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#### **EXECUTIVE**

### **SUMMARY**

Australia is one of the global leaders in solar energy adoption, capitalising on its abundant sunlight to power homes and businesses sustainably. With over 3.6 million households in Australia now equipped with solar panels on their rooftops, the country has significantly reduced its reliance on fossil fuels and enabled families to save on electricity costs (Monaghan, 2025; Rayner et al., 2024). Solar power firms further support this effort by supplying clean energy to the national grid and reducing greenhouse gas emissions (P. Beth, 2024). By 2024, it is forecast that power generation from coal will be surpassed by rooftop solar capacity during peak daylight hours, underscoring its important role in Australia's transition towards renewable energy sources (Rayner et al., 2024). this development However, presents environmental concerns associated with the management of the increasing volume of solar panel waste. Usually, the lifespan of solar panels lasts 20-30 years, and as early installations approach their end-of-life stage, Australia faces a looming waste crisis. In 2025 alone, 280,000 tonnes of discarded panels are projected to generate, with annual waste volumes estimated to exceed 685,000 tonnes by 2030 and surpass 1.1 million tonnes by 2035 (Energy Live News, 2025; Nguyen, 2024). Initially driven by residential systems, waste contributions from utility-scale solar farms are projected o rise significantly by the mid-2030s (Energy Live News, 2025; Vorrath, 2025).

#### Key findings highlight both challenges and opportunities:

- Projected waste volumes will primarily affect major cities such as Sydney, Melbourne, Brisbane, Perth, and Adelaide before spreading to regional areas as largescale systems reach their end-of-life stage (Goh et al., 2024; Monaghan, 2025; Nguyen, 2024).
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- before spreading to regional areas as large-scale systems reach their end-of-life stage (Goh et al., 2024; Monaghan, 2025; Nguyen, 2024).
- Recycling Opportunities exist in key components of solar panels, which contain economically significant materials, such as silicon for semiconductor layers, aluminium for framing, tempered glass for protective coverings, and minor quantities of scarce metallic elements (Goh et al., 2024). Recycling efforts could unlock significant economic values- estimated at \$1 billion cumulatively by 2035- while mitigating environmental risks associated with improper disposal (Monaghan, 2025).
- Policy Gaps remain, as Australia lacks a harmonised national recycling framework. While some states have banned solar panel disposal in landfills, comprehensive stewardship policies are urgently needed to ensure sustainable management of endof-life panels (Baric, 2024; Monaghan, 2025).

This report explores the implications of solar panel waste for Australia's clean energy future and outlines actionable strategies for addressing this pressing issue.







### **IN AUSTRALIA**

Australia is a prominent global leader in solar energy adoption, leveraging its extensive landmass and high solar irradiance levels to significant photovoltaic facilitate deployment. In 2022, 36% of the energy sources come from renewable energy, of which small to large-scale solar power accounts for 15%. Since overtaking Spain in 2017, the country has achieved the highest per capita solar power generation globally (see Figure 1). This rapid development of solar adoption is powered by increasing electricity costs. financial incentives from government, sustainability awareness, and improved PV efficiency (Farmonaut, 2025; Fuentes et al., 2024).



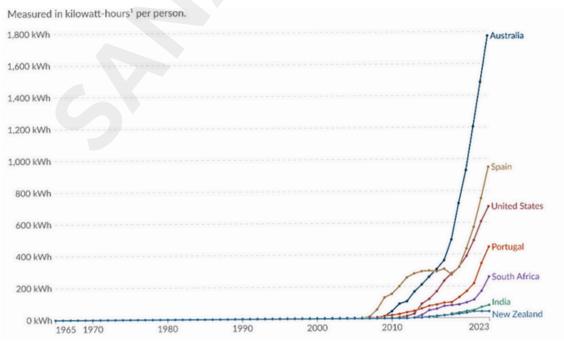


Figure 1: Per capita electricity generation from solar (Source: Our World in Data, 2021)





Residential rooftop solar systems are the backbone of this transformation, representing approximately 60% of all solar installations in the country. Nationally, residential solar PV installation averages 33%, with significant regional variation. South Australia leads with household adoption, followed Queensland (40%) and Northern Territory (19%) (see Figure 2) (Fuentes et al., 2024). Homeowners in Australia have increasingly adopted solar PV technology to mitigate electricity expenses and contribute environmental sustainability (Monaghan, 2025). On average, households can save A\$538 on electricity bills yearly through feed-in- tariff and self-generated electricity (Best et al., 2019).

