Australia's Solar Manufacturing Opportunity

Solar is positioned to be a global strategic energy source, delivering low-cost, easily deployed, distributed generation and offering significant economic benefits to Australia, with an abundant solar resource.

Despite producing many raw materials used in the solar photovoltaics (PV) value chain, owning significant portions of the world's PV intellectual property and having a strong and consistent demand, Australia is almost totally reliant on imported PV products and balance of system components.

Without action, Australia can expect to see the lack of PV supply chain diversity as a security risk, as well as a significant loss of economic opportunity.

Australia is already a leader in solar energy supply, delivering some of the cheapest energy prices and highest penetration of rooftop systems for residential consumers globally.

Australia has high aspirations regarding the production of green hydrogen, green steel and other materials manufactured using green energy.

Any green energy in Australia will be predominantly solar power and, unless Australia gains some control over the PV value chain, the success of these substantial industrial shifts within Australia will be completely dependent on foreign powers.

We have a pressing need, we have the natural resources, and we have a very sizeable market. Now is the time for Australia to invest in the independence of our energy supply.

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The Opportunity

"If you think about the great economic challenges underway, if you think about the national security challenges underway, they all come back to energy."

Hon Chris Bowen, Australian Minister for Climate Change and Energy (The Sydney Energy Forum, July 2022)

Remembering IEA's five key policy action areas to ensure solar PV security of supply[1]

1. Diversify raw material supplies and manufacturing
2. De-risk manufacturing investment
3. Ensure environmental and social sustainability
4. Continue to foster innovation
5. Develop and strengthen recycling capabilities.

During the first stage of the Covid19 crisis, Australian installers could not access imported PV modules and other components, leading to many planned installations being delayed. The cost of solar projects is also increasingly impacted by rising prices for polysilicon, silver, copper, aluminium and steel, as well as significant increases in international shipping costs.

With the majority of PV system components (>80%) now manufactured in China, the present trade tensions exacerbate the potential threat to supply restrictions or sudden price changes. Adding to this risk is the growing concern over the possible use of forced labour in parts of China, where much of the silicon, wafers and steel used in PV components are produced. All of these issues are placing increasing strain on Australian PV suppliers and installers who need to provide their customers with firm quotes and timelines for their systems.

"Australia has hit an impressive milestone with 26GW of installed solar. That's more solar per capita than anywhere else in the world!"

(Australian PV Institute, Feb 2022)

The Australian PV market is growing strongly, with installation rates now over 4 GWp per annum with an economic value of over 4 billion dollars per year. The cumulative installed capacity is over 27 GWp and Australia is in the top 10 countries by both annual and installed PV capacity (APVI Solar Map, PV in Australia report 2021[2]).

The Australian market is now large enough to justify the local supply of solar PV cells and panels, and their component materials including silicon, aluminium and glass, as well as other balance of system components and PV recycling facilities. Yet, it is not only the local market that is rapidly increasing. Significant export markets also exist, especially for refined minerals used in the PV value chain, established and new PV technologies and products, integrated PV systems and smart controllers. In addition, emerging 'green' markets will need green manufacturing and Australia has an opportunity to support green PV and PV component manufacturing with its low-cost, abundant clean energy supply. Further, Australia's extensive experience in off-grid system design and management will provide a key market advantage as regional and island power systems in Australia and internationally move from diesel towards PV-based systems.

Over the past three decades, the solar PV market in Australia has moved from off-grid to residential grid to commercial systems, with strong growth now in the large-scale utility and industrial markets. PV now constitutes approximately 30% of installed generation capacity in Australia and contributes about 15% of electricity generation across the country. AEMO expects distributed PV alone to provide up to 22% of total electricity demand by 2040[3], while the installed capacity of distributed PV is expected to reach as much as 75 GW by 2050[3], with a further 5-25 GW of large-scale solar installations needed to replace retiring coal plants. A major push to 'electrify everything' (i.e., manufacturing, mining and construction) is likely to see the doubling of electricity demand in the same timeframe[4]. Adding to these increases will be the large-scale development of export markets in DC electricity, green hydrogen, green steel, aluminium and other products which will create new demand for solar PV, taking AEMO's projections of grid-scale solar and wind out to over 140 GW by 2050 [5].

Unless Australia gains control over the most strategic parts of the PV value chain, the development of any "green" export market will be completely dependent on foreign powers. Australia is in the unique position to achieve a sustainable, competitive advantage in terms of cheap and abundant solar electricity because of the extraordinary solar irradiance and land availability across the nation.

Where We Are Now ?

