Commonwealth House of Representatives Standing Committee on Climate Change, Energy, Environment and Water inquiry into solar panel reuse and recycling in Australia

NSW Government submission

March 2026

NSW GOVERNMENT

Acknowledgement of Country

The NSW Environment Protection Authority acknowledges the Traditional Custodians of the land on which we live and work, honours the ancestors and the Elders both past and present and extends that respect to all Aboriginal people.

We recognise Aboriginal peoples' spiritual and cultural connection and inherent right to protect the land, waters, skies and natural resources of NSW. This connection goes deep and has since the Dreaming.

We also acknowledge our Aboriginal and Torres Strait Islander employees who are an integral part of our diverse workforce and recognise the knowledge embedded forever in Aboriginal and Torres Strait Islander custodianship of Country and culture.

Commonwealth House of Representatives Standing Committee on Climate Change, Energy, Environment and Water inquiry into solar panel reuse and recycling in Australia

Published by the NSW Environment Protection Authority.

First published: March 2026

Acknowledgements

NSW Department of Climate Change, Energy, the Environment and Water.

Copyright and disclaimer

Contents

1. Introduction 4
2. Response to terms of reference 5
a) Current and projected waste volumes from end-of-life solar panels in Australia....5
b) Current disposal practices and trends....5
c) The comparative costs of solar panel reuse, recycling and landfill disposal, including valuation processes behind landfill disposal prices 6
d) Potential benefits to Australia of expanding onshore reuse and recycling of solar panels, including for households, the environment, energy security supply chain resilience and the economy, including the economic benefits of recovering solar panel resources (such as glass, silicon, aluminium, copper, silver and other critical minerals)....7
e) The state of development of Australia's solar panel reuse and recycling capabilities, domestic markets for second-hand solar panels and recycled materials, and relevant policy and regulatory frameworks at state and federal levels 8
f) Barriers to reusing and recycling solar panels at scale in Australia, including technical, commercial, regulatory or any other challenges 8
g) Alternative policy options for governments to help overcome these challenges 9
h) Any other relevant matter....10
3. Further reading 12

1. Introduction

The NSW Government welcomes the opportunity to provide a submission to the Commonwealth House of Representatives Standing Committee on Climate Change, Energy, Environment and Water inquiry into solar panel reuse and recycling in Australia (the inquiry).

This submission draws on work underway by the NSW Environment Protection Authority (EPA) to develop a regulatory impact statement (RIS) for a national mandatory product stewardship team solar panel, as agreed by the Energy and Climate Change Ministerial Council in August 2025.

NSW has consistently advocated for a mandatory product stewardship scheme for solar panels. The clean energy transition is driving a surge in projected solar panel and associated batteries waste volumes. A stewardship scheme will divert solar panels from landfill, reducing pressure on NSW limited landfill capacity and recapturing critical minerals. A scheme will provide certainty and security to resource recovery facilities, who are currently struggling to compete with cheaper disposal methods including landfill, exports and low-level resource recovery operators.

More than 95% of a solar panel is recyclable and contains valuable materials, including aluminium, glass, copper, silver and silicon, which can be beneficially recovered and reused.

It is important to implement a scheme urgently within the next 12 months to address growing waste volumes and to support the viability of the recycling industry for solar panels. Without a national stewardship scheme, there is likely to be an increase of incidents of illegal dumping, stockpiling and hoarding, creating negative impacts to visual amenity with clean-up costs potentially burdening local and state governments.

2. Response to terms of reference

a) Current and projected waste volumes from end-of-life solar panels in Australia

The clean energy transition is driving a surge in projected solar panel waste volumes, as more panels will be reaching their end-of-life. Over 4.2 million rooftop solar panel systems (<100kW)[1] and over 2,500 large scale solar panel systems (>100kW) have been installed in Australia since 2001, with some solar farms containing over one million panels.[2].[3]

Since 2018, the annual number of small-scale PV installations has consistently exceeded 200,000, driven by a response to Commonwealth and state and territory governments provision of regulatory pathways and incentives supporting solar uptake, and the low cost and increasingly efficient solar panel technology.

These increases in installations will eventually translate into equally high waste volumes in the next few decades. See the material flow analysis (MFA) attached for further information on waste generation.

Current waste generation is predominantly small-scale solar panels in metropolitan cities, including Sydney, Brisbane, Melbourne and Adelaide, with volumes beginning to grow from large-scale solar facilities in regional areas after 2030.[4] By 2045, almost 40% of solar panel waste will be generated from large scale systems over 100kW.

