.3 Key enablers of PV development 14
2 Competitiveness of PV electricity 15
2.1 Module prices 15
2.2 System prices 16
2.3 Cost breakdown of PV installations 18
2.4 Additional Country information 20
3 Policy Framework 21
3.1 National targets for PV 22
3.2 Direct support policies for PV installations 22
3.3 Self-consumption measures 28
3.4 Tenders, auctions & similar schemes 29
3.5 Other measures including, floating and agricultural PV 29
3.6 Indirect Policy Issues 30
3.7 Financing and cost of support measures 33
3.8 Merchant PV – Large scale PV outside of support measure 33
3.9 Grid integration 33
4 Industry 34
4.1 Production of feedstocks, ingots and wafers 35
4.2 Production of photovoltaic cells and modules (including TF and CPV) 35
4.3 Manufacturers and suppliers of other components 36
5 PV In The Economy 38
5.1 Labour places 38
5.2 Research and development 38
6 Interest From Electricity Stakeholders 40
6.1 Structure of the electricity system 40
6.2 Interest from electricity utility businesses 40
6.3 Interest from municipalities and local governments 41
6.4 States and Territories 43

7 Highlights and Prospects 44
7.1 Highlights 44
7.2 Prospects 44

Figure 1 Gold Fields St. Ives Mine, 35 MW solar farm. Source Dr Ukarshaa Varshney (pictured).

ACKNOWLEDGEMENTS

This report is prepared by the Australian PV Institute (APVI) in its role representing Australia on the International Energy Agency (IEA) in the IEA PV Power Systems (PVPS) Technical Collaboration Platform. The APVI is supported in this by ARENA and by its members who are active in the IEA PVPS program of work.

The Institute receives funding from the Australian Renewable Energy Agency (ARENA: www.arena.gov.au) to assist with the costs of IEA PVPS Programme membership, Task activities and preparation of this report.

The IEA programme is headed by an Executive Committee composed of representatives from each participating country or organisation. The Australian Executive Committee member is Olivia Coldrey (APVI) and the ExCo Alternate is Renate Egan (ACAP, UNSW).

Australian participation in the IEA PVPS tasks is managed by the APVI. The management of Tasks (research projects/activity areas) is the responsibility of Operating Agents, with participating countries providing Task Leaders and Experts. In Australia, tasks are represented by Australian Experts including;

- Task 1 Communications. Strategy and Outreach. Australian Experts are Linda Koschier and Renate Egan (UNSW)
- Task 12 Sustainability. Australian Expert is Rong Deng (UNSW)
- Task 13 Performance and Reliability. Australian Expert is David Parveliet (Murdoch University)
- Task 15 Building Integrated PV. Australian Expert is Rebecca Yang (University of Melbourne)
- Task 16 Solar Resource for High Penetration and Large-Scale Applications. Australian Expert is John Boland (University of South Australia)
- Task 17 PV and Transport. Australian Experts are Julie Macdonald (ITPower) and N Ekins-Daukes (UNSW)
- Task 18 Off Grid and Fringe of Grid. Australian Expert is Chris Martell (GSES)
- Task 19 PV Integration in Electricity Markets and Networks. Australian Expert is Iain Macgill (UNSW)
- Task 20 Energy Hubs Australian Expert is Rob Dickinson, University of Adelaide

Information about the active and completed tasks can be found on the IEA-PVPS website.
www.iea-pvps.org

THE AUSTRALIAN PV INSTITUTE (APVI)

The objective of the APVI is to support the increased development and use of PV via research, analysis and information. The APVI provides; up to date information and analysis of PV developments in Australia and around the world, as well as issues arising, a network of PV industry, government and researchers who undertake local and international PV projects, with associated shared knowledge and understanding; Australian input to PV guidelines and standards development; and management of Australian participation in the IEA SHC and PVPS Programme.

More information on the APVI can be found: www.apvi.org.au

EXECUTIVE SUMMARY

The Australian market for grid-connected photovoltaics (PV) saw a recovery in 2024, to a new annual record of 5.3GW. A late surge in utility scale solar completions boosted installs 5mw and over to an annual total of 2GW, bringing volumes back toward the peak levels of 2018-2019. Annual rooftop installations on residential, commercial and industrial roofs remained stable with a total of 3.2 GW. Despite recording a record volume of installations in 2024, Australia did not rank among the world's top ten markets for annual installations. This marks the second consecutive year outside the top ten, a position it had held since the IEA PVPS began tracking market dynamics in the 1990's.

In Australia, rooftop solar continues to see strong demand, distinguishing it from most other nations where the solar market is not dominated by rooftop installations. This demand is significantly bolstered by a successful government incentive that reduces the upfront capital cost. By June 2025, solar power will be used in 44% of Australian free-standing homes.

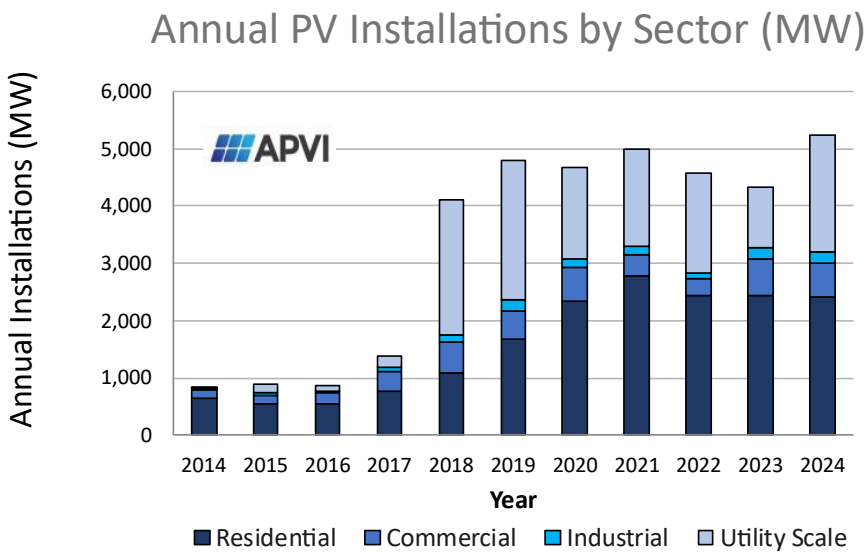

Figure 2 Annual PV installations by sector.

The total installed capacity at the end of 2024 reached 40 GW, maintaining Australia's position in the top 10 for total installed capacity reflecting a world leading installation rate of greater than 1.52kW per capita. With an impressive total 26.1 GW of distributed solar and an additional 13.4 GW total centralized solar, combined with excellent insolation, solar power now meets over 20% of the nation's total electricity demands.

Notably, the average size of residential rooftop installations in Australia is 10kW which has triggered a revision of the residential-commercial split in the data. Previously residential installations were up to 10kW and this number has now been revised upwards to, 15kW. Commercial systems are now classified from 15kW to 100kW.

Historical trends in total installed capacity are shown in Figures 2 and 3, where a few highlights can be seen:

- Over the past decade, from 2014 to 2024, the annual solar installation rate has increased more than five-fold, growing from 1 GW/year to 5.3 GW/year.
- In 2024 alone, Australia installed 5.3 GW of solar, installing more in one year than the cumulative total of all installations up to the end of 2015, which was 5.1 GW.
- With over 40% of free-standing homes now using rooftop solar, declining incentives and curtailment suggest Australia has largely satisfied the early majority for this technology, leading to stabilized installation rates.
- A new incentive, introduced in 2025 for battery installations, is expected to drive significant uptake, in turn complementing a recovery in solar installations.

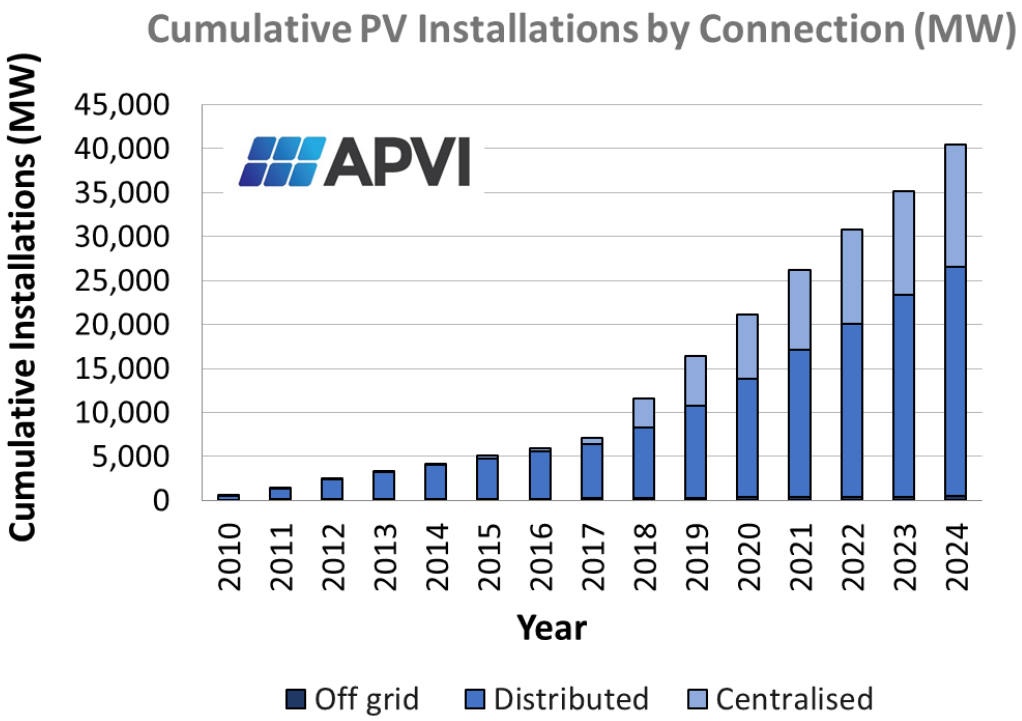

Figure 3 Cumulative Installs in Australia by connection.

