

Issues paper: Developing NSW's solar panel recycling, remanufacturing and manufacturing industries

Introduction

The transition to renewable energy is one of the most significant economic and environmental transformations of our time, with the rapid growth of solar energy being a key component of this shift. As increasing numbers of solar panels reach the end of their life, the challenge is no longer simply how to manage solar panel waste, but how to best recover valuable materials, enhance NSW's industrial capability, and ensure NSW captures the full economic benefits of the product lifecycle, including for workers and communities.

The NSW Government sees solar panel recycling as an important step in building NSW's longer-term sovereign manufacturing capability. Recycling facilities are not just recovering materials; they also provide valuable employment, developing workforce skills, technical expertise, operational knowledge and innovation capability that can be transferred into higher-value manufacturing and remanufacturing activities.

The proposed solar panel stewardship scheme is an opportunity to capture greater economic value from the transition to renewable energy in NSW. As the stewardship scheme matures, a reliable volume of recovered materials from solar panels will be consistently available for remanufacture and advanced manufacturing. Retaining these materials within NSW will strengthen local supply chains, drive innovation, create skilled jobs, and increase the long-term economic benefits of the renewable energy transition.

The issues paper seeks stakeholder feedback on the opportunities and barriers to building a domestic advanced manufacturing industry. It considers how a mandatory solar panel product stewardship scheme can support the growth of local recycling, manufacturing and remanufacturing capabilities, unlocking investment and creating new workforce opportunities. Feedback will inform the design of the stewardship scheme and future policies that support industry growth and workforce development.

Building a circular future for NSW's solar panels

NSW is a leader in solar uptake, with more than 1.18 million rooftop solar installations and 8.6 GW of capacity across households, businesses, schools and communities. Large-scale solar farms are also playing an increasingly important role in the state's energy system.

As solar panel uptake continues to grow, it is important to consider how they are handled at the end of their life. Annual end-of-life solar panel waste in NSW is projected to grow from approximately 14,000 tonnes today to around 89,000 tonnes by 2045–46, creating an urgent need for effective recovery and reuse of valuable materials. Diverting this waste from landfill will be critical to supporting NSW's environmental sustainability. This challenge is particularly urgent as NSW's landfills approach capacity.

The annual economic cost to NSW resulting from current disposal practices for end-of-life panels is estimated to be around \$15 million, increasing to around \$101 million in 2045–46. In present value terms, these base-case costs total around \$650 million over the next 20 years.

The NSW Government’s proposed mandatory product stewardship scheme under the *Product Lifecycle Responsibility Act 2025* and associated regulation aims to address these economic and environmental challenges by making brand owners responsible for the life cycle of solar panels, increasing investment in collection, recycling and processing infrastructure. By creating a consistent supply of recovered materials, the scheme can improve recycling outcomes while supporting the long-term development of remanufacturing and manufacturing industries in NSW.

The proposed stewardship scheme is intended to be more than a recycling initiative. It represents the first stage of an industry development pathway that transforms end-of-life solar panels into a strategic resource for NSW. The draft regulation stipulates that, as far as is reasonably practicable, regulated PV panels, and materials recovered from regulated PV panels, must be managed in a way that considers the development of recycling, remanufacturing and resource recovery capabilities within NSW.

By establishing reliable collection systems and increasing resource recovery, the scheme can form the foundation for an industry development pathway encompassing advanced materials processing, remanufacturing and manufacturing, ultimately strengthening NSW’s sovereign manufacturing capability.