The environmental benefits of this solar transition are profound. Solar energy produces zero emissions at the point of generation, reducing dependence on electricity generated from coal- and gas-fired electricity and lowering the country's carbon footprint. As a result, solar power has become integral to Australia's efforts in meeting the renewable energy targets and international climate commitment, supporting the nation's transition to a low-carbon economy and energy security (Monaghan, 2025).





### **WASTE CHALLENGE**

"Australia's solar success story now faces a mounting challenge: managing over 1 million tonnes of solar panel waste by 2050 in South Australia alone."

Despite the impressive achievement of the adoption of solar energy in Australia, it has also led to a rapidly emerging challenge: the management of end-of-life solar panels (Mahmoudi et al., 2019; Tan et al., 2024), emphasizing the urgency for recycling solutions that are effective, eco-friendly, and economically viable. Oteng et al. (2022) indicated that, by 2050, over 1 million tonnes

of PV waste will be accumulated in South Australia.

Solar panels can fail in various ways; the most frequent causes are design flaws and manufacturing defects (Mao et al., 2024). The deterioration rate of solar panels throughout their lifespan is 0.58-0.83% per year. As these panels degrade and reach failure over time, they turn into waste, posing significant challenges for waste management. Photovoltaic (PV) panels that are decommissioned at the end of operational life are classified as electronic waste (Daljit Singh et al., 2021), contributing to considerable accumulation of waste (Nimesha et al., 2024). Figure 3 compares the regular and early loss of projected cumulative PV waste in Australia.

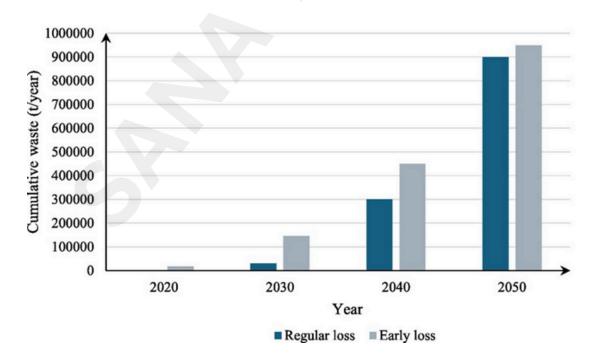


Figure 3: Projected cumulative end-of-life PV modules in Australia (adapted from Nikolina, 2016)



In the early stages, most solar panel waste will originate from small-scale rooftop systems, which are expected to represent over 80% of discarded panels by 2030 due to the early development of the country's residential PV sector. However, by 2035, utility-scale solar firms will generate an increasing portion of this waste, with their share rising from 9.8% in 2023 to 22.9% as large-scale installations from the past decade reach the end of their operational life (Monaghan, 2025; Nguyen, 2024). This transition highlights the pressing requirement for comprehensive strategies and infrastructure to effectively manage the disposal of solar panel across both urban and rural regions of Australia. This energy transition underscores the pressing requirement for thorough strategies and infrastructure to effectively manage the disposal of solar panels throughout both urban and rural regions of Australia.

From a technical perspective, the recycling of photovoltaic (PV) modules in Australia is currently limited in scope. Although the recovery of aluminium frames and junction boxes are relatively efficient, the extraction of other valuable materials, such as glass, silicon, and silver, are economically challenging due to of specialized recycling the absence infrastructure. The current process, which depends heavily on manual frame removal and mechanical shredding, aligns with general ewaste protocols but is inadequate for acquiring high-purity material recovery. Advancing dedicated PV recycling technologies remains a critical policy and industry priority to enable more efficient and cost-effective material reclamation (Deng et al., 2024).