The Australian market is very different to most world markets, as it has been historically dominated by rooftop solar rather than utility-scale systems. The demand for rooftop solar has kept Australia in the top ten markets for photovoltaics for total installed capacity for over twenty years, a remarkable outcome for a country with only 25.7 million people.

At the end of 2024,

- The total number of installations in Australia exceed 4 million.
- Over 44% of free-standing households across the nation are now powered with a solar system.
- In Queensland and South Australia, the number of free-standing homes with solar averages close to 50% - with a significant number of localities having densities of rooftop solar over 60%.

The individual state percentages of residential rooftop dwellings are shown in **Figure 4.** With low insolation relative to the rest of Australia (3.7kWhrs per year), Tasmania has only 20% of free-standing homes powered by solar PV.

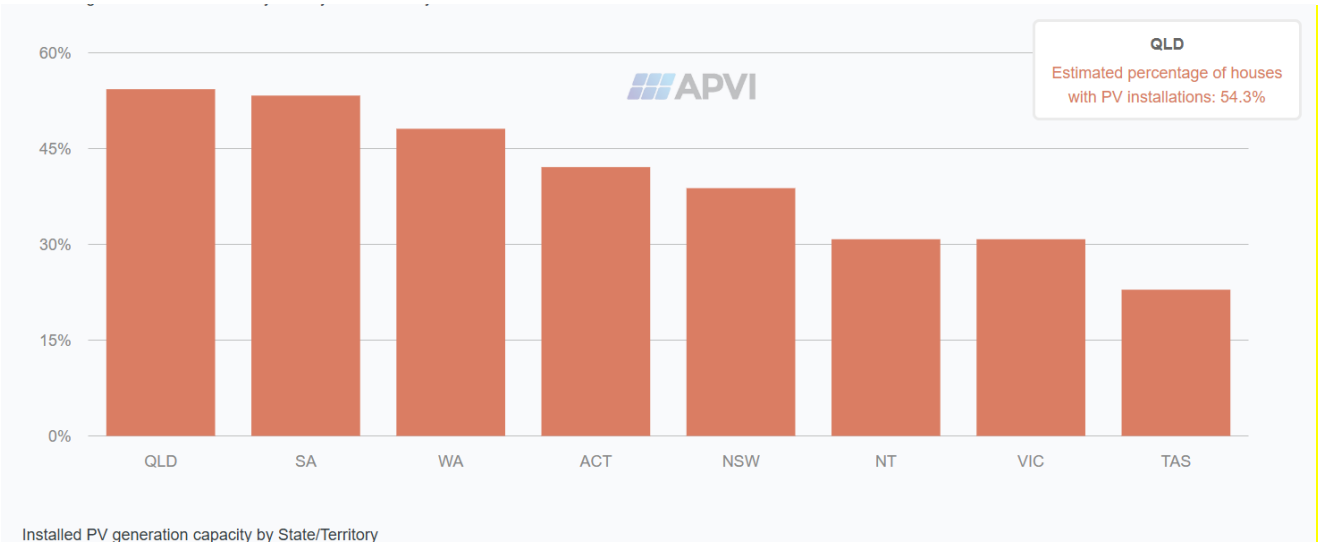

Figure 4 Percentage of residential dwellings with a PV system by state/territory. Screenshot July 2025. Source APVI. https://pv-map.apvi.org.au/historical

The average PV system size has grown steadily in the ten years since 2012, when systems averaged less than 3kW. Since this time, system prices have been dropping. At the same time, electricity prices have been rising. The improved economics has resulted in an increased number of commercial and industrial rooftop systems, and an increase in the average size of residential rooftop systems increasing to close to 10kW.

In 2024, the size of the average rooftop installation (<100kW) grew to nearly 10kW peaking over 10kW in December, up from an average of less than 9kW in 2021 and 2022. .

Driven by advancements in technology and manufacturing, solar prices experienced a sharp decline between 2007 and 2013. While prices continued to fall until 2022, the decrease was less dramatic. In 2023 we saw international manufacturing develop a significant overcapacity, resulting in a return to discounted pricing, which has continued into 2024.

There is significant interest in Australia for very large utility scale solar systems with ambitions of 10 to 30GW of solar for both industrial use and electricity export, with a number of projects in the planning stages.

The Australian Government introduced the Capacity Investment Scheme (CIS), to deliver an additional 32GW of electricity generating capacity by 2030 (updated to 40GW in July 2025) This will support an additional 23 to 26 GW of renewable generation capacity and 9 to 14 GW of clean, dispatchable capacity. The scheme aims to create jobs, reduce pressure on energy bills, lower emissions, and foster social and economic benefits for First Nations people, local communities.
Policy settings continue to pose a challenge, as issues related to connection approvals, congestion management, and fragmented access arrangements increase costs and risks for grid-scale projects.

Australia's long-standing off-grid market continues to be important, particularly in residential applications where solar continues to displace diesel in hybrid power systems and industrial and agricultural applications, including power systems for telecommunications, signalling, water pumping and lighting. In Western Australia and the Northern Territory, microgrids and stand-alone power systems (SPS) are being tested for wider implementation to better serve remote communities by taking advantage of new renewable energy system technologies. These systems make use of solar technology along with energy storage and advanced management systems to provide reliable renewable power generation to isolated and fringe-of-grid communities, particularly those in areas prone to extreme weather events

Figure 5 Image reproduced from June 2024 UTS Report on Powering First Nations Jobs in Clean Energy [www.uts.edu.au/globalassets/sites/default/files/2024-06/LIT0065_FNCE_Report_DIGITAL_FA-compressed.pdf]

Australia's rooftop market is expected to remain strong through to 2030, due to; system prices continuing to fall, the introduction of the 2025 Better Batteries policy, and increasing reliability issues with cold-fired plants that are reaching end of life.

For utility scale solar, there is a firm pipeline of projects, supported by the national capacity investment scheme, along with state-based initiatives (all Australian states now have zero-carbon targets by 2050).

In mid-2022, the Australian Federal government moved to accelerate commitments to net-zero emissions. Policy settings are designed to increase consumer and investor confidence and growth in the solar PV sector. Several large prospective projects, aimed at supporting energy exports and green-minerals processing, could significantly boost the market, with each project potentially adding 4 GW per year if implemented.

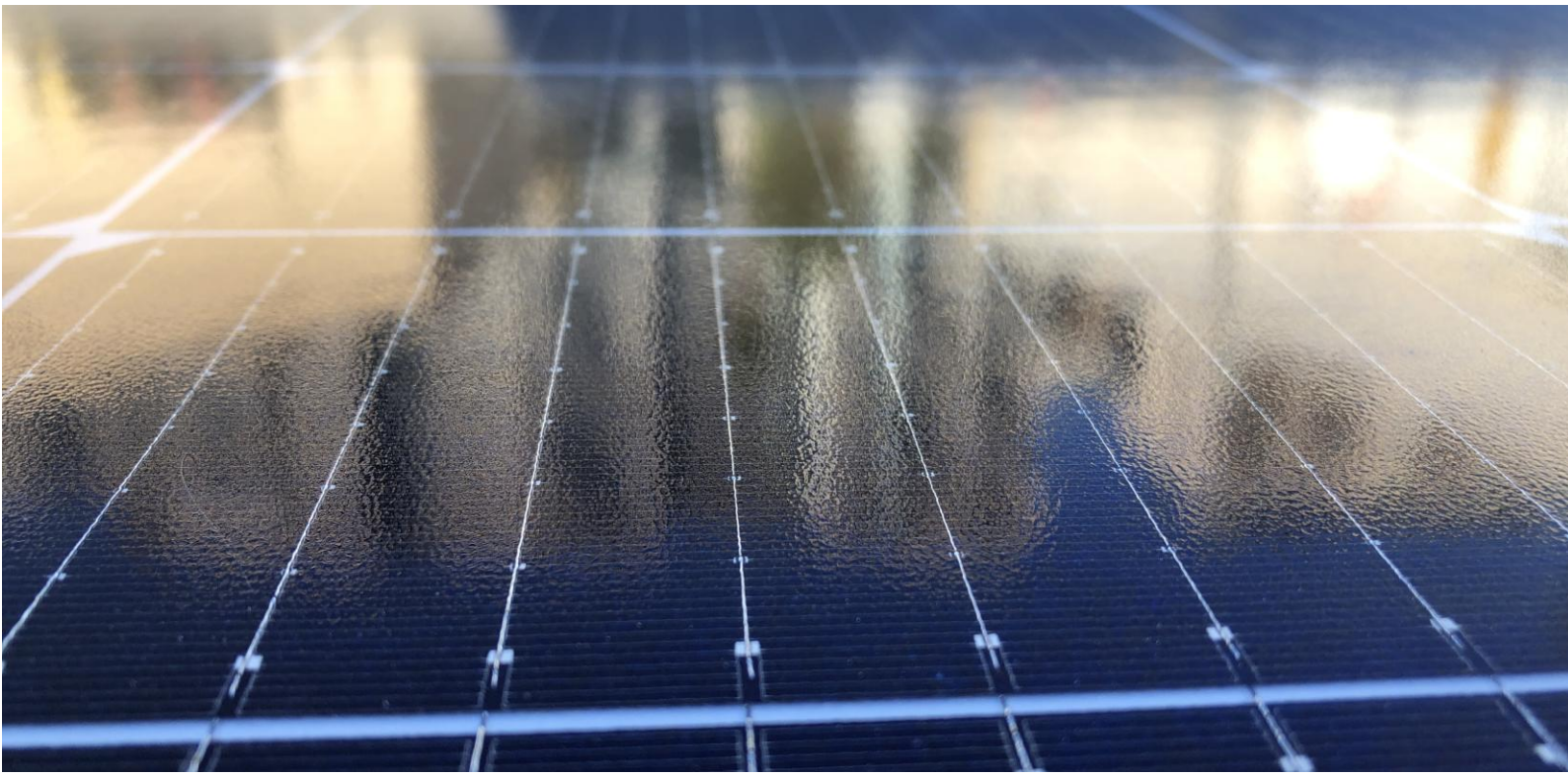

Figure 6 Close up of half-cell module technology

1 INSTALLATION DATA

This report defines the PV power systems market as all terrestrial photovoltaic (PV) applications with a capacity of 40 W or more installed nationwide. A typical PV system includes modules, inverters, batteries, and all necessary installation and control components. Small mobile devices and other applications are not included in this analysis. For this report, PV installations are counted in the 2024 statistics if their PV modules were installed and connected to the grid between January 1 and December 31, 2024, regardless of the commissioning date.