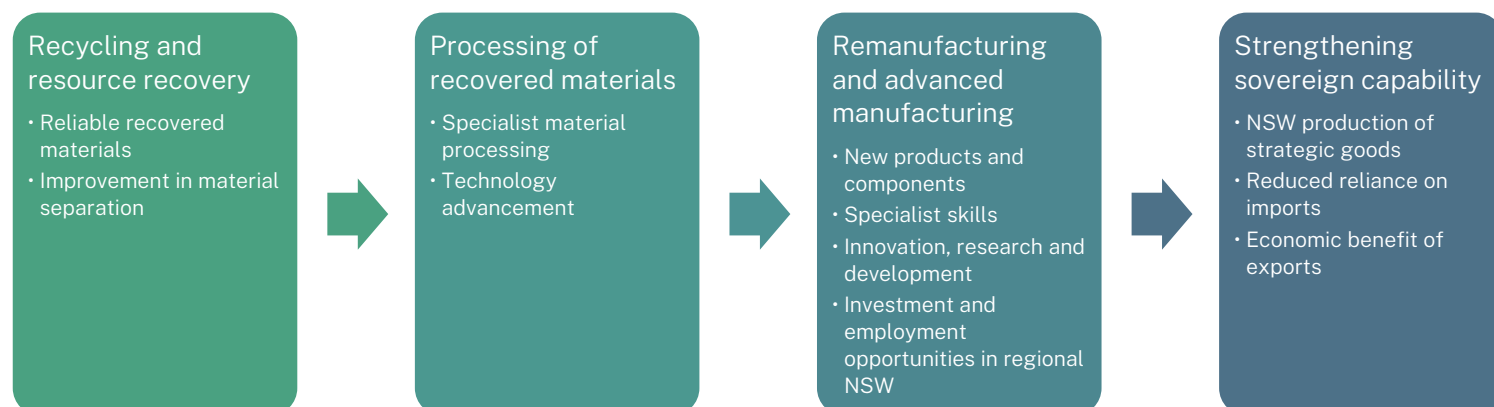
Remanufacturing and advanced manufacturing development pathway

The growing volume of end-of-life solar panels presents an opportunity to reclaim elements of the solar value chain domestically. Currently, Australia imports 99% of our solar panels, with ~85% of this sourced from China. Once solar panels reach their end of life, it is estimated that about 40% are landfilled or exported, and about half are sent to low-level recyclers who extract the metal frames and discard the remaining materials (including valuable silver and silicon).

When materials are consistently recovered and processed to higher levels of purity and quality, they can become reliable inputs for remanufacturing, where those materials are transformed into new materials, products or components. As remanufacturing capabilities grow, they create the skills, infrastructure, intellectual property and industrial base needed for sovereign manufacturing capability: the ability to produce strategically important goods domestically, thereby reducing reliance on imports. Each stage of the chain retains more value, knowledge and economic activity within NSW.

By retaining more materials and economic value from solar panels within Australia, the scheme can strengthen domestic remanufacturing and manufacturing capability, reduce reliance on imports, and contribute to a world-leading circular economy that delivers lasting benefits for industry, workers and communities.

Figure 1 Industry development pathway



Without local recycling and remanufacturing capability, NSW risks exporting not only valuable materials from solar panels but also opportunities to build skilled employment, specialised expertise and advanced manufacturing capability.

Question 1: What measures would help grow solar panel remanufacturing and manufacturing capability in NSW and what are the main barriers to building this capability?

Question 2: What is a realistic time frame for developing solar panel remanufacturing and manufacturing capability in NSW, and what would need to be in place to support this growth?

Building capability through solar panel resource recovery

NSW has a very limited number of established and dedicated solar panel recyclers that can recover a significant portion (i.e. around 85%) of a solar panel, including the aluminium frame and solar glass. These facilities have raised concerns about ongoing commercial viability if unable to secure sufficient numbers of end-of-life panels. Collectively, these facilities have an unrealised maximum processing capacity of less than half of the current 14,000 tonnes of end-of-life solar panels generated in 2025–26.

Currently there are no solar panel recyclers in NSW capable of recovering 100% of panel materials. Several emerging technologies being developed by Australian universities, including prominent NSW universities, have been proven technically viable, but are yet to be commercially scaled. These technologies can separate all materials within solar panels to high levels of purity, enabling recovery of high value silver and silicon.

Recovered materials from solar panels are often not fully separated due to current high costs and technology limitations. The lowest order of solar panel recycling is recycling of the aluminium frames, with the remaining material downcycled into mixed, crushed, low-value materials suitable only as aggregates and construction additives. Diverting more solar panels to higher-value processing should be encouraged.

Question 3: What non-financial barriers currently limit the use of recovered materials from end-of-life solar panels in manufacturing and remanufacturing?