Moreover, identifying viable markets for materials recovered from EoL solar panels-particularly glass, which accounts for approximately 70% of a panel's weight-remains a significant barrier. In the absence of a domestic solar manufacturing industry capable of reusing recycled glass, its primary



application in Australia is currently limited to use as a sand substitute in construction materials. This market limitation is not confined to glass alone; the complex and heterogeneous composition of PV modules further complicate the reuse of other recovered materials. Additionally, repurposing used solar panels within the domestic market is constrained by concerns related to safety and performance reliability (Deng et al., 2024).



#### **ENVIRONMENTAL AND**

#### **ECONOMIC IMPLICATIONS**

"By 2035, Australia is projected to accumulate 1 million tonnes of end-of-life solar panels, with an estimated material value exceeding \$1 billion (Deng et al., 2024)."

Photovoltaic (PV) panels are categorised into four generations based on their production technologies. Among them, first-generation (silicon-based) and second-generation (thinfilm) cells are the most widely applied in commercial applications, while third- and fourth-generation technologies remain largely experimental. Currently, crystalline silicon continues to dominate the global PV market, constituting 92%, due to its high efficiency, strong durability. and cost-effectiveness, Crystalline silicon photovoltaic (c-Si PV) panels are primarily composed of approximately 76% glass, 10% backsheet foil, 8% aluminium, 5% silicon solar cells, and 1% copper (see Figure 4) (Venkatachary et al., 2020).

Although PV power generation significantly reduces the environmental emissions during operation phase, numerous studies highlight the environmental impacts in the production stage (Mao et al., 2024). This is because manufacturing the PV panels requires the intense consumption of environmental and natural resources. The process of transforming raw materials into crystalline silicon-based PV products is very energyintensive. In contrast, recovering silicon from recycled solar panels consumes only about one-third of the energy and cost compared to producing it from raw resources (Choi & Fthenakis, 2010). Furthermore, heave metals contained in solar panels, such as tin, lead, and cadmium (Bakhiyi et al., 2014; Galán et al., can deteriorate the quality environment and human health. Therefore, recycling EoL solar panels helps minimise energy consumption and environmental

contamination. Life cycle assessments indicate that PV installations in Europe emits between 53-76 grams of CO2 equivalent per kilowatthour (Miller et al., 2019), while Nordin et al. (2022) reported that greenhouse emission ranging from 44.96 to 90.45 g CO2 eq/kWh for PV modules, Notably, landfilling PV panels

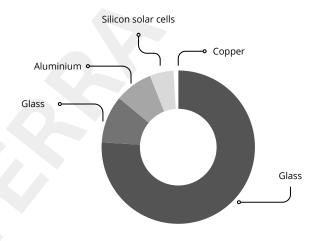


Figure 4: Material Composition of a Crystalline Silicon Solar Panel

leads to considerable resource losses of precious recoverable materials.

On the economic front, solar panels contain several valuable materials, primarily silver, copper, and crystalline silicon (Hurdle, 2023). By 2035, Australia is projected to accumulate 1 million tonnes of end-of-life solar panels, with an estimated material value exceeding \$1 billion (Deng et al., 2024). This substantial volume presents a considerable economic opportunity for the recycling industry and the broader economy. Effective recycling minimises environmental impacts, preserves natural resources, decreases reliance on virgin materials extraction, and promotes job creation in the recycling and manufacturing industries.



#### CURRENT RECYCLING PRACTICES

#### **IN AUSTRALIA**

Despite growing demand, Australia's solar panel recycling infrastructure remains underdeveloped and fragmented. As of August 2023, only approximately 17% of componentsprimarily aluminium frames and junction boxes- are recycled (Sustainability Victoria, 2025), with the remaining 83% including glass, silicon, and polymer back sheets (Baumgurtel et al., 2024), predominantly sent to landfills or stockpiled (Deng et al., 2024). At landfills, there are no preventive measures for chemical leaching, due to the lack of a dedicated largescale PV recycling facility currently operating in the country (Daljit Singh et al., 2021). However, states, such as Victoria and South Australia, have proactive measures to ban landfilling PV

"Only 17% of solar panel components are currently recycled in Australia — the rest ends up in landfills or stockpiles."



modules (Sustainability Victoria, 2025; Suyanto et al., 2023).