"We've put 60 million solar panels on roofs in Australia in the last 10 years. One per cent of them have been made in Australia. That's got to change. This is Australian technology; we want to see more of it made in Australia,"

- Chris Bowen, Australian Minister for Climate Change and Energy (Renew Economy, July 2022)

Australia led early developments in solar PV manufacturing, as early as the 1980s, with Philips, Tideland Energy, BP Solar and Solarex manufacturing cells and modules here, until 2008. Despite now having a vibrant and competitive PV installation industry, the current Australian PV manufacturing industry is fragmented and small-scale, with each company typically working on its own developments and systems. The largest module line is run by Tindo Solar Pty Ltd in Adelaide, and although continuously growing, has only 150 MW capacity--enough to meet just 3% of Australia's annual PV demand. Australian company SunDrive Pty Ltd, is looking at commercial-size, silicon-based solar cell fabrication through innovation and have demonstrated record-breaking efficiencies, while 5B Pty Ltd is innovating in fast and low-cost PV deployment. To succeed on a global scale, these emerging companies would benefit from market certainty and a co-ordinated effort to reach scale.

In order to achieve globally relevant manufacturing scale along the PV value chain in a timely manner, Australia will need to deploy standard state-of-the-art manufacturing processes, in the first instance, as well as adopting innovative technology as it becomes available.

Some of the original off-grid and balance-of-system component manufacturers remain in Australia, including one of the world's oldest inverter companies: Selectronics, a company that is now entering the grid market for bi-directional inverters as distributed battery uptake increases.

Australia has cell-level measurement and accreditation, needed for technical competency standards in support of R&D, available through several Australian research laboratories, including the PV Performance Laboratories at CSIRO and the PV Characterisation laboratories at ANU. In terms of module-level reliability however, Australia is still lacking local certification, making imports vulnerable to variations in quality.

Recent State and Commonwealth government support has revived interest in manufacturing[6] with the establishment of local battery, PV module and system controller manufacturing facilities, as well as pilot PV recycling facilities. The federal government's Australian Renewable Energy Agency (ARENA) has been instrumental in the success of solar in Australia and remains a strong supporter of innovation, deployment and strategies to increase the uptake of solar PV, with two of this year's funding rounds dedicated to ultra-low-cost solar PV R&D and large-scale battery storage.

The Manufacturing Value Chain

The manufacturing value ecosystem for crystalline silicon PV is illustrated in ***Figure 1***.

Figure 1: The Manufacturing Value Ecosystem for Crystalline Silicon PV

Australia is a source of raw materials for silicon, glass and aluminium that make up solar panels, and local PV panel manufacturing could drive upstream industry development, creating additional value.

With high levels of automation in modern plants, the labour cost differentials that once existed between Australia and the key Asian PV suppliers are reduced. Yet still, economies of scale, long-term planning, market certainty and support for supply chain development, have provided advantages elsewhere that have been absent in Australia.

There is a renewed and vital interest coming from the US and the European countries regarding resilience, diversity of supply and local PV manufacture and they are also looking to ramp up their production capacities[7]. Australia will need to assess how best to exploit its own advantages, if it is to re-enter the manufacturing supply chain, and also to seek synergistic global developments to diversify the supply chain.

The Path Forward

In order to develop a strategy for local manufacture across the PV value chain in Australia, it is important to analyse the current value chain, to answer key questions such as where are input materials and products coming from, and who might we partner with? It will also be critical to understand activities that may already be underway, and to coordinate these efforts.

It will be important to know where the gaps in the value chain are, and where Australia has a competitive advantage or a strategic driver to extend manufacturing into these areas. There are also new opportunities to develop green manufacturing in supply chains to the PV sector, including aluminium, glass and steel[2], which would provide a market advantage for any new Australian-made PV products.

As the PV market develops, there will also be opportunities for new Australian PV technologies and products. In particular, products that address the issues of input material constraints or carbon intensity (for instance in polysilicon, silver, copper, aluminium and steel). Similarly, there will be an opportunity to improve the PV market for those that favour local products, to capitalise on a new green PV industry to service Australian and international markets, and to provide new skilled jobs across the country.

In the long term, any healthy national economy requires energy security. At the same time, decarbonisation targets must be met in a timely manner to avoid what could be catastrophic climate change, and in accordance with Australia's climate commitments. The rapid growth of solar PV technology and subsequent reduction in the cost of electricity to unprecedented low levels in many countries of the world, make this technology a strategic asset for global energy generation.

Australia is an energy supply leader and internationally recognised hub for PV intellectual property, with the benefit of low population density and extraordinary renewable resources. This means Australia may very well be in the best position of any developed country to reach zero emissions and become a clean energy "superpower".