1.1 Applications for photovoltaics

Unlike most other markets, Australian solar installations are dominated by rooftop demand, supported by a successful government incentive that delivers an upfront capital cost reduction running until 2030. Over 40% of Australian free-standing homes are now powered by solar, and an estimated 20% of total electricity demand is currently supplied by solar.

The commercial, industrial rooftop and utility scale market remains strong across the nation.

There are only small activities that target BIPV, floating PV and VIPV, typically only at research or demonstration scale.

AgriPV is however of growing interest, largely involving the grazing of sheep under the array.

In the state of South Australia, with a population of 1.77 million, rooftop solar alone has routinely been sufficient to power the state with excess power from rooftop and large scale being exported to neighbouring states for over the four hours around mid-day (https://reneweconomy.com.au/rooftop-solar-meets-all-local-network-demand-in-south-australia-for-more-than-five-hours/).

1.2 Total photovoltaic power installed

PV connected to the grid in Australia has benefitted from incentives and support from the national government through a Renewable Energy Target (RET). The RET is delivered through the Small-scale Renewable Energy Scheme (SRES) for systems up to 100kW, and Large-Scale Certificates for systems over 100kW. Data is collected by the Federal Governments Clean Energy Regulator.

Small-scale systems create trading certificates (STCs) which are redeemable as an upfront capital subsidy. Large systems produce generation certificates (LGCs) which are redeemable annually based on energy generated. Residential solar is typically considered 0-15kW. This category was revised in 2023 from 0-10kW to 0-15kW as the average small system size grew to over 10kW. Commercial and industrial installations are typically rated at 15-100kW. Above 100kW there is a mix of commercial, industrial, and ground mount up to 5MW; installations above 5MW are usually ground mounted.

Table 1: Annual PV power installed during calendar year.

		Installed PV capacity in 2024 [MW]	AC or DC
	Decentralized	3211	DC
	Centralized	2040	DC
	Off grid	39	DC
	Total	5290	DC

Table 2: PV power installed during calendar year.

			Installed PV capacity [MW]	Installed PV capacity [MW]	AC or DC
Grid-connected	BAPV	Residential	3210		DC
		Commercial			DC
		Industrial			DC
	BIPV	Residential			
		Commercial			
		Industrial			
	Utility-scale	Ground-mounted	2040	2040	DC
		Floating			
		Agricultural			
Off-grid		Residential	40		DC
		Other			
		Hybrid systems			
Total			5290		DC

Table 3: Data collection process

If data are reported in AC, please mention a conversion coefficient to estimate DC installations.	
Is the collection process done by an official body or a private company/Association?	Official

Link to official statistics (if this exists)	Large Scale: https://cer.gov.au/markets/reports-and-data/large-scale-renewable-energy-data Small Scale: https://cer.gov.au/markets/reports-and-data/small-scale-installation-postcode-data

Table 4: The cumulative installed PV power in sub-markets

Year	Off grid [MW] (including large hybrids)	Grid-connected distributed [MW] (BAPV, BIPV)	Grid-connected centralized [MW] (Ground, floating, agricultural…)	Total [MW]
2015	173	4 776	199	5 109
2016	210	5 522	290	5 985
2017	247	6 726	492	7 132
2018	284	8 465	2 851	11 586
2019	317	10 832	5 279	16 414
2020	343	13 911	6 873	21 115
2021	375	16 854	8 553	26 152
2022	409	19 695	10 299	30 772
2023	446	22 958	11 376	35 148
2024	485	26 169	13 416	40 438

Small changes have been made to historical values reflecting changes in the source data. Installs can be reported as much as a year later.

Table 5: Other PV market information

		2024
Number of PV systems in operation in your country	Residential	4 041 489
	Commercial	
	Industrial	
	Utility-scale	
	Off-grid	
Decommissioned PV systems during the year [MW]*		Unknown
Repowered PV systems during the year [MW]		Unknown

Table 6: PV power and the broader national energy market

	2023	2024
Total power generation capacities [TWhrs]	273.3	274
Estimated total PV electricity production (including self-consumed PV electricity) in [TWh]		56.1

1.3 Key enablers of PV development

Table 7: Information on key enablers.

	Description	Annual Volume	Total Volume	
Decentralized storage systems	Grid connected batteries registered	31,120 residential units, averaging around 7kWh	124,425 residential units, averaging around 7kWh	CER data for count https://cer.gov.au/markets/reports-and-data/small-scale-installation-postcode-data
Residential Heat Pumps [#]		135,631	1,822,504	https://cer.gov.au/markets/reports-and-data/small-scale-installation-postcode-data
Electric cars [#]		98 436	180 000	https://electricvehiclecouncil.com.au/
Electric buses and trucks [#]				
Other (up to you)				

2 COMPETITIVENESS OF PV ELECTRICITY

2.1 Module prices

Table 8: Typical module prices

Year	Lowest price of a standard module crystalline silicon	Highest price of a standard module crystalline silicon	Typical price of a standard module crystalline silicon
	[$ /W]	[$ /W]	[$ /W]
2006	7.5		8.5
2008	5		8
2010	2		3.2
2012	0.9		1.5
2014	0.62		0.8
2015	0.62		0.8
2017	0.53	1.35	0.67
2018	0.35	1.15	0.55
2019	0.35	1.15	0.52
2020	0.3	1.15	0.47
2021	0.3	1.15	0.55
2022	0.35	1.3	0.57
2023	0.25	0.9	0.30
2024	0.15	0.9	0.20

Average price, inferred from system prices.

- The minimum price that has been achieved in 2024 was from imported panels.
- Module prices declined over 2023-2024 to record lows as the industry moved into overcapacity, after supply chain challenges and increased shipping costs in 2021 and 2022.

2.2 System prices

Table 9: Turnkey PV system prices of different typical PV systems

Category/Size	Typical applications and brief details	Current prices [$ /W]
Off-grid 1-5 kW	A stand-alone PV system is a system that is installed to generate electricity to a device or a household that is not connected to the public grid.	NA
Residential BAPV 5-10 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected households. Typically roof-mounted systems on villas and single-family homes	1.20
Residential BIPV 5-10 kW	Grid-connected, building integrated, distributed PV systems installed to produce electricity to grid-connected households. Typically, on villas and single-family homes.	NA
Small commercial BAPV 10-100 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	1.20
Small commercial BIPV 10-100 kW	Grid-connected, building integrated, distributed PV systems installed to produce electricity to grid-connected commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	NA
Large commercial BAPV 100-250 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected large commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	1.20
Large commercial BIPV 100-250 kW	Grid-connected, building integrated, distributed PV systems installed to produce electricity to grid-connected commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	NA
Industrial BAPV >250 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected industrial buildings, warehouses, etc.	1.20
Small centralized PV 1-20 MW	Grid-connected, ground-mounted, centralized PV systems that work as central power station. The electricity generated in this type of facility is not tied to a specific customer and the purpose is to produce electricity for sale	1.20
Large centralized PV >20 MW	Grid-connected, ground-mounted, centralized PV systems that work as central power station. The electricity generated in this type of facility is not tied to a specific customer and the purpose is to produce electricity for sale.	1.20

The figures reported in the table above are an average price for a rooftops installation of 9kW excluding subsidies which reduce the system cost by a further 40c/W (on average), depending on insolation.

Residential and commercial prices are based upon a dataset provided by PV lead generator Solar Choice. Small-scale systems are eligible for an up-front subsidy that is excluded in the table below. Prices quoted are also exclusive of sales tax (GST).

Pricing is all inclusive for rooftop solar mounts including installation, connection, and registration.

Table 10: National trends in system prices for different applications

Year	Residential BAPV (Grid connected, roof-mounted, distributed PV systems 5-10 kW [$/kW]	Small commercial BAPV (Grid connected, roof-mounted, distributed PV systems 10-100 kW [$/kW]	Large commercial BAPV (Grid connected, roof-mounted, distributed PV systems 100-250 kW [$/kW]
2006	12.5		
2007	12		
2008	12		
2009	9		
2010	6		
2011	3.9		
2012	3		
2013	3.1		
2014	2.77	2.68	
2015	2.45	2.07	
2016	2.42	2.08	
2017	2.22	2.01	
2018	1.72	1.77	1.77
2019	1.6	1.58	1.44
2020	1.52	1.58	1.44
2021	1.55	1.6	1.6
2022	1.5	1.55	1.55
2023	1.35	1.30	1.35
2024	1.20	1.20	1.20

2.3 Cost breakdown of PV installations

The cost breakdown of a typical (5-15 kW) roof-mounted, grid-connected, distributed PV system on a residential single-family house and a typical (>10 MW) Grid-connected, ground-mounted, centralized PV systems is presented in Table 11 and Table 12, respectively.

The cost structure presented is from the customer's point of view, i.e. it does not reflect the installer companies' overall costs and revenues. The “average” category in Table 11 and Table 12 represents the average cost for each cost category and is the average of the typical cost structure. The average cost is taking the whole system into account and summarizes the average end price to customer. The “low” and “high” categories are the lowest and highest cost that has been reported within each segment. These costs are individual posts, i.e. summarizing these costs do not give an accurate system price.