Two main approaches are applied to recycle solar panel waste in Australia: (1) mechanical delamination, which separates panels into bulk materials and directs valuable fractions to recovery facilities for existing further processing; and (2) dedicated complete material recovery facilities, which focus solely on solar panel recycling through specialised processes to achieve higher recovery rates and revenues. The National Waste Policy set the targets for both methods to meet an 80% material recovery rate. While mechanical delamination is already in practice, developing dedicated facilities is in plan for the future (Deng et al., 2024). The main impediments for recycling of solar panel waste are the high cost- around \$28 per panel or \$500-\$1,000 per tonne, including logistics and before factoring in material resale revenues- reduces its financial competitiveness against landfill disposal, which costs roughly \$4.50 per panel (Baumgurtel et al., 2024; Tan et al., 2024). In addition, logistic challenge arises from the huge geographical coverage and population dispersed of the country. Coordinating the collection and transportation of bulky, fragile panels from distant locations to centralized processing centres is complex and costly, further complicating the process (Monaghan, 2025).

Although recycling solar panel waste presents certain implications, numerous studies have shown that its benefits far exceed the drawbacks. Recycling offers a more sustainable solution that supports Australia's Sustainable Development (SD) and Circular Economy (CE) goals while also reducing the environmental impacts of end-of-life (EoL) solar panels, making it a preferable alternative to landfill disposal (Halog & McGavin, 2024).

#### INNOVATIONS IN

#### **SOLAR PANEL RECYCLING**



In response to these challenges, researchers in Australia from the University of New South Wales (UNSW) are leading efforts to develop innovative technologies. Recent breakthroughs have introduced advanced methods capable of efficiently separating and recovering up to 99% of photovoltaic (PV) cell components, including aluminium, glass, silicon, silver, and copper. In the recycling process, solar cells are crushed in fine particles within 5-15 mins by stainless steel balls in a vibrator chamber. This method facilitates efficient material separation. Such advancements are designed to create scalable, industry-compatible recycling systems while simultaneously optimizing photovoltaic (PV) panel structures to enhance the recovery of precious components. By enhancing the efficiency and sustainability of solar panel recycling, these innovations have the potential to transform management and support development of a circular economy for solar PV materials in Australia (Carroll, 2024).





### POLICY LANDSCAPE AND GAPS

At present, Australia lacks formal national legislation or a regulatory framework for solar panel waste management (Marcuzzo et al., 2022; Oteng et al., 2022). Although states, such as Victoria and South Australia, have classified solar panels as e-waste and prohibited their disposal in landfills, comprehensive policies for sustainable SPWM are still absent (Clayton, 2023). In Victoria, a landfill ban on solar panels was introduced in July 2019, alongside a \$16.5 million investment to enhance e-waste facilities (Sustainability Victoria, 2025).

Compared to global efforts, Australia is left behind the regions like the European Union, where the Waste Electrical and Electronic Equipment (WEEE) Directive in 2012 enforces an extended producer responsibility (EPR) scheme, requiring solar manufacturers to oversee the disposal and recycling of their products (EU, 2012). The EU's Full Recycling EoL Procedure (FRELP) offers detailed protocols for collection, transport, treatment, and legal compliance (Daljit Singh et al., 2021). In an effort to advance circular economy initiatives, Australia formed the 'Ministerial Advisory Group on the circular economy' in late 2022, targeting a transition to a circular economy by 2030 and emphasising waste prevention during the manufacturing phase- an essential step toward managing SPWM challenges (DCCEEW, 2022). In addition, similar to those implemented in Europe, the University of South Australia introduced a comprehensive product stewardship scheme to address these gaps. These programs typically oblige manufacturers to design solar panels for easier recycling and to take responsibility for their collection and processing at their EoL. In addition, the financial burden of waste management will shift to manufacturers for small-scale system owners. In contrast, owners of large-scale photovoltaic (PV) systems