Solar panels have an average lifespan of 20-30 years however replacement ahead of end-of-life is occurring. Small-scale solar panels are decommissioned on average at 15 years as households upgrade to newer and more efficient panels. The Commonwealth Government's *Cheaper Home Battery Program* is driving an increase in early panel replacement for more efficient ones. Over 18% of 2025 solar panel installations were considered replacements of an existing system, increasing from 9% in 2020.[5]

b) Current disposal practices and trends

Traditional solar panels models are comprised of layers of solar cells, encased in encapsulant, connected by copper ribbons, with tempered glass within an aluminium frame. Each PV panel has a junction box that functions as a terminal to output electricity. These components contain materials that can be beneficially recovered, including glass (70% of panel weight) and critical minerals and high-value metals including silver, silicon, aluminium and copper.

Once a solar panel reaches end-of-life, it is decommissioned and can follow several disposal pathways to an endpoint, where the material flow ends. Panels may be sent to collection and transfer points for temporary consolidation, or they may be reused, stockpiled or hoarded for a time, before moving to an end-of-life destination like landfill, resource recovery or export.

There are various levels of solar panel recycling representing increasing levels of processing complexity, material separation, and overall recovery rates, from basic frame removal through to advanced delamination and high-purity material extraction.

---

[1] Clean Energy Regulator 2026, Small scale installation data.

[2] Randell Environmental Consulting 2026, Material flow analysis data on existing and proposed large scale installations.

[3] Clean Energy Regulator 2026, 1.5 million solar panels on the horizon; Queensland Cabinet and Ministerial Directory, Over one million solar panels powering Australia's largest solar farm.

[4] Rong Den, Verity Tan, Chence Niu & Renate Egan (UNSW) 2024, Solar panel end-of-life management in Australia, Australian Centre for Advanced Photovoltaics.

[5] Based on Clean Energy Regulator data

Despite recycling options available, the lowest cost of disposal is a substantial factor in determining the material flows pathways of solar panels. Currently, little solar panel waste is currently going to recycling, and is instead being disposed to landfill, set to the scrap metal trade, or export. See the MFA attached for further information on waste generation pathways.

c) The comparative costs of solar panel reuse, recycling and landfill disposal, including valuation processes behind landfill disposal prices

PV panels today are thinner, stronger and generate more energy than older PV panels.[6] These improvements mean that new PV panels are increasingly cost and power efficient and competitive with second hand PV panels.

The cost of landfill disposal is highly variable depending on location. In NSW, metropolitan areas generally have higher landfill fees than rural and remote areas, supporting higher rates of recycling or export. In contrast, regional and remote areas have lower landfill fees.

Through consultation, NSW understands that the costs of transport and logistics of panels may be up to 50% the cost of recycling, with recyclers required to charge a fee to cover these costs. Dispersed locations and lower volumes of PV panels in regional and rural areas increase the cost of transport. There is also an uneven playing field for reused or refurbished goods, which are often at a disadvantage when competing with new products. Stakeholders pointed to warranty regulations and product standards that tend to favour new products over reused or refurbished alternatives. This creates market disadvantages for circular solutions. Furthermore, testing standards are costly and underdeveloped for reused solar panels, and this limits their market uptake.

There are only a limited number of solar panel recycling facilities and associated collection points in Australia, and solar panels are large, bulky and may need to remain intact for recycling (depending on the technology used).

d) Potential benefits to Australia of expanding onshore reuse and recycling of solar panels, including for households, the environment, energy security supply chain resilience and the economy, including the economic benefits of recovering solar panel resources (such as glass, silicon, aluminium, copper, silver and other critical minerals)

There are significant benefits of expanding onshore reuse and recycling of solar panels. In particular, expanding recycling will divert panels from landfill, stock piling and illegal dumping, preserving limited landfill space and reducing environment harm.

When landfilled in large quantities, solar panels consume limited air space that could be used for materials without alternative disposal options. Landfill capacity is already constrained in some locations across Australia, including Greater Sydney, where non-putrescible waste airspace expected to fall short of demand by 2 Mt per year by 2031.[7] Regional landfills may also lack the capacity or design manage the large waste volumes generated by solar farms.

Illegal dumping of solar panels reduces amenity and creates additional clean-up costs for land managers and governments. Improperly disposed panels can leach materials into soil and waterways, while large stockpiles of loose panels pose risks during storms, high winds and floods.[8]

Additionally, solar panels contain critical minerals and high value metals that can be recovered, including silicon, silver, aluminium and copper. Many of these are mined or refined overseas and recovering them may reduce

---

[6] Stephanie Weckend, Andreas Wade & Garvin Heath 2016, End of life management solar photovoltaic panels, International Renewable Energy Agency.