Question 4: Are there barriers for the uptake of new recycling technologies that increase the value of recovered materials?

Question 5: Which industries or activities have the most potential to use recovered materials from solar panels such as glass, silicon, aluminium or other materials?

Advanced materials processing and specialist knowledge transfer

As the implementation of the mandatory stewardship scheme for solar panels increases the volume of material recovered from recycled panels, technologies to extract the highest commercial value from recovered material will continue to advance.

Provided with the right incentives, resource recovery facilities may expand operations to process greater numbers of solar panels, while also improving their recovery technologies. This would increase both the volume and value of recovered materials. Resource recovery facilities may also be able to build interdependent relationships with end markets and users to better understand their needs and requirements for recovered materials. This would allow them to adapt their operations to match end-user needs, and to preference those materials and users with the highest commercial value.

Over time, advanced manufacturing will develop increasingly specific material requirements that may justify the introduction of specific materials processing facilities into the supply chain. These facilities may further process recovered material for consistent quality, textures or forms; or combine recovered materials to make other materials that can be used for advanced manufacture (i.e. combining recovered metals to make alloy metals).

Question 6: How can cooperative relationships between recyclers and remanufacturing be supported and enhanced to provide greater awareness of, and access to, high-quality recovered materials?

Question 7: How could remanufacturing and advanced manufacturing prioritise use of recovered material in new products?

Remanufacturing and advanced manufacturing

Solar panels are made from highly recyclable and versatile materials that can support the establishment of a remanufacturing and advanced manufacturing industry once the volume and quality of recovered material become established and reliable. Australia has a long history of innovation, including a significant role in developing more efficient solar panel technology commonly adopted in today's solar panels across the world; however, most manufacturing of new solar panels has moved offshore.

A mandatory solar panel stewardship scheme will generate thousands of tonnes of valuable material suited for remanufacture into new solar panels and other higher-value products.

Silicon and solar glass recovered from solar panel cells are versatile materials when recovered in high purities. They lend themselves to a broad range of potential advanced manufacturing opportunities that can be pursued in NSW, including:

- renewable energy manufacture, including solar panels and energy storage components
- fibreglass products such as wind turbine blades and insulation for homes
- semiconductor manufacture
- medical applications such as nano-medicine
- metal alloys suited for mechanical engineering and industrial manufacturing
- agricultural fertilisers.

Question 8: What infrastructure, technology or investment is needed to support development of remanufacturing and advanced manufacturing of materials recovered from end-of-life solar panels in NSW?

Question 9: What secondary or supporting services might be essential for an advanced manufacturing industry?

Building sovereign capability

A resilient onshore remanufacturing and manufacturing sector is critical to improve NSW's manufacturing capability, reduce reliance on imports in times of geopolitical uncertainty, and avoid impacts to global supply chains for imported products Australia has a dependency on, including solar panels. Increasing the recovery and use of materials from end-of-life solar panels is one opportunity to mitigate global supply chain risks, strengthen domestic manufacturing capability and retain more value within NSW while supporting investment, technology development and uptake, and job creation.

Metals such as copper and aluminium recovered from solar panels are already absorbed into local recycling and manufacturing, and there is growing demand for the recovered silver as extraction processes mature.

The further development of a remanufacturing or manufacturing industry in NSW will require the support of specialist skills, including:

- technical knowledge to explore remanufacture opportunities and processes, and improve recycling processes to increase the value of recovered solar panel materials
- training for a range of technical skills to ensure the workforce is appropriately skilled for these new remanufacturing industries
- manufacture and repair of specialist equipment needed for solar panel recycling and remanufacture

- expansion of existing supporting industries such as construction and development, logistics and wholesale/retail sale of remanufactured products made from recycled solar panels.

Question 10: How can workers be attracted, educated and retained in remanufacture and advanced manufacturing in NSW? What barriers and opportunities currently exist?

Question 11: How could the recycling industry more rapidly adopt new technologies and processes to improve the value of recovered material for remanufacturing and advanced manufacturing use?