"Recycling 95% of PV waste is possible—if Australia aligns policy, technology, and industry."



exceeding 100 kW may choose to incur the responsibility for end-of-life management themselves (Deng et al., 2024). The Australian government has planned to launch this national stewardship scheme by the end of 2025, aiming to ensure the recycling or reuse of solar panels domestically and to bring Australia's practices in line with global standards (Wheeler, 2023).



#### RECOMMENDATIONS FOR

#### A SUSTAINABLE FUTURE

"Recycling 95% of PV waste is possible—if Australia aligns policy, technology, and industry."

Solar panel waste challenge requires a sound approach from various aspects. Uniform landfill bans across all states are essential to channel photovoltaic (PV) waste into circular management systems and assist enterprises in accumulating sufficient material volumes, thereby enabling the development of economies of scale (Hallam et al., 2024; Wheeler, 2023). Along with such bans, incentives should be as part of the national PV product stewardship to achieve material recovery rates of over 80% of material recovery from solar panels to align with the National Waste Policy (Hallam et al., 2024).

collaboration is Industry also critical. Partnerships manufacturers, between recyclers, and installers can enhance efficiency in logistics and minimise costs, while the establishment of centralised recycling facilities in major cities will improve the high material recovery rate of EoL PV panels (Baumgurtel et al., 2024; Deng et al., 2024). Public awareness campaigns are also important to foster local capacity for the extension the lifespan of photovoltaic systems, thus aiding in reducing apacity for the extension the lifespan of photovoltaic systems, thus aiding in reducing waste generation. These initiatives should also



educate consumers regarding appropriate disposal methods and emphasize environmental benefits concerned with solar panel recycling (Deng et al., 2024; Wheeler, 2023). Besides, wider collaboration among stakeholders should be promoted to identify and cultivate domestic markets for reclaimed photovoltaic materials. A targeted strategy for glass recovery is crucial, given that glass comprises the most significant component of PV panels by weight. This involves improving sorting and cleaning methods to repurpose finely crushed glass, and alternative uses for mixed materials will enhance overall recycling outcomes and reduce landfill dependency. Through coordinated efforts among industry, government, and the research sector, Australia can build a more resilient and sustainable PV waste management system (Deng et al., 2024).



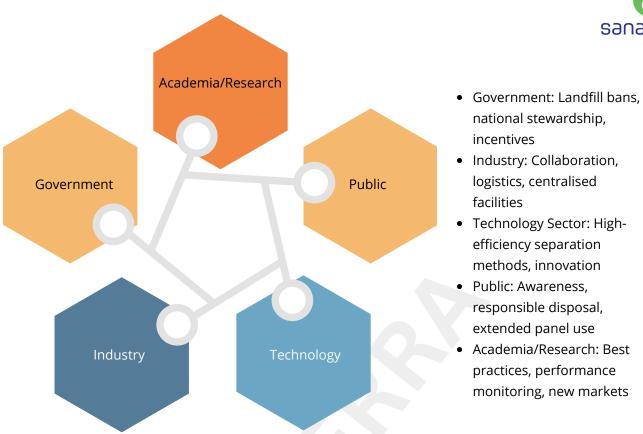


Figure 5: Key Pillars of a Circular PV Waste System

To overcome the technical challenge, developing dedicated technical capabilities and investing in specialised recycling infrastructure tailored to PV modules are essential, which include advancing separation technologies-mechanical, chemical, thermal, and electrostatic- that can enable material recovery rates exceeding 95% with a focus on reclaiming high purity materials for reintegration into PV manufacturing rather than diversion into lower-

value sectors. To optimize material recovery rates, targeted support in alignment with national practices with international best standards should be in place strengthening the capacity of local recyclers. Moreover, the integration of these modern technologies with supportive policies and industry collaboration will drive long-term circularity and environmental benefits across the solar value chain (Deng et al., 2024).