Ambitious projects, such as the Sun Cable Australia-Asia PowerLink project, which aims to develop the world's biggest solar and storage infrastructure, have just reached Stage 3 status (investment ready) on Infrastructure Australia's Priority List. This allows the project to access government funding, and confirms it is an economically viable project for Australia. Yet Australia's domestic capacity to supply this demand, as well as the growing national demand, is completely inadequate.

Recognising the value of energy independence, diversification and domestic manufacture is the first step towards the achievement of a more resilient economy. We must now act positively and confidently, knowing that Australia has several strengths to harness and that there is a great opportunity at hand. Bridging the gap between the now largely fragmented and siloed Australian solar PV industry can; provide national security, create jobs, improve public health, grow the export economy and drive the electrification revolution of the 21st century.

APVI and UNSW, in partnership with other APVI members, is committed to guiding Australia towards a more resilient clean energy economy in these critical times. The aim is to provide a unified path towards all segments of a competitive PV industry in Australia. Our activities will concentrate on the assessment of the opportunities and challenges faced by the industry to develop ethical local supply chains and overall in-house green manufacturing. In the first instance, we will develop a comprehensive plan to deliver competitive local PV manufacturing in Australia before 2030. We are seeking input from any organisation in Australia which is interested in this endeavour. A strategy will be published in 2023 for discussion by players across the PV value chain.

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Reference Material

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[2] APVI 2021, National Survey Report of PV Power Applications in AUSTRALIA

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[4] Blakers et al. "A zero-carbon, reliable and affordable energy future in Australia", Energy, Volume 220, 2021, https://doi.org/10.1016/j.energy.2020.119678

[5] AEMO, 2022, 2022 Integrated System Plan

[6] Make it Happen: The Australian Government's Modern Manufacturing Strategy | Department of Industry, Science, Energy and Resources

[7] See for instance: Catalyzing American Solar Manufacturing; and European Solar Initiative