Table 11: Cost breakdown for a grid-connected roof-mounted, distributed residential PV system of 5-15 kW

Cost category	Average [$/ W]	Low [$ /W]	High [$ /W]
Hardware			
Module	0.25	0.2	
Inverter	0.2		
Mounting material	0.21		
Other electronics (cables, etc.)			
Subtotal Hardware	0.66		
Soft costs			
Planning	0.55		
Installation work			
Shipping and travel expenses to customer			
Permits and commissioning (i.e., cost for electrician, etc.)			
Project margin			
Subtotal Soft costs	0.55		
Total (excluding VAT)	1.21		
Average VAT			
Total (including VAT)	1.21		

Table 12: Cost breakdown for a grid-connected, ground-mounted, centralized PV systems of >10 MW

Insufficient public data is available for grid-connected, ground-mounted PV systems as these are commercial installations.

Figure 7 Commercial and industrial rooftops present a significant growth opportunity.

2.4 Additional Country information

Table 13: Country information

Retail electricity prices for a household [$/W]	AUD 0.25-0.80 $/kWh
Retail electricity prices for a commercial company [$/W]	AUD 0.24-0.65 $/kWh
Retail electricity prices for an industrial company [$/W]	AUD 0.24-0.65 $/kWh
Population at the end of 2023	25,750,198
Country size [km²]	7.69m
Average PV yield in [kWh/kW] and range	1400
PV yield value information	generalised average as conditions vary significantly across Australia

Figure 8 Large Scale Solar, waiting for sunrise.

3 POLICY FRAMEWORK

This chapter examines the support policies, both direct and indirect, that aim to foster PV development. Direct support policies directly influence PV growth through incentives, simplification, or the establishment of appropriate regulations. Conversely, indirect support policies create a regulatory environment that encourages PV expansion.

Table 14: Summary of PV support measures

Category	Residential		Commercial + Industrial		Centralized	
Measures	**On-going**	**New**	**On-going**	**New**	**On-going**	**New**
Feed-in tariffs	yes					
Feed-in premium (above market price)						
Capital subsidies	yes		yes			
Green certificates			yes		yes	
Renewable portfolio standards (RPS) with/without PV requirements						
Income tax credits						
Self-consumption	yes		yes			
Net-metering						
Net-billing						
Collective self-consumption and virtual net-metering						
Commercial bank activities e.g. green mortgages promoting PV	yes		yes			
Activities of electricity utility businesses	yes		yes			
Sustainable building requirements			yes			
BIPV incentives						
Merchant PV/PPA facilitating measures						yes
Other (specify)						

3.1 National targets for PV

The Renewable Energy Target (RET) is designed to reduce emissions of greenhouse gases in the electricity sector and encourage the additional generation of electricity from sustainable and renewable sources.

The Renewable Energy Target (RET) comprises two components: the Large-scale Renewable Energy Target (LRET), which achieved its 33,000 GWh goal by 2020, and the Small-scale Renewable Energy Scheme (SRES). The SRES has no fixed target and offers an upfront capital cost reduction for systems under 100 kW. This reduction is based on the energy generated and gradually decreases until 2030. Further details are provided below.

3.2 Direct support policies for PV installations

3.2.1 The Renewable Energy Target

3.2.1.1 The Renewable Energy Target

The Renewable Energy Target works by allowing large-scale power stations and the owners of small-scale systems to create large-scale generation certificates and small-scale technology certificates respectively for every megawatt hour of power they generate. Certificates are then purchased by electricity retailers (who supply electricity to householders and businesses) and submitted to the Clean Energy Regulator to meet the retailers' legal obligations under the Renewable Energy Target. This creates a market which provides financial incentives to both large-scale renewable energy power stations and the owners of small-scale renewable energy systems.

The RET is funded by a cross-subsidy, leveraged upon all electricity consumption except for certain classes of industrial electricity consumers. (such as emissions intensive trade-exposed industries)

3.2.1.2 Small-scale Renewable Energy Scheme (SRES)

The SRES covers small generation units (small-scale solar photovoltaic, small wind turbines and micro hydroelectric systems) and solar water heaters, including heat pumps, which can create small-scale technology certificates (STCs).

There is no cap on the number of STCs that can be created, but the scheme has a completion date of 2030. Deeming arrangements meant that PV systems up to 100 kW could claim 15 years' worth of STCs up front to 2015 (based on expected output at the system location). Since 2015, new solar installations receive one year less deeming each year, until the RET completion date of 2030.

Small-scale technology certificates can be created following the installation of an eligible system and are calculated based on the amount of electricity a system produces or replaces (that is, electricity from non-renewable sources). Generally, householders who purchase these systems assign the right to create their certificates to an agent in return for a lower purchase price. The level of this benefit differs across the country depending on the level of solar energy.

The Clean Energy Regulator (CER) manages transfer of STCs through a voluntary 'clearing house' and liable entities are required to surrender STCs to the CER four times a year. The dollar value of these STCs is discounted from the upfront cost of the installation. With support from the SRES, and the declining cost of PV systems, both the volume of new small-scale installs and the average system size has grown year on year.

3.2.1.3 Large-scale Renewable Energy Target (LRET)

The LRET, covering large-scale renewable energy projects like wind farms, commercial-scale solar and bioenergy includes legislated annual targets and had an initial target of 41 000 GWh, and was reduced in 2015 to 33 000GWhr. This target was achieved in late 2019, ahead of the targeted 2020 date. Liable entities meet their obligations by acquiring and surrendering Large-scale Generation Certificates (LGCs), with 1 LGC created for each MWh of renewable electricity.

3.2.2 National government agencies

3.2.2.1 National government agencies

The Australian Renewable Energy Agency (ARENA), Clean Energy Finance Corporation (CEFC), and Clean Energy Innovation Fund (CEIF) continued to operate to support the deployment of renewable and clean energy technologies.

The Australian Renewable Energy Agency (ARENA) is an Australian Government statutory agency, established in 2012 by the Australian Renewable Energy Agency Act 2011 (ARENA Act). ARENA supports the global transition to net zero emissions by accelerating the pace of pre-commercial innovation, to the benefit of Australian consumers, businesses and workers. ARENA supports renewable energy technologies to become commercially viable by investing in innovation and knowledge. It invests throughout the innovation chain, balancing investment in emerging commercial technologies with earlier-stage research, development and demonstrations to address long-term needs.

ARENA has been directly responsible for many renewable energy success stories including:

- world-leading solar photovoltaic (PV) research, through ongoing funding of the Australian Centre for Advanced Photovoltaics (ACAP), including, in 2022 announcing a renewed commitment to support research out to 2030, and a suite of commercially driven research projects valued at AUD 40m, with a focus on driving cost reductions through world-leading solar PV research into both high efficiency solar cells and low-cost deployment.
- support for innovation, trials and pilots in demand response, virtual power plants and energy engagement to help pave the way for a better understanding of consumer behaviour and identify opportunities to reduce consumer costs.
- co-investment in large-scale solar and batteries to de-risk large projects, to enhance the reliability of supply and to provide support for power system security as Australia transitions to a low emissions energy future.

3.2.2.2 Clean Energy Finance Corporation (CEFC)

The Clean Energy Finance Corporation (CEFC) is a Commonwealth Government initiative with a clear mission to accelerate investment in Australia's transition to net zero emissions. The CEFC invests to lead the market, operating with commercial rigour to address some of Australia's toughest emissions challenges.

With the increase in experience and competitive pricing for utility scale solar, CEFC investment is shifting away from solar to enabling technology, including increased storage and transmission, as well as energy-efficiency, electrification and decarbonisation of industry and agriculture.

3.2.2.3 Clean Energy Innovation Fund (CEIF)

The Clean Energy Innovation Fund is an AUD 200 million program supporting the growth of innovative clean energy technologies and businesses, including Australia's first Clean Energy Seed Fund.

3.2.2.4 Australian Energy Market Operator (AEMO)

AEMO develops and maintains an Integrated System Plan (ISP); a whole of electricity system plan that provides a roadmap for the efficient development of the National Electricity Market (NEM) over the next 30 years and beyond. It outlines the mix of generation, storage and network investments required to meet both consumer needs and government energy and emissions targets between now and 2050.

2024 saw the release of the latest roadmap. The 2024 ISP confirms that as coal-fired power stations retire, renewable energy connected with transmission and distribution, firmed with storage, and backed up by gas-powered generation is the lowest-cost way to supply electricity to homes and businesses through Australia's transition to a net zero economy.

Source: https://www.aemo.com.au/energy-systems/major-publications/integrated-system-plan-isp/2024-integrated-system-plan-isp

3.2.3 Community solar

Community Solar - No ongoing programs. The Federal Government Community Energy Efficiency and Solar Grants program closed in 2021.

Figure 9 Majura Community Solar Farm. Image c/o ITP Renewables Pty Ltd

3.2.4 State-based incentives

Complementing the established RET, state-based incentives have helped support PV markets through feed-in-tariffs, cash incentives and reverse auctions.