[7] NSW EPA 2025, Waste and Circular Infrastructure Plan.

[8] Theocharis Tsoutsos, Niki Frantzeskaki & Vassilis Gekas 2005, Environmental impacts from the solar energy technologies; M. Massoud, G. Vega, A. Subburaj & J. Partheepan 2023, Review on recycling energy resources and sustainability.

dependency on international supply chains, particularly for critical minerals and high value metals with higher forecast demand than supply. Recovering materials from solar panels is often less energy intensive than extraction and refinement of raw minerals, particularly silicon. Solar panels are comprised of less than 0.1% silver and consumed 14% of the global silver supply in 2025. This share is expected to grow to 20% by 2030.[9] Based on average solar panel composition and projected waste volumes, full resource recovery of solar panels may be able to recover 15Kt of polysilicon, and 1.5Kt of silver.

Recycling and remanufacturing solar panels may also improve national energy security. Currently, Australia is heavily reliant on overseas manufactured solar panels, with production highly concentrated in China. There is one facility in South Australia that manufactures solar panels, producing approximately 7,000 cells per day to suit the intense Australian desert climate.

In 2024, solar energy generated 18% of Australia's total electricity.[10] The Australian Electricity Market Operator (AEMO) forecasts this to grow and calls for investment to support a six and four-fold increase to grid-scale and rooftop solar capacity by 2050 under its optimal development path for meeting electricity needs and emissions targets. [11] Given the significant contribution of solar PV systems to the national energy market, it is critical for our national energy security to establish and maintain an onshore recycling and manufacturing capacity for solar PV systems.

e) The state of development of Australia's solar panel reuse and recycling capabilities, domestic markets for second-hand solar panels and recycled materials, and relevant policy and regulatory frameworks at state and federal levels

NSW engagement with stakeholders indicates that basic recycling and scrap metal operators removing frames is commercially viable. There are several dedicated solar panel recyclers achieving higher levels of material recovery; however, some have struggled with commercial viability and are in competition with scrap metal recyclers. There is opportunity to develop and test new technologies to recover more materials efficiently.

There is a small domestic reuse market, but consultation has indicated upscaling is challenging due to economic viability issues, including competition with cheaper and more efficient new panels, and several technological and regulatory barriers.

NSW has identified limited end markets for recovered solar glass, which is of low value and comprises up to 70% of each solar panel. Solar glass is treated with antimony to improve panel efficiency, which prevents it from being mixed with other recycled glass for remanufacturing.[12] It is typically downcycled into low value construction materials with limited demand and competition with other waste inputs. [13] Reuse options are also constrained, as panel dimensions, chemistry and glass thickness differ by manufacturer, despite technology available for intact glass removal.

f) Barriers to reusing and recycling solar panels at scale in Australia, including technical, commercial, regulatory or any other challenges

The key barriers to recycling include high logistics costs, consistency of feedstock for recyclers, developing technology for high level recovery and competition with cheaper disposal pathways such as landfill and scrap metal processing.

---

[9] The Silver Institute 2022, World Silver Survey 2022.

[10] Department of Climate Change, Energy , the Environment and Water 2025, Australian Energy Statistics - Update Report 2025

[11] AEMO 2024, 2024 Integrated system plan.

[12] European Solar PV Industry Alliance 2023, Addressing uncertain antimony content in solar glass for recycling.

[13] NSW EPA stakeholder feedback.

Without continuity of feedstock and addressing the cost of logistics, stakeholders have indicated higher level resource recovery of solar panels will face financial barriers in Australia in the short-term. High level recovery processes are expensive and resource intensive. Operators must secure a consistent, critical mass of feedstock to be commercially viable. These challenges are compounded by large upfront equipment costs and logistics costs. Resource recovery operator Sircel has recently gone into voluntary administration due to financial difficulties associated with these issues. [14,15]

The solar panel reuse market has several barriers to commercial viability. New panels are more efficient than older second-hand panels, and large-scale of production makes them substantially cheaper. Transport, handling and safety and efficiency testing add additional costs to second-hand panels. There is a lack of clarity regarding state and territory installation regulations for older panels, which may no longer comply with updated standards.

g) Alternative policy options for governments to help overcome these challenges

The NSW Government is developing a regulatory impact statement and associated cost benefit analysis for a national mandatory solar panel product stewardship scheme. A stewardship scheme will divert PV panels from landfill, reducing pressure on NSW limited landfill capacity and recapturing critical minerals. This work considers options to increase solar panel recycling and encourage the remanufacture of recovered materials.