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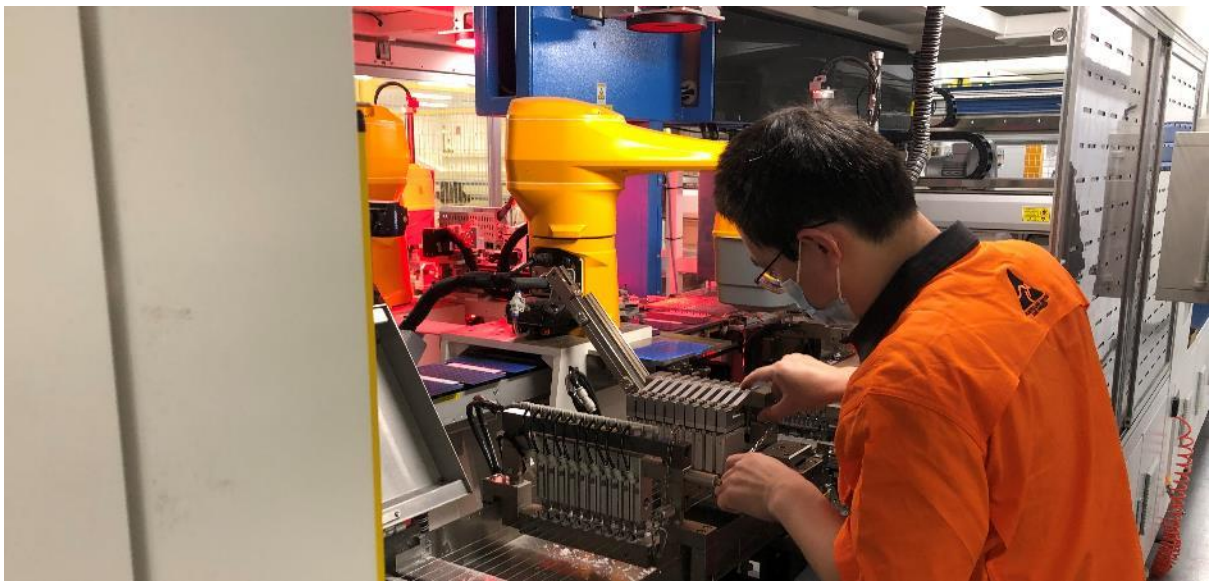
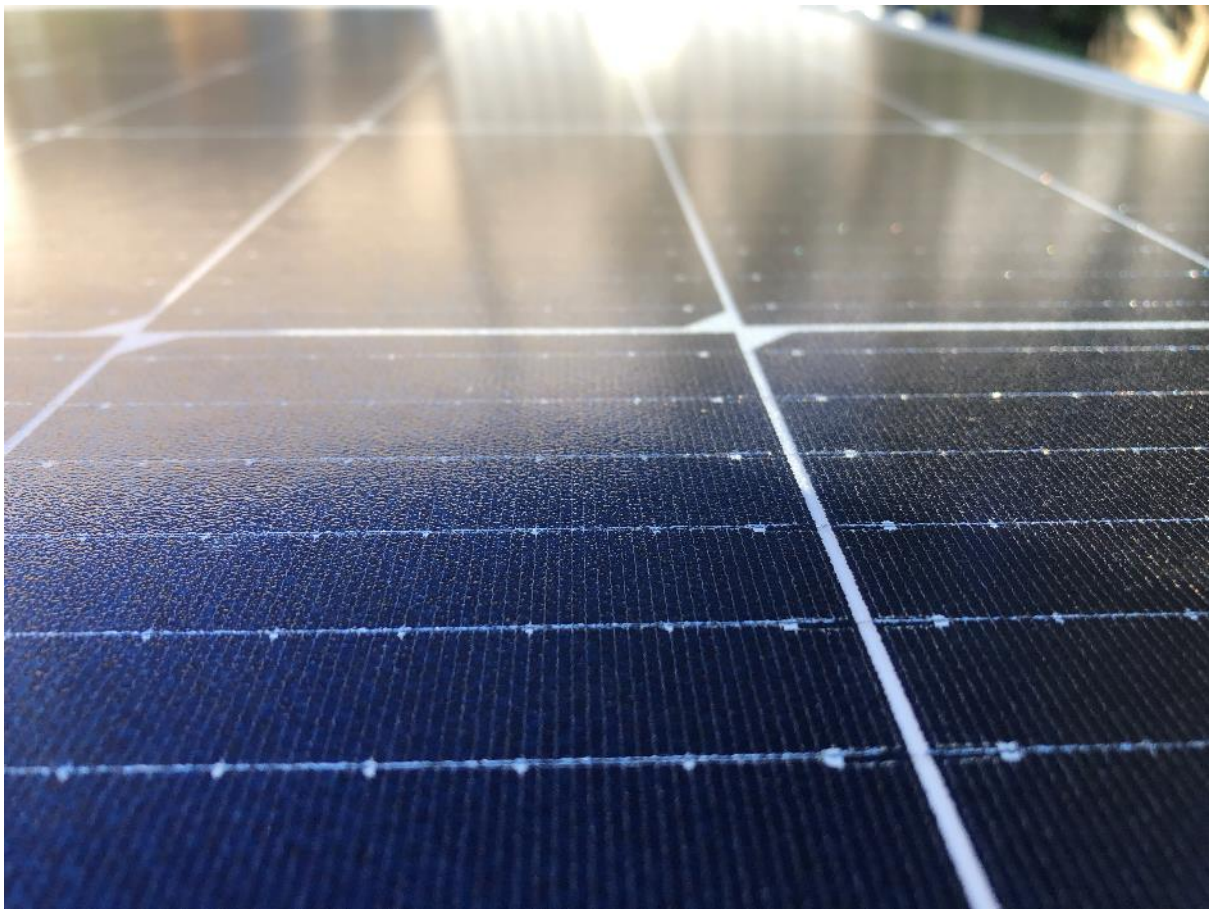
Images



PV Manufacturing at Tindo Solar Pty Ltd. Image courtesy of APVI Pty Ltd.



Solar Panel. Image courtesy of APVI Pty Ltd.

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About the APVI

The Australian PV Institute is a not-for-profit, member-based organisation which focuses on data analysis, independent and balanced information, and collaborative research. Our objective is to support the increased development and use of PV via research, analysis and information.

The APVI promotes solar through its live solar mapping platform [http://pv-map.apvi.org.au], the national solar research conference and Australia's participation in two International Energy Agency (IEA) programs – PVPS (Photovoltaic Power Systems) for solar photovoltaics and SHC (Solar Heating and Cooling), concerned with new solar thermal products and services.

www.apvi.org.au

About ACAP

The Australian Centre for Advanced Photovoltaics (ACAP) at UNSW is developing the next generations of photovoltaic technology, providing a pipeline of opportunities for performance increase and cost reduction. Through national and international collaboration, ACAP provides a pathway for structured, highly visible, photovoltaic research that is significantly accelerating photovoltaic development - beyond that achievable by the institutions acting individually, leveraging past and current funding.

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