## THE ROADMAP **AHEAD**



Managing Australia's solar panel waste effectively requires a clear roadmap. In the short term, efforts should focus on expanding collection points and testing facilities to prepare for increasing volumes of EoL panels (Baumgurtel et al., 2024; Monaghan, 2025). Medium-term goals include developing centralised recycling hubs in major metropolitan areas by 2030 to handle growing waste streams efficiently (Baumgurtel et al., 2024; Carroll, 2024).

Lastly, circular economy should be prioritized for the long-term goals by maximizing the recovery and reuse of materials, lessening the dependence on raw material imports, and minimizing adverse environmental impacts (Carroll, 2024; Wheeler, 2023). Achieving a sustainable future for solar energy necessitates coordinated action among governments, industry stakeholders, and research institutions.



#### CONCLUSION



Australia has made a significant progress in its transition to a low-carbon future by adopting the solar energy. However, the country faces challenges regarding the management of solar panel waste. With 1 million tonnes projection of solar panel waste generation by 2035, immediate actions are required to prevent this renewable revolution from a potential waste crisis. The environmental risks of improper disposal and the untapped economic potential in recovered materials underscore the urgent need for a nationally coordinated, well-regulated recycling system.

At present, there is a limitation of recycling efforts in terms of scale and scope posed by technical barriers, policy gaps, and inadequate infrastructure. However, this challenge presents a unique opportunity. By investing in specialised recycling technologies, standardizing national stewardship policies, and stimulating market demand for recovered materials, Australia can lead the world not only in solar energy generation, but also in sustainable solar lifecycle management. A circular approach to solar waste will safeguard the already achieved environmental gains, create economic value, and build a more resilient and sustainable energy future for future generations.

"Lead in clean energy, lead in clean disposal—Australia's solar waste is a challenge and an opportunity."

#### REFERENCES

- Bakhiyi, B., Labrèche, F., & Zayed, J. (2014). The photovoltaic industry on the path to a sustainable future Environmental and occupational health issues. Environment International, 73, 224–234. https://doi.org/10.1016/j.envint.2014.07.023
- Baric, D. (2024). Recycling Solar Panels: Chipping Away at our Mountain of Waste. Keep Australia Beautiful. https://kab.org.au/recycling-solar-panels-chipping-away-at-our-mountain-of-waste/
- Baumgurtel, M., Merwe, A. van der, & KC, K. (2024). Australia's Solar Panel Recycling Challenge and Market Outlook - Hamilton Locke. https://hamiltonlocke.com.au/australias-solar-panel-recycling-challenge-and-market-outlook/
- Best, R., Burke, P. J., & Nishitateno, S. (2019). Evaluating the effectiveness of Australia's Small-scale Renewable Energy Scheme for rooftop solar. Energy Economics, 84, 104475. https://doi.org/10.1016/J.ENECO.2019.104475
- Carroll, D. (2024). UNSW researchers eye redesigned panel as part of recycling plans pv magazine Australia. PV Magazine Australia. https://www.pv-magazineaustralia.com/2024/07/09/unsw-researchers-eye-redesigned-panel-as-part-of-recyclingplans/
- Choi, J. K., & Fthenakis, V. (2010). Design and optimization of photovoltaics recycling infrastructure. Environmental Science and Technology, 44(22), 8678–8683. https://doi.org/10.1021/ES101710G
- Clayton, R. (2023). Solar panels are leading the clean energy revolution, but recycling them isn't easy. ABC News. https://www.abc.net.au/news/2023-01-22/solar-panel-recycling-nano-silicon-extraction/101865624
- Daljit Singh, J. K., Molinari, G., Bui, J., Soltani, B., Rajarathnam, G. P., & Abbas, A. (2021).
   Life Cycle Assessment of Disposed and Recycled End-of-Life Photovoltaic Panels in Australia. Sustainability 2021, Vol. 13, Page 11025, 13(19), 11025.
   https://doi.org/10.3390/SU131911025
- DCCEEW. (2022). New expert group to guide Australia's transition to a circular economy
   Ministers. Department of Climate Change, Energy, the Environment and Water.
   https://minister.dcceew.gov.au/plibersek/media-releases/new-expert-group-guide-australias-transition-circular-economy
- Deng, R., Tan, V., Niu, C., & Egan, R. (2024). Scoping Study: Solar Panel End-of-life Management in Australia. In Deng, Rong Tan, Verity Niu, Chence Egan, Renate.
- Energy Live News. (2025). Australia faces solar scrapheap challenge. https://www.energylivenews.com/2025/03/06/australia-faces-solar-scrapheap-challenge/
- EU. (2012). Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast) Text with EEA relevance. Official Journal of the European Union. https://eurlex.europa.eu/eli/dir/2012/19/oj/eng
- Farmonaut. (2025). Revolutionizing Solar Adoption in Australia: Performance Guarantees Boost Consumer Confidence in Renewable Energy -. Farmonaut. https://farmonaut.com/australia/revolutionizing-solar-adoption-in-australia-performance-guarantees-boost-consumer-confidence-in-renewable-energy/