Question 12: What barriers and opportunities exist for increasing investment in domestic remanufacturing and advanced manufacturing using materials recovered from solar panels?

Industry clustering and regional development

The location of solar panel remanufacturing and manufacturing facilities will be shaped by access to end-of-life panels, and the availability of supporting industries, existing infrastructure and a skilled workforce. Strategically locating remanufacturing and manufacturing facilities close to resource recovery infrastructure can reduce transport costs and support more efficient supply chains, while also providing additional benefits to local communities. Co-locating these facilities can also encourage knowledge sharing between resource recovery and advanced manufacturing industries, better tailoring recycling and recovery processes to meet specific remanufacturing needs. These industries can attract additional investment and supporting services, further strengthening specialist skills and knowledge over time.

Regions with existing networks of manufacturing capability, skills and knowledge, energy infrastructure and transport may be well placed to attract investment in solar panel remanufacturing and manufacturing.

Case study: Hunter region

The Hunter region is an example of how historical and existing conditions could support future industry development. As the region transitions from coal-fired power stations to renewable energy, it is leveraging its historical expertise and infrastructure by attracting investment in clean energy industries. The NSW Government is supporting investment in the local manufacture of solar panels through the Net Zero Manufacturing Initiative.

The Hunter region is also relatively close to Greater Sydney, where the largest proportion of NSW's residential rooftop solar panel installations are located, many of which are beginning to reach their end of life. The co-location of waste generation, recycling infrastructure and manufacturing infrastructure would increase local employment opportunities and investment in supporting businesses. In turn, this would boost local economies and communities, increase the efficiency of remanufacturing, better support workforce training and development, increase collaboration between recycling and remanufacturing, reduce the cost of transport between facilities, and lower carbon emissions generated within the supply chain.

Question 13: What factors should influence the location of future solar panel remanufacturing and manufacturing industries in NSW?

Question 14: Which regions in NSW are well placed to support a recycling and advanced manufacturing hub? Why?

Question 15: What barriers hinder local communities from maximising the benefits of hosting co-located recycling and remanufacturing capabilities, and how can they be addressed?

Supporting skilled jobs into the future

The NSW Renewable Energy Skills Strategy is already supporting the workforce needed for the renewable energy transition. These technical skills will be critical as renewable infrastructure reaches end-of-life, enabling the reuse, refurbishment and recycling of solar panels. Embedding these capabilities in the skills pipeline will help NSW build a workforce that supports the circular economy of renewable energy technologies.

The co-location of recycling, remanufacturing and manufacturing infrastructure and specialist training centres would provide more local employment and the development of specialist skills, while also improving local employment outcomes. Strategic investment in these industries could help establish hubs that bring together expertise in resource recovery, advanced materials processing, product design and remanufacturing. This would support local and statewide growth in skilled jobs and the development of higher-value applications for recovered solar panel materials.

As these industries grow, the education and training sector will be critical in developing the skilled workforce needed within these sectors. It will also be key in supporting innovation through research and development, and in technology deployment by recycling, remanufacturing and manufacturing firms.

Future industries will need a range of supporting services including communications, logistics, sales and finance, legal, design and maintenance. These interactions can encourage further collaboration, skills sharing and development, and technology advancement and deployment.

Question 16: What workforce knowledge and skills are essential to support more advanced solar recycling, and a solar panel remanufacturing and manufacturing industry, in NSW?

Question 17: What barriers exist to skill development and how could they be addressed?

Next steps

Establishing a pathway for remanufacturing and advanced manufacturing that uses materials recovered from end-of-life solar panels should occur before significant volumes of solar panels reach end-of-life in NSW.

Investment in solar panel recycling critically lays the groundwork for large-scale processing and recovery of a range of valuable materials, simultaneously supporting innovation and advanced manufacturing, and securing NSW sovereign manufacturing capabilities. By retaining and growing



both valuable material recovery and workforce capability within NSW, the proposed stewardship scheme can support long-term sovereign manufacturing capability and enable NSW to capture greater economic value from the renewable energy transition.

Question 18: Do you have any further thoughts or insights on how NSW might maximise the benefits of the high-value materials recovered from a mandatory solar panel stewardship scheme?