Source: https://www.energy.gov.au/rebates

3.2.4.1 Direct Subsidies

Most state governments are now offering some type of incentive for solar plus battery installations or to add a battery to an existing solar system:

NSW:

- The NSW Government is offering up to 3,000 free 3kW solar systems, including installations, for low-income households.
  Find out more: https://www.energy.nsw.gov.au/households/rebates-grants-and-schemes/rebate-swap-solar-and-energy-efficient-upgrades

ACT

- The ACT government is offering a solar for low-income program which can provide low income houses up to AUD 2,500 to invest in a rooftop solar system. This involves an incentive for supply and installation and an added interest-free loan which you pay back within three years.
  Source: https://www.climatechoices.act.gov.au/policy-programs/home-energy-support-rebates-for-homeowners

VIC:

- Solar Victoria is providing a rebate of up to $1,400 for solar PV system installation, for homeowners with existing homes, homes under construction and rental properties.
  Find out more: https://www.solar.vic.gov.au/solar-panel-rebate
- Solar Victoria is supporting eligible Victorian households to install a solar battery by providing a point-of-sale discount up to a maximum of $2,950 for eligible customers.
  Find out more: https://www.solar.vic.gov.au/solar-battery-rebate
- Solar Victoria Not-for-profit community housing providers are eligible to apply for solar panel rebates on behalf of their renter with a rebate amount up to $1,400 per tenancy.
  Find out more: https://www.solar.vic.gov.au/solar-community-housing
- The Solar for Business Program offers rebates that cover up to 50% up to AUD 3,500 to reduce the upfront cost of installing a solar PV system on a business, and access to interest free loans.
  Find out more: https://www.solar.vic.gov.au/solar-business-program

NT:

- Under the Home and Business Battery Scheme the Northern Territory Government homes and businesses are able to purchase a battery to fit their needs with a grant of $450 per kilowatt hour of battery system capacity, up to $6,000.
  Find out more: https://territoryrenewableenergy.nt.gov.au/programs

SA:

- The Residential Solar PV program offers; 20% up to $1000 (1.5 kW to <10 kW), 20% up to $2,500 (10 kW to <20 kW), 20% up to $5,000 (>20 kW) rebates on solar PV systems.
- The Business Solar PV program offers; 20% up to $1,250 (10 kW to <20 kW), 20% up to $2,500 (>20 kW) rebates on solar PV systems for businesses.
- The Energy Storage Systems program offers; 50% up to $2,000 on Battery energy storage.
- The Shared Solar Program offers; 20% up to $20,000 per site (with a maximum of $500 per premise) Sharing of solar electricity between tenants in multi-storey premises (>20 kW). Minimum 25% shared to individual tenants, not common areas.
- The Energy Smart Building Program offers; 20% up to $25,000 Innovative, whole-building approaches that make a measurable impact to energy efficiency and electrification of the building.

  Find out more about these incentives at: https://www.cityofadelaide.com.au/about-council/grants-sponsorship-incentives/incentives-for-sustainability/#terms_4942717

WA:

- Distributed Energy Buyback Scheme (DEBS) offers eligible customers a time of export payment for electricity they export to the grid, including from rooftop solar PV systems, batteries and electric vehicles.
  Find out more at: https://www.wa.gov.au/organisation/energy-policy-wa/energy-buyback-schemes

Feed in Tariffs: Each of the State and Territory jurisdictions have run their own feed-in tariff (FiT) schemes, with all now closed to new entrants but with many still operating. Most PV systems now receive feed-in tariffs with a value that is ostensibly based on the wholesale electricity price but is often more because of customer acquisition value; in some states a minimum value is stipulated by the government but in other states the value is left to electricity retailers to decide. In Victoria, the value of avoided greenhouse gas emissions is included in the mandatory minimum feed-in tariff.

3.2.5 Local government incentives

Local Government Support: In 2024, local governments continued to play a part in supporting the deployment of solar power systems. Local governments installed PV on their own premises, offered Environmental Upgrade Agreements, supported community bulk-buy initiatives, and have financially supported the Australian PV Institute's SunSPoT that allows households and businesses to obtain a better understanding of the financial outcomes of installing solar in their roof https://www.sunspot.org.au/.

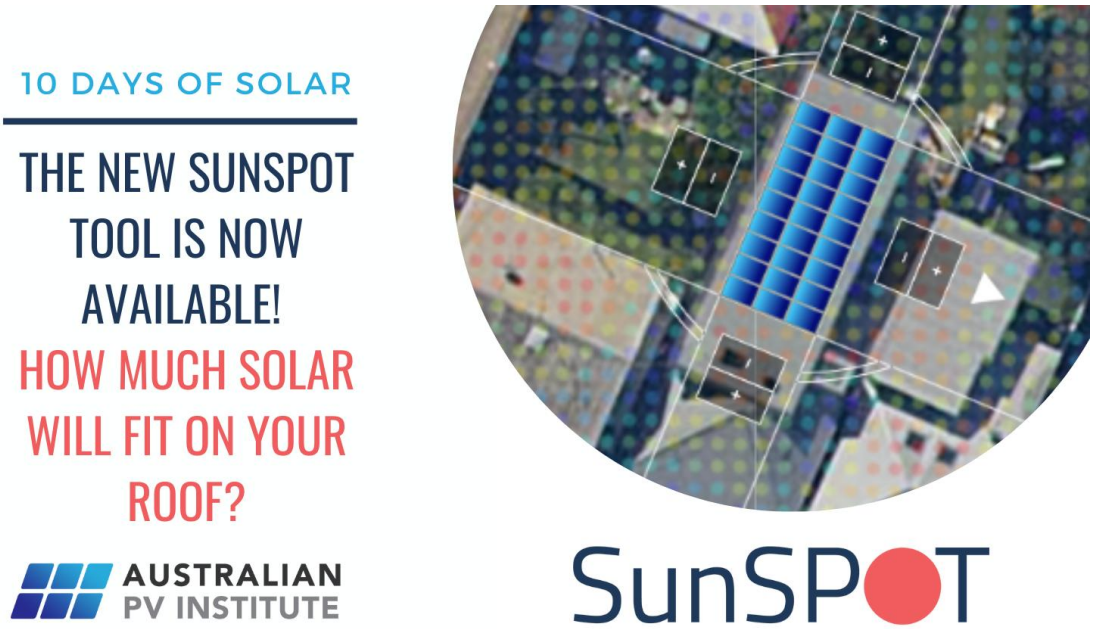

Figure 10 APVI Social Media on Solar Mapping Tool, SunSpot https://www.sunspot.org.au/

3.2.6 BIPV development measures

There are no additional measures in place to specifically promote BIPV development in Australia, though BIPV installations could qualify for some or all of the measures described above for residential and commercial PV systems.

3.3 Self-consumption measures

Table 15: Summary of self-consumption regulations for small private PV systems

PV self-consumption	1	Right to self-consume	Yes
	2	Revenues from self-consumed PV	Savings on the electricity bill
	3	Charges to finance Transmission, Distribution grids and renewable levies	Charged to consumers, incorporated in the retail tariff in c/kWh.
Excess PV electricity	4	Revenues from excess PV electricity injected into the grid	Different types of Feed-in Tariffs
	5	Maximum timeframe for compensation of fluxes	In 2021, the market operator changed the settlement period from the former current 30-minute wholesale electricity spot market settlement period to five-minutes, providing a better price signal for investment in faster response technologies, such as batteries and gas peaking generators
	6	Geographical perimeter (use of the public or private grid)	Feed-in-tariff payments only, no use of grid possible for trading
Other characteristics	7	Number of participants (individual or collective self-consumption)	no collective self-consumption, distribution costs apply to all excess PV electricity
	8	Regulatory scheme duration	Premium FiTs differ between jurisdictions, and standard FiTs are revised annually
	9	Third party ownership accepted	Yes (for ex solar leasing)
	10	Grid codes and/or additional taxes, fees impacting the revenues of the prosumer	No
	11	Regulations on enablers of self-consumption (storage, DSM)	None
	12	PV system size limitations	Some regional limits on system size to connect. Some regional limits requiring self-consumption only.
	13	Electricity system limitations	None (except additional grid codes)
	14	Additional Features	None

3.3.1 Collective self consumption

Current network pricing regulations in Australia stipulate that full network charges must be paid even for locally transmitted electricity, which acts as a barrier to collective self-consumption or virtual net-metering (which are therefore only practical within 'embedded networks'). Microgrids that include PV operate across the country, particularly in new housing developments and in power supplies for remote communities. Community solar investment occurs at relatively low levels in Australia.

3.4 Tenders, auctions & similar schemes

3.4.1 Solar tenders

Solar tenders come from a mix of state governments, local governments, electricity retailers, and the Australian Renewable Energy Agency (ARENA). Each has its own process with varying funding mechanisms, the most common being PPAs for energy generation or Renewable Energy Certificates (or both). In addition to state government tenders, corporations are running tenders for supply of electricity, known as Corporate PPAs.

3.5 Other measures including, floating and agricultural PV

3.5.1 Floating solar

After a lull in activity since the construction of one floating solar plant in 2017, a 350kW array was installed at Gippsland Water treatment plant in 2023 and 'turned on' in 2024 [https://www.greenwoodsolutions.com.au/floating-solar-farm].

3.5.2 Ultra large-scale solar

Australia has several mega-solar projects under development:

1) SunCable's Australian-ASEAN Power Link in the Northern Territory has survived a restructure and will be proceeding its goal to develop a 20GW solar farm and battery facility designed to deliver power to Singapore by under-sea cable.

2) The HyResource project (formerly the Asian Renewable Energy Hub) in Western Australia targets 26GW of wind and solar proposed to provide energy to large energy users in the Pilbara region, including new and expanded mines and downstream mineral processing. The bulk of the energy is expected to be used for large scale production of green hydrogen products for domestic and export markets.

3) The North Queensland Super Hub under development aims to deploy 10GW of wind and solar over the next ten years, to support large-scale green hydrogen production.

3.5.3 Social policies

Australia continues to build on initiatives for policy to support deployment of residential solar at a community and low-income level, as well as social licence for large scale solar.

Tools that promote social acceptance include;

- The Solar Consumer guide - an Australian Government website released in 2023, that helps consumers through the process of installing, using, and maintaining rooftop solar systems. It covers financial benefits, basic technology, design options, and choosing

retailers and installers. And finally, it provides advice on post-installation care, monitoring, and maximizing system effectiveness.
- Solar Homes Program – offered by Solar Victoria and providing Victorian customers with rebates and interest-free loans to enhance the financial benefits of solar energy. They also provide a Solar Buyers Guide, which assists in planning and correctly installing the right system for your needs. https://www.solar.vic.gov.au/solar-panel-pv and fact sheets for solar homes in a variety of languages
- Australia Energy Council Solar Report is for policymakers, energy companies and researchers to provide comprehensive data on PV adoption, market trends and policy impacts. Updated quarterly, it helps professionals make informed decisions.