- Fuentes, P. M. J., Khalilpour, K., & Voinov, A. (2024). Solar energy surge: The socioeconomic determinants of the photovoltaic systems growth in Australia. Energy Research & Social Science, 116, 103695. https://doi.org/10.1016/J.ERSS.2024.103695
- Galán, J., López, L., Wambach, K., & Röver, I. (2005). Recovering of waste monocrystal silicon solar cells in order to be used in PV modules manufacturing.
- Goh, K. C., Kurniawan, T. A., Goh, H. H., Zhang, D., Jiang, M., Dai, W., Khan, M. I., Othman, M. H. D., Aziz, F., Anouzla, A., & Meidiana, C. (2024). Harvesting valuable elements from solar panels as alternative construction materials: A new approach of waste valorization and recycling in circular economy for building climate resilience. Sustainable Materials and Technologies, 41, e01030. https://doi.org/10.1016/J.SUSMAT.2024.E01030
- Hallam, B., Renewables, I. T. P., Thompson, D., Renewables, I. T. P., Deng, R., & Sydney, U. (2024). AUS02 PV Circularity Policy Recommendations Report.
- Halog, A., & Mcgavin, L. (2024). Policy design for solar waste management in a decarbonised, circular economy: a systematic review. https://doi.org/10.25647/LIEPP.WP.166
- Hurdle, J. (2023). As Millions of Solar Panels Age Out, Recyclers Hope to Cash In. Yale School of Environment. https://e360.yale.edu/features/solar-energy-panels-recycling
- Mahmoudi, S., Huda, N., & Behnia, M. (2019). Photovoltaic waste assessment: Forecasting and screening of emerging waste in Australia. Resources, Conservation and Recycling, 146, 192–205. https://doi.org/10.1016/J.RESCONREC.2019.03.039
- Mao, D., Yang, S., Ma, L., Ma, W., Yu, Z., Xi, F., & Yu, J. (2024). Overview of life cycle assessment of recycling end-of-life photovoltaic panels: A case study of crystalline silicon photovoltaic panels. Journal of Cleaner Production, 434, 140320. https://doi.org/10.1016/J.JCLEPRO.2023.140320
- Marcuzzo, R., de Araujo, W. C., Maldonado, M. U., & Vaz, C. R. (2022). A multi-country simulation-based study for end-of-life solar PV panel destination estimations.
   Sustainable Production and Consumption, 33, 531–542. https://doi.org/10.1016/J.SPC.2022.07.021
- Miller, I., Gençer, E., Vogelbaum, H. S., Brown, P. R., Torkamani, S., & O'Sullivan, F. M. (2019). Parametric modeling of life cycle greenhouse gas emissions from photovoltaic power. Applied Energy, 238, 760–774. https://doi.org/10.1016/j.apenergy.2019.01.012
- Monaghan, T. (2025). Australia's Solar Waste: A Growing Problem. Australian Energy Council. https://www.energycouncil.com.au/analysis/australia-s-solar-waste-a-growing-problem/
- Nguyen, N. (2024). Solar Panel Waste Predicted to Hit 1 Million Tonnes by 2030: Australian Research | The Epoch Times. The Epoch Times. https://www.theepochtimes.com/world/solar-panel-waste-predicted-to-hit-1-million-tonnes-by-2030-australian-research-5619878
- Nikolina, S. (2016). International renewable energy agency (IRENA). https://policycommons.net/artifacts/1340810/international-renewable-energy-agency-irena/1951671/
- Nimesha, K. M. D., Robert, D. J., Giustozzi, F., & Setunge, S. (2024). Sustainable management of end of life crystalline silicon solar panels in Australia: Advancing circular economy practices. Solar Energy, 282, 112933. https://doi.org/10.1016/J.SOLENER.2024.112933
- Nordin, A. H. M., Sulaiman, S. I., & Shaari, S. (2022). Life cycle impact of photovoltaic module degradation on energy and environmental metrics. Energy Reports, 8, 923–931. https://doi.org/10.1016/J.EGYR.2022.05.257