A stewardship scheme would address key barriers to solar panel recycling by providing a coordinated, national approach. Establishing a scheme could catalyse the recycling industry, creating economies of scale and coordinating recycling pathways to improve cost efficiency for recycling.

h) Any other relevant matter

Solar ESS stewardship scheme

In addition to panels, there may be complementary benefits in exploring stewardship schemes for battery systems. Like panels, waste from solar panel energy storage systems (ESS) is expected to rapidly increase due to the surge in installations driven by the Commonwealth Government's *Cheaper Home Battery Program*, which commenced in July 2025. Over 188,000 installations have occurred in the first 6 months of the program (60% of all installations since 2014) most with 10-year warranties.[16] Decommissioning at scale is expected to being around 2035, generating a large volume of waste (see the MFA attachment for more detail).

Most solar EES are lithium-ion batteries, which pose a significant fire hazard when disposed of incorrectly, creating environmental and human health risks. Fires can occur when lithium-ion batteries are crushed or pierced during waste processing at recovery facilities or landfills, triggering thermal runaway and causing intense, difficult to extinguish fires that release harmful pollutants and may become explosive. [17] Landfill fires can ignite deeply-buried materials and smoulder for months or years (for example, Kealba Victorian landfill fire burned from

[14] Rachel Williamson 2025, Shock and dismay as one of Australia's biggest solar recycling hopes put into administration, Renew Economy.

[15] Sircel 2025, Update: Sircel Operations; NSW EPA stakeholder feedback.

[16] Clean Energy Regulator 2026, Small scale installation data.

[17] Wojciech Mrozik, Mohammad Ali Rajaeifar, Oliver Heidrich & Paul Christensen 2021, Environmental impacts, pollution sources and pathways of spent lithium-ion batteries; Yuying Chen, Lei Zhang, Yichao Zhang, Yuxin Zhou, Zifan Zhang, Shaorun Lin, Wei Wei & Xinyan Huang 2025, Underground fires induced by disposed Li-ion battery in peatland and landfill; Wei Liu, Xuehu Zhong, Junwei Han, Wenqing Qin, Tong Liu, Chunxiao Zhao & Ziyong Chang 2018, Kinetic Study and Pyrolysis Behaviors of Spent $LiFePO_4$ Batteries.

November 2019-May 2022).[18] In 2022–23, NSW Fire and Rescue attended six waste facility fires caused by lithium-Ion batteries.[19]

Solar ESS contain critical minerals and high value metals that can be recovered from recycling. However, Australia has few recycling facilities These facilities operate separately to solar panel recycling, as lithium-ion ESS require discharge, disassembly, immersion and shredding. The metals and black mass are then separated and refined. Large batteries with hundreds of cells must be manually disassembled, increasing handling costs. Non-standard design and disassembly procedures further complicate processing, and high fire risk increases insurance costs.

Previous NSW DCCEEW consultation

The NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) conducted stakeholder consultation into circular economy opportunities in the clean energy sector in 2023. Forty-four submissions were received from across local government, industry, researchers and non-government organisations. The issues paper released ahead of the consultation also contains useful information and is linked in the 'Further Reading' section at the end of this submission.

[18] Chen et al. 2025; NSW EPA 2020, Fire safety in waste facilities information; Margaret Paul 2021, Residents in Melbourne's west fear the worst Kealba Landfill fire to burn through summer, ABC News.

[19] Fire and Rescue NSW 2024, Lithium-Ion Battery Incidents 2022-23.

3. Further reading

Deng R, Tan V, Chence N & Egan R (UNSW) 2024, *Scoping Study: Solar Panel End-of-life Management in Australia*. Australian Centre for Advanced Photovoltaics.

Contreras M, Egan R, Chang N, Hallam B, Hartle O, Watt M, Rayward-Smith W, Walden M, Boylan E, Thoran A, Malbrain C 2023, *Silicon to Solar.* Australian Photovoltaic Institute.

NSW Office of Energy and Climate Change, 2023, *'Going circular in clean energy' Issues paper*, https://www.energy.nsw.gov.au/sites/default/files/2023-01/202301-Going-circular-in-clean-energy-issues-paper.pdf

Published by NSW Environment Protection Authority

6 Parramatta Square
10 Darcy Street
Parramatta NSW 2150

Locked Bag 5022
Parramatta NSW 2124

Phone: +61 2 9995 5000 (switchboard)

TTY users:
Phone 133 677, then ask for 131 555

Speak and listen users:
Phone 1300 555 727, then ask for 131 555

E: info@epa.nsw.gov.au
W: epa.nsw.gov.au

NSW GOVERNMENT