Initiatives on social licence include an ARENA report on the social licence to operate large scale solar in Australia: https://arena.gov.au/knowledge-bank/establishing-the-social-licence-to-operate-large-scale-solar-facilities-in-australia/, a CSIRO study on how social licence shapes large scale solar (https://ecos.csiro.au/how-social-licence-could-shape-large-scale-solar/) and the development of a model (https://www.csiro.cl/en/research/social-license-to-operate/). In addition, the AEMC recently called for clarity around social licence to assist in transmission planning: https://www.aemc.gov.au/news-centre/media-releases/greater-clarity-around-social-licence-among-final-recommendations-improve-certainty-transmission

In 2024, several measures for solar for low-income households were maintained by State Governments:

3.6 Indirect Policy Issues

3.6.1 Social or rural electrification measures

Some examples of rural electrification measures are: The

- The Commonwealth government is providing up to AUD 50.4 million from 2019/20 to 2023/24 to support feasibility studies looking at microgrid technologies to replace, upgrade or supplement existing electricity supply arrangements in off-grid and fringe-of grid communities located in regional and remote areas.
- The Western Australian government has developed the Distributed Energy Resources (DER) Roadmap which includes a strong focus on microgrids in rural areas. They have also announced regulatory changes that allow the state government owned network operator, Western Power, to excise customers from fringe-of-grid areas and service them with solar powered microgrids to improve power quality.
- As part of the AUD 3.6 million Decarbonising Remote Communities program, four Indigenous communities in Queensland's far north – Doomadgee, Mapoon, Pormpuraaw and the Northern Peninsula Area – are receiving over 1MW solar PV installed to reduce the use of diesel power.

3.6.2 Support for electricity storage and demand response measures

There are numerous trials of virtual power plants, demand response and battery integration. Some offer discounts on hardware, others premium payments for demand response. There are currently about 20 commercially available Virtual Power Plant (VPP) products, testing different business models. There is around 300 MW of household VPP aggregated under all the schemes and around 350MW in commercial and industrial VPP arrangements. Most major energy providers in Australia have provisions for virtual power plants.

Fast development of renewables has led to a real need for provisions of system services – many of which are being provided big batteries. Eight very big batteries (over 100MWh) were commissioned in 2023, and when combined with residential storage gave a cumulative additional storage capacity of 2.5GWh – and up to 8GWh in construction in 2024.

source: https://ieefa.org/wp-content/uploads/2022/03/What-Is-the-State-of-Virtual-Power-Plants-in-Australia_March-2022_2.pdf

- South Australia is making strides in VPP, currently holding the world's largest network of potentially 50,000 battery systems working together to make up a single VPP.

  Source: https://www.energymining.sa.gov.au/consumers/solar-and-batteries/south-australias-virtual-power-plant

  In addition to this, South Australia's Virtual Powerplant (SAVPP) is also undergoing an AUD 33 million expansion funded by Tesla to assist low-income households that aren't able to fit rooftop solar to fit a battery only option. This is set to bring an additional 3,000 households into the scheme.

  Source: https://www.energymagazine.com.au/sas-virtual-power-plant-set-to-expand/

  IKEA's Adelaide location microgrid has just gone live boasting Australia's largest VPP.

  Source: https://www.microgridknowledge.com/distributed-energy/virtual-power-plant/article/33005727/ikea-commissions-the-largest-gridconnected-urban-virtual-power-plant-in-australia

- Western Australia's VPP 'Project Symphony' is set to enrol up to 900 DERs at around 500 homes and businesses.

  Source: https://www.energy-storage.news/project-symphony-western-australias-biggest-virtual-power-plant-goes-online/

- Victoria, the ACT, and South Australia all have solar rebates for battery installations. NSW Govt offers interest free loans to support household batteries.

In 2022, the Australian Government called for applications for community battery systems to support PV on distribution grids: https://www.dcceew.gov.au/about/news/community-battery-grant-guidelines-now-available. Systems are likely to be installed in 2023/24.

3.6.3 Support for electric vehicles and VIPV

In 2023, the federal government introduced a tax exemption to remove the fringe benefits tax on EVs which makes them more affordable and attractive. This policy helps reduce the cost of an EV to be at parity with an equivalent petrol or diesel car and is already generating significant demand for EVs in the near term.

In late 2022 Australia established its first electric vehicle strategy that provided AUD 2,000 off the purchase price of electric vehicles (plug in hybrid vehicles will be included until April 1, 2025). In addition, some state Governments offer additional rates, or Stamp Duty waivers on Electric Vehicles and are supporting the roll out of charging stations.

In 2021, one state (Victoria) introduced an EV specific tax that has since been revoked. It charged electric vehicle owners 2.5 cents per kilometre to partially account for the declining fuel excise paid by those filling up with petrol or diesel. For a car travelling 15,000km annually, that means $375 in a road user charges.

Source: https://www.whichcar.com.au/news/electric-vehicle-incentives-australia#new-south-wales

3.6.4 Curtailment policies

The Australian Energy Market Operator (AEMO) poses strict rules that limit total large-scale solar (and wind) output to protect what it calls system strength.

Curtailment happens when combined output reaches a pre-defined level and happens regularly in South Australia, where there is a rapidly growing large-scale solar capacity now standing at 110MW and more than 1 800MW of wind capacity.

Output of solar farms is also discounted using a Marginal Loss Factor (MLF). The MLF is a location-specific calculation used to estimate how much a plant's output reaches a destination and reflects distance to load. An MLF of 0.9, for instance, suggests losses of 10 per cent, so a solar plant will be credited for just 90MWh out of every 100MWh registered at the meter at the plant.

MLFs are revised and set annually and lead to increased risk in establishing business models around return on investment in large-scale solar.

3.6.5 Other support measures

3.6.5.1 State-based emission reduction targets

State and territory governments are driving the Australian energy market's progress in emissions reductions. All states and territories except Western Australia now have strong renewable energy targets or net zero emissions targets in place. Both the ACT and Tasmania are now powered by 100% renewables, and in addition now Tasmania plans to decarbonise their whole electricity and energy system with a 200% renewables target. The state-based targets that are in place are broadly consistent with the level of renewable energy needed across Australia by 2030 to contribute to keeping global temperature rise below two degrees Celsius (2°C).

In mid-2022, Australia has become significantly more progressive in a bid to reach net-zero by 2050, including a commitment to cut emissions by 40% by 2030.

3.6.5.2 Renewable Energy Zones (REZs)

State based Renewable Energy Zones (REZs) aim to motivate investment in specified regions in generation from wind and solar, in storage (e.g., batteries), and in high-voltage poles and wires.

Queensland has announced plans for three REZs with 60GW of projects proposed from the market.

NSW has announced plans for a targeted AUD 32 billion investment in five REZs, calling for 12GW of renewable energy to be built and an additional 2GW for storage, with bipartisan support.

Victoria has announced an AUD 1.6 billion plan for clean energy including the biggest battery in the southern hemisphere.

3.6.5.3 Hydrogen industry initiatives

In the Federal Budget for May 2023, the Australian Government announced a commitment of up to $2 billion towards the Hydrogen Headstart Program. This initiative is designed to

financially support expansive hydrogen production projects, aimed at expediting the growth of Australia's hydrogen industry. https://arena.gov.au/funding/hydrogen-headstart/

3.7 Financing and cost of support measures

The cost of the SRES and LRET schemes and most feed in tariffs are passed through to energy consumers as a levy on their bills. Nevertheless, the bulk of financing for PV systems installed on the distribution grid comes for individual customers. Most solar installers offer finance.

Financing for large scale projects from government funds in 2020 was by way of recuperable grants or equity.

3.8 Merchant PV – Large scale PV outside of support measure

3.8.1 Description of private merchant/PPA/CPPA markets

In Australia, Variable Renewable Energy (VRE) projects are typically supported by run-of-plant Power Purchase Agreements (PPAs). However, there is a growing trend towards semi-merchant projects where a certain level of exposure to the spot market is retained. According to Simshauser and Gilmore (2022) *, over the past six years, 149 VRE projects (19,275MW, worth $37.7 billion) have secured financial close. Government support in the form of Contract for Difference (CfD) arrangements is widespread, with increasing volumes of corporate and utility-backed PPAs. However, out of the total 19,275MW of committed VRE capacity, at least 3,600 MW is exposed to the spot market, as highlighted by Simshauser and Gilmore in their research.

**Simshauser, P. and Gilmore, J. (2022) 'Climate change policy discontinuity & Australia's 2016-2021 renewable investment supercycle', Energy Policy, 160(August 2021), p. 112648. Available at: https://doi.org/10.1016/j.enpol.2021.112648.*

3.9 Grid integration

Grid access reform remains a work in progress with the Energy Security Board being closed in May 2023.

Each jurisdiction of the National Energy Market is designing their own approach to access, introducing complexity and creating potential administrative overlap.

Access arrangement ultimately remains somewhat uncertain.

Technology in Australia is moving faster than policy and regulation.

To maintain the pace of renewable energy development, Australia needs to support National Energy Market reforms.

4 INDUSTRY

Australia's solar manufacturing industry began in the 1990s with early domestic manufacturers Tideland, Solarex, and BP Solar and was globally competitive at the time. Investment was short-lived, despite a strong local market and world leading solar education, research and development, and manufacturing moved offshore to Germany, then China, leaving Australia with only ~ 100MW of local manufacturing from Tindo Solar. In 2024, with local and global commitments to decarbonisation and demonstrated success in manufacturing in China, there is interest in re-investing in the solar supply chain.

In 2024, the APVI released the Silicon to Solar Report. The APVI undertook the study in partnership with the Australian Centre for Advanced Photovoltaics (ACAP) and was funded by ARENA. Key recommendations included:

- Establishing Solar PV Manufacturing as a Strategic Priority Industry for Australia.
- Examining ways to facilitate PV manufacturing workforce development, approvals, permitting, and international partnerships.
- Developing supply-side policy support levers, including concessional finance and production credits.
- Encouraging demand-side policy levers across all levels of government, including government procurement, circular economy drivers and local content incentives.