- Oteng, D., Zuo, J., & Sharifi, E. (2022). Environmental emissions influencing solar photovoltaic waste management in Australia: An optimised system network of waste collection facilities. Journal of Environmental Management, 314, 115007. https://doi.org/10.1016/J.JENVMAN.2022.115007
- Our World in Data. (2021). A Global Breakdown of Greenhouse Gas Emissions by Sector. https://www.visualcapitalist.com/cp/a-global-breakdown-of-greenhouse-gas-emissions-by-sector/
- P. Beth. (2024). The Environmental and Economic Impact of Solar Farms in Australia. https://www.energymatters.com.au/renewable-news/the-environmental-and-economic-impact-of-solar-farms-in-australia/
- Rayner, J., Zou, A., Mcleod, B., & Tidswell, K. (2024). Seize The Sun: How to supercharge australia's rooftop solar | Climate Council. In Climate Council. https://www.climatecouncil.org.au/resources/seize-the-sun/
- Sustainability Victoria. (2025). National approach to manage solar panel, inverter and battery life cycles. https://www.sustainability.vic.gov.au/circular-economy-and-recycling/product-stewardship/national-approach-to-manage-solar-panel-inverter-and-battery-lifecycles
- Suyanto, E., Sofi, M., Lumantarna, E., Production, L. A.-J. of C., & 2023, U. (2023). Comparison of waste photovoltaic panel processing alternatives in Australia. ElsevierER Suyanto, M Sofi, E Lumantarna, L AyeJournal of Cleaner Production, 2023•Elsevier. https://www.sciencedirect.com/science/article/pii/S0959652623022862
- Tan, V., Deng, R., & Egan, R. (2024). Solar photovoltaic waste and resource potential projections in Australia, 2022–2050. Resources, Conservation and Recycling, 202, 107316. https://doi.org/10.1016/J.RESCONREC.2023.107316
- Venkatachary, S. K., Samikannu, R., Murugesan, S., Dasari, N. R., & Subramaniyam, R. U. (2020). Economics and impact of recycling solar waste materials on the environment and health care. Environmental Technology & Innovation, 20, 101130. https://doi.org/10.1016/J.ETI.2020.101130
- Vorrath, S. (2025). Australia's rooftop solar waste problem is hurtling towards 1.2 gigawatts a year | RenewEconomy. Renew Economy. https://reneweconomy.com.au/australias-rooftop-solar-waste-problem-is-hurtling-towards-1-2-gigawatts-a-year/
- Wheeler, M. (2023). Product stewardship scheme proposed for solar panels Inside Waste. https://www.insidewaste.com.au/85129-2-product-stewardship-scheme/

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