Informed by the study, on 28 March 2024, the Federal Government announced an investment of $1 billion in a new Solar Sunshot Program [https://arena.gov.au/funding/solar-sunshot/] to support the commercialisation of Australian solar photovoltaic (PV) innovations and to enhance solar PV supply chains in Australia.

Figure 11 The APVI's Silicon to Solar (S2S) study, released in 2024, examined the opportunity for Australia to establish viable, relevant, and timely local manufacturing along the solar PV supply chain from polysilicon to modules. https://apvi.org.au/silicon-to-solar-foundations-for-solar-pv-manufacturing-in-australia/.

4.1 Production of feedstocks, ingots and wafers

Table 16: Silicon feedstock, ingot and wafer producer's production information

Manufacturers (or total national production)	Process & technology	Total Production	Product destination	Price
Simcoa Pty Ltd – producers of metallurgical grade silicon	Silicon feedstock [Tonnes]	50,000	Predominantly USA	na
	sc-Si ingots. [Tonnes]	nil		
	mc-Si ingots [Tonnes]	nil		
	sc-Si wafers [MW]	nil		
	mc-Si wafers [MW]	nil		

4.2 Production of photovoltaic cells and modules (including TF and CPV)

Module manufacturing is defined as the industry where the process of the production of PV modules (the encapsulation) is done. A company may also be involved in the production of ingots, wafers or the processing of cells, in addition to fabricating the modules with frames, junction boxes etc. The manufacturing of modules may only be counted to a country if the encapsulation takes place in that country.

For many years, Tindo Solar has been the sole manufacturer of solar panels in Australia. Tindo imports cells, doing module assembly and testing in Australia. Tindo's business model is to sell modules to wholesalers and also to the retail market through parent company Cool or Cosy.

In early 2021, Tindo secured funds to expand manufacturing capacity to 150MW/yr. This was completed in 2022, and production will gradually increase.

Total PV cell and module manufacture, together with production capacity information, is summarised in Table 18 below.

Table 17: PV cell and module production and production capacity information

Cell/Module manufacturer (or total national production)	Technology (sc-Si, mc-Si, a-Si, CdTe, CIGS)	Total Production [MW]		Maximum production capacity [MW/yr]	
		Cell	Module	Cell	Module
Wafer-based PV manufacturers					
Tindo Solar	Sc-Si	nil	60MW	nil	150 MW
Thin film manufacturers					
		nil	nil		
Cells for concentration					
https://raygen.com/		nil	nil		
Totals			60 MW		

4.3 Manufacturers and suppliers of other components

- Balance of system component manufacture and supply is an important part of the PV system value chain.

4.3.1 PV Inverters (for grid-connection and stand-alone systems)

- Australian company Selectronics design and manufacture inverters for use in both grid and off-grid applications. Latronics exited the inverter industry in 2022, but continues to accept returns at end of life for recycling.
- Magellan Power is an Australian based manufacturer of power electronics including PV inverters designed for both residential and commercial applications.
- Redback Technologies is an Australian intelligent hybrid PV-storage inverter manufacturer.
- MIL Systems is an Australian power system engineering company that produces a residential grid-connect inverter.

4.3.2 Storage batteries

- Australian company RedFlow manufactures Zinc Bromine flow batteries. Its ZBM product delivers up to 3kW of continuous power (5kW peak) and up to 8kWh of energy. RedFlow has launched a product to serve the residential market.
- Ecoult batteries, ceased operation in 2022: The Ecoult UltraBattery was a CSIRO invention combining a lead-acid battery and a supercapacitor to provide a fast-charging, long-life battery.
- Gelion are developing a revolutionary zinc-bromide battery technology and additives for lithium-ion batteries for the transport sector (https://gelion.com/)

- There are large numbers of foreign manufactured battery companies, particularly Li-ion batteries, supplying to the Australian market, some of whom are setting up local manufacturing.

4.3.3 Battery charge controllers and DC switchgear

A range of specialised fuses, switches and charge controllers are made locally. Here are a few examples of charge controllers & switchgear implementations in Australia:

- Magellan Power have a range of battery, control and switching technologies.
- Solari Energy – Solagrid Energy Storage System (ESS) a stand-alone energy storage system suitable for any sized solar energy installation. They also produce Solagrid audible alarm safety device in case of faults.
- Wattwatchers have developed low-cost, ultra-compact, multi-circuit meters with built in wireless communications.
- Solar Analytics – provide a home energy monitoring solution with a focus on solar, with over 35,000 sales.
- CatchPower, SwitchdIn, Greensync, Reposit and Evergen are developing internet-of-energy solutions including to optimise solar and battery interactions with the grid.

4.3.4 Supporting structures

Most large-scale systems in Australia now use trackers, with hardware predominantly imported.

PV Hardware have set up local manufacturing (https://pvhardware.com/australia/) and IXL (http://ixlsolar.com.au/) manufacture a range of mounting and tracking systems to suit local conditions.

5B is a Sydney based renewable energy technology business that has created a completely prefabricated and rapidly deployable ground mount solar array solution - enabling faster, lower cost and more flexible solar projects.

4.3.5 BIPV

Tractile Solar manufactures composite roof tiles that combine PV cells with Thermal Hot Water. Tractile listed on the Australian Stock Exchange in 2015 and was showcased in the Desert Rose House, that took second place in 2018 Solar Decathlon, Middle East. https://tractile.com.au/

Bristile roofing (part of the Brickworks group of companies) make a PV integrated rooftile. [See https://bristileroofing.com.au/solar/]

5 PV IN THE ECONOMY

The Australian solar supply chain is typically structured as follows:

- Wholesalers (Distributors) import modules from overseas manufacturers and sell to PV Retailers.
- PV retailers buy products from wholesalers, or direct from the manufacturer, and arrange for installation. PV retailers often outsource installation to contract installers, though it's not uncommon for them to employ in-house accredited installers. The retailer is responsible for collecting the paperwork from the installer that is needed for STC creation.
- Installers collect equipment from retailers (or from wholesaler's bonded warehouses) and transport it to site for installation. The installer is responsible for physical installation and commissioning of the system, as well as signing off on critical paperwork for electrical connection and STCs. Installation teams must include at least one accredited installer (electrician), where this accreditation is run by the Clean Energy Council (CEC). The CEC-accredited installer signing off on the job is liable to ensure both the system design and installation meet Australian Standards and CEC guidelines. Some PV installers are also micro-retailers.

5.1 Labour places

Table 18: Estimated PV-related full-time labour places

Market Category		Number of full-time labour places [FTE]		
Upstream	Research and development (not including companies)	250		25,550
	Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D	300		
Downstream	Distributors of PV products	25,000		
	System and installation companies			
	Operation and maintenance companies			
	Electricity utility businesses and government			

5.2 Research and development

Research, development and innovation are incentivised in Australian industry through a Federal Government tax incentive known as the R&D Tax Incentive by offsetting some of the

costs of eligible research and development (R&D). Financial support for R&D is also possible for industry and research institutions through the Australian Renewable Energy Agency. Universities and the Commonwealth Scientific Industry Research Organisation are supported from Commonwealth funds directly and through competitive funding through organisations such as the Australian Research Council and Cooperative Research Centres to carry out research, development and innovation.

Australia has been a global leader in solar research and development, with UNSW celebrating 50 years of solar research in 2024. Research and Development continues at the Australian Centre of Advanced Photovoltaics (ACAP) [https://www.acap.org.au/]. ACAP is a nation centre, hosted by UNSW and in partnership with ANU, CSIRO, the University of Melbourne, Monash University, University of Queensland, Sydney University, and the Australian Renewable Energy Agency (ARENA).

6 INTEREST FROM ELECTRICITY STAKEHOLDERS

6.1 Structure of the electricity system

In most areas of the country on main grids the electricity system is split into generation, transmission, distribution, and retail sectors, where smaller grids are (typically) vertically integrated. There is a mix of public and private ownership across all jurisdictions and sectors.

The National Electricity Market (NEM) spans Australia's eastern and south-eastern coasts and comprises five interconnected states that also act as price regions: Queensland, New South Wales (including the Australian Capital Territory), South Australia, Victoria, and Tasmania.

There are over 400 registered participants in the NEM, both State government owned and private, including market generators, transmission network service providers, distribution network service providers, and market customers.

The NEM is a wholesale commodity exchange for electricity across the five interconnected states. The market works as a "pool", or spot market, where power supply and demand is matched in real time through a centrally coordinated dispatch process. Generators offer to supply the market with specified amounts of electricity at specified prices for set time periods and can re-submit the offered amounts at any time. From all the bids offered, the Australian Energy Market Operator (AEMO) decides which generators will be deployed to produce electricity, with the cheapest generator put into operation first. A dispatch price is determined every five minutes, and six dispatch prices are averaged every half-hour to determine the "spot price" for each NEM region. AEMO uses the spot price as its basis for settling the financial transactions for all electricity traded in the NEM. Network, retail and environmental charges are added to the energy price in calculating retail tariffs and these are all charged to the customer by the retailer.

Western Australia and the Northern Territory are not connected to the NEM. Western Australia operates two separate networks, the South West Interconnected System (SWIS) and the North West Interconnected System. A range of smaller grids also operate in remote areas of the states. The SWIS operates via a short-term energy market and a reserve capacity market. Capacity and energy are traded separately. The Northern Territory operates several grids both large and small to service population centres and regional townships.

6.2 Interest from electricity utility businesses

The businesses that make up the electricity industry have collectively recognised the inevitability of solar power rolling out across Australia, and most have opted to play a constructive role.

Solar is impacting the energy market operation both technically and financially.

- Financially, solar is reducing the amount of energy transported and sold and reducing the wholesale electricity price during the daytime.
- Technical issues most commonly relate to inverter response to system disturbance and impacts upon local voltages.

Network operators have been given the ability to constrain the amount of solar power that is connected to their networks and impose these constraints upon individual applicants, unless applicants use inverters with operation modes under the network operators' influence.

6.2.1 Electricity network operators

Though the energy market operator has stopped electricity network operators from discriminating with solar-specific tariffs that would financially penalise solar households, network operators still impose delays and conditions to network connection approval that increase the soft costs of solar deployment.

Australian energy regulators, while becoming mindful of the need to change regulatory frameworks considering these developments, are currently themselves restricted by their own governance arrangements and reporting structures. Nevertheless, new regulatory frameworks are needed to cater for rapidly increasing distributed energy options. For instance, network businesses are currently prevented from implementing distributed energy options themselves, even if these may provide more cost-effective solutions than grid upgrades or extensions, while third party access to this market is not available. Regardless, momentum is swinging towards a more neutral playing field that balances the needs of both incumbents and the new entrant distributed energy market participants.

The Energy Networks Association is actively considering a future with high-penetration PV, working with CSIRO to produce an Electricity Network Transformation Roadmap.

6.2.2 Electricity generators and retailers

Electricity generators and retailers are commonly the same company in many parts of Australia and are therefore collectively referred to as 'gentailers'.

Australia's energy retail sector is dominated by three large companies that have made some investment in large-scale solar. This has created an opportunity for smaller, solar-focused retailers to emerge, catering to community demand for solar access, the many Australian households with solar investments, and rising electricity prices..

6.3 Interest from municipalities and local governments

There is high (and increasing) interest in PV implementation from local governments and community organisations around Australia. These groups are typically less well-resourced than utility or large government organisations and must operate within the electricity market described above. However, they are backed by a high level of community support for local generation and employment creation.

Many local governments install PV on their own buildings, operate bulk-buy initiatives, set their own renewable energy goals and support community-owned solar installations.

Specific examples of local government solar PV support initiatives include:

- Council support for the APVI Solar Sunspot tool, that enables the Council to track major sustainability KPIs using APVI's Solar Installation Dashboard. Participating councils include Northern Beaches, Hornsby and the ACT Government.

- City Power Partnerships, an initiative of the Climate Council that brings together over 150 local government organisations, over 500 cities and towns representing 60% of the population. The CPP has a commitment to clean energy, representing almost 60% of the Australian population.
- Solar My School, a Council-run program initially founded by Sydney Councils and involving over 160 schools across NSW. This program aims to help schools install solar with support through the whole process.

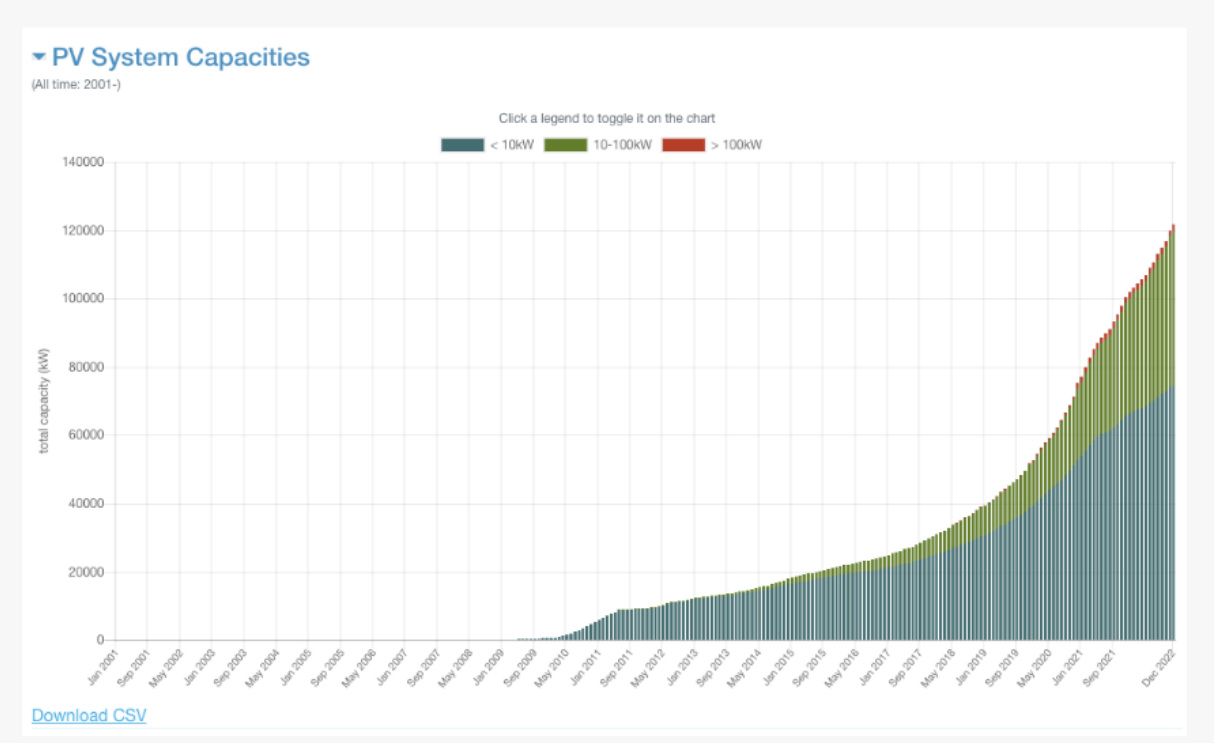

Figure 12 Graph taken from the APVI Solar Installation Dashboard for Hornsby Shire Council. It shows the cumulative growth in installed solar PV system capacity month on month. [https://www.sunspot.org.au/blog/https/wwwsunspotorgau/blog/hornsby-councils-community-embrace-solar-with-the-help-of-sunspot-and-apvis-solar-education-webinars]

Other examples of broader programs used by, and in some cases established by, local governments include:

- Solar Bulk Buy Programs, which give households and businesses in these municipalities access to bulk purchase discount deals. Many local government bulk-buy programmes exist.
- Many local governments have initiated Environmental Upgrade Agreements to assist in reducing the carbon intensity of energy use. This can include solar PV and is implemented by lower than market fixed interest rate loans over a longer than usual loan term.
- Community Groups and Energy Foundations including the Coalition for Community Energy (C4CE), the Community Power Agency, Solar Citizens and the Yarra Energy Foundation.

6.4 States and Territories

In 2024, state governments continued to progress measures that would support the deployment of renewable energy, by identifying areas of opportunity, tendering for renewable energy for their facilities, creating state-based targets for renewable energy uptake, and launching tenders for grid-scale batteries. Collectively Australian governments are investing billions in clean energy stimulus measures, with the Tasmanian and ACT governments leading progress having already achieved 100% renewables.

7 HIGHLIGHTS AND PROSPECTS

7.1 Highlights

In 2024, 5.29GW of solar was installed in Australia, reflecting a return to a strong market with a recovery late in 2024. With over 40 GW total, Australia remains in the top ten markets in the world for total installed capacity and retains a world-leading position in solar per capita at over 1.5kW/person.

Due to 26.2 GW of distributed solar, 13.4 GW of centralized solar, and excellent insolation, solar energy is responsible for more than 20% of the nation's total electricity demand. Utility-scale solar experienced a significant rebound at the end of 2024, with 2.0 GW installed after a 2023 decline to 1.05 GW. This resurgence reflects renewed interest in new schemes aligning with Australia's targets, including the federal Capacity Investment Scheme (supporting storage and solar) and state initiatives like Renewable Energy Zones (promoting co-located generation and transmission infrastructure).

Australia stands out in the global energy market; its stable overall market and strong demand for rooftop solar mean installations are primarily rooftop-based, a rarity elsewhere. By June 2025, 43.9% of all free-standing Australian homes utilized solar power. Activities targeting Building-Integrated Photovoltaics (BIPV), floating PV, and Vehicle-Integrated Photovoltaics (VIPV) remain minimal, typically confined to research or demonstration scales, AgriPV, however, is gaining significant interest, primarily involving sheep grazing. Notably, Australia's largest solar farm, the New England Farm (720MW solar, 200MW/2-hour battery, in its first operational stage (400MW, 1,200 hectares, ~1 million panels) currently provides power while simultaneously offering shade and shelter for over 2,000 grazing merino sheep.

7.2 Prospects

Building off a strong base, Australia needs to see continued growth in the solar PV market to meet ambitious commitments to net zero emissions.

- Continuing support under the Renewable Energy Target, through to 2030 will provide ongoing momentum for rooftop and large scale solar, with growth expected in the commercial, industrial and utility scale markets.
- State-based government competition for investment in Renewable Energy Zones, including related infrastructure investments, will drive large-scale investment in solar and wind by providing a roadmap, reducing risk and increasing investor confidence.
- The Commonwealth Government funded Australian Renewable Energy Agency (ARENA) supports Australia in the global transition to net zero emissions, by accelerating the pace of precommercial innovation, to the benefit of Australian consumers, businesses, and workers.
- Network operators are looking at setting up autonomous micro and mini-grids and generator/retailers are investing in virtual power plants, aimed at optimising costs and resilience in electricity supply.

- Storage capacity is seeing significant growth with several large-scale storage project approvals and the increasing competitiveness of small-scale, behind the meter storage options.

With increasing investment in solar both centralised and distributed, the value of energy produced around mid-day is declining, driving investment in storage and motivating demand shifting. The ongoing investment in renewables will present market and engineering challenges that will need to be met by policy and regulatory change, by a redesign of tariffs to incentivise use of low-cost, low-emissions power, investments in storage, in transmission and distribution.

For behind-the meter PV, challenges include restrictions on system size, increasing network access costs and a regulatory focus on central generation, despite the high interest in and penetration of distributed PV. Technology is moving faster than policy and regulation and, to maintain the rapid pace of renewable energy deployment, Australia needs to support national electricity market reforms and provide policy certainty to support the needed electricity infrastructure investments and additional electricity transmission, energy storage and demand response mechanisms.

This report was prepared by the APVI and its members
www.apvi.org.au

AUSTRALIAN PV INSTITUTE