AUSTRALIAN ALUMINIUM COUNCIL LTD

Inquiry into solar panel reuse and recycling in Australia
https://www.aph.gov.au/Parliamentary_Business/Committees/House/Climate_Change_Energy_Environment_and_Water/Solarpanelrecycling

26 March 2026

Dear Committee Chair;

Re: Inquiry into solar panel reuse and recycling in Australia

The Australian Aluminum Council (the Council) welcomes the opportunity to make a submission to the Standing Committee on Climate Change, Energy, Environment and Water inquiry into solar panel reuse and recycling in Australia. The Council has completed three reports which are of relevance to the work of this committee:

1. 2022 – Cast Anew - Opportunities to bring aluminium to life through manufacturing & recycling (including closed loop mine to panel solar value chain); Deloitte and Coreo;
2. 2026 - Aluminating the Path, Driving Aluminium Circularity in the Solar Photovoltaic Sector, Rennie; and
3. 2026 - Enabling Development of Aluminium Recycling Capability in Australia, L.E.K. Consulting.

The Council's submission provides context for the industry in Australia, and will draw upon these three reports in this submission, in response to the specific Terms of Reference.

A domestic aluminium recycling and remelting industry — including a closed-loop solar value chain — would strengthen Australia's industrial resilience and complete the existing value chain from mining through to finished products by adding a recycled option. This would help retain more value in Australia rather than exporting it overseas. Recycling just 40 kt of pre-consumer scrap domestically (around 10% of Australia's aluminium scrap arisings and a practical starting point) could directly support more than 130 jobs and generate up to AU$300 million in economic value. It would also create a scalable foundation for a circular aluminium industry capable of processing future aluminium from solar PV systems as volumes grow, keeping more value onshore.

The Council would welcome the opportunity to appear at one of the Public Hearings, should the Committee have any questions.

Kind regards,

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Australia's Aluminium Industry

The Australian Aluminium Council represents Australia's bauxite mining, alumina refining, aluminium smelting and downstream processing industries. The aluminium industry has been operating in Australia since 1955, and over the decades has been a significant contributor to the nation's economy. Earnings for Australian exports of aluminium, alumina and bauxite are expected[1] to rise from $18 billion in 2025–26 to $19 billion in 2026–27. More than $14B of this comes from the alumina and aluminium industries, as value adding mineral processing sectors. The industry includes six bauxite mines which collectively produce over 100 Mt per annum, making Australia one of the world's largest producers of bauxite. Australia is the world's largest exporter of alumina with five alumina refineries producing around 18 Mt per annum of alumina. Australia is the seventh largest producer of aluminium, with four aluminium smelters and additional downstream processing industries including more than 20 extrusion presses. Aluminium is Australia's top manufacturing export. The industry directly employs more than 21,000 people, including 6,600 full time equivalent contractors. It also indirectly supports a further 55,000 families predominantly in regional Australia.

Aluminium in Solar Panels

Aluminium is one of the commodities most widely used in the global transition to a clean energy future[2]. It is also recognised for its importance to both economic development and low emissions transition. Aluminium use is highly correlated with GDP, so as countries urbanise, per capita use of aluminium increases. It is expected that by 2050, global demand for aluminium is expected to nearly double from around 100Mt per annum to around 190Mt[3]. While an increasing proportion will be met through recycled aluminium, there will still be a need for increased production of primary aluminium requiring a comparable increase in global bauxite mining and alumina refining rates.

Australia is one of the very few countries which has bauxite mining, alumina refining, aluminium smelting and aluminium extrusion industries, making aluminium one of the few commodities in which the raw materials are mined and processed into consumer products right here in Australia. However, there is an opportunity to leverage this existing industry further. For example, aluminium accounts for more than 88% of the metal in a solar panel. The aluminium frame and rail are examples of extrusions which can be made using existing manufacturing capability in Australia. For every GW of solar PV, 5.5 kt of aluminium extrusion is needed for frames and for every GW of rooftop solar, an additional 13 kt of aluminium extrusion is needed for rails and mountings. Aluminium frame and rail can be reused or recycled if circularity is considered in design. Installed solar in Australia will need more than 1.5 M tonnes of aluminium extrusion by 2050, creating a substantial increase in demand for both aluminium and extrusions. But today more than 70% all semi-finished aluminium used in Australia is imported and <3% of Australian extrusion capacity is supplied as solar rail and none as solar frame. Leveraging opportunities under the National Renewable Energy Supply Chain Action Plan for Australian aluminium to be used in the development of a solar PV industry could see Australian bauxite become Australian made solar panels. In addition, the upstream aluminium industry has a growing demand for renewables including solar[4], which could further catalyse demand for manufacturing.

As aluminium is a high value commodity and infinitely recyclable, aluminium rail and frame is readily recycled at the end of its life. However, there is the potential for this to be a closed loop value chain, as articulated in work undertaken by the Council in conjunction with Deloitte and Coreo in 2022[5] (Figure 1).

Further support is needed to prioritise Australian made aluminium to supply Australia's solar panel module production, in the form of both frame and rail. One of the biggest threats to Australia manufacturing sector

[1] https://www.industry.gov.au/sites/default/files/2025-06/resources-and-energy-quarterly-june-2025.pdf

[2] https://www.worldbank.org/en/topic/extractiveindustries/brief/climate-smart-mining-minerals-for-climate-action

[3] International Aluminium Institute High Substitution Scenario, https://alucycle.international-aluminium.org/

[4] https://www.riotinto.com/en/news/releases/2024/rio-tinto-to-drive-development-of-australias-largest-solar-farm-at-gladstone and https://www.riotinto.com/en/news/releases/2023/rio-tinto-approves-new-solar-farm-and-battery-storage-to-power-its-amrun-bauxite-operations-on-cape-york

[5] https://aluminium.org.au/wp-content/uploads/2022/11/Cast-Anew-Aluminium-Discussion-Paper_Public-FINAL.pdf

is imports below internationally accepted pricing standards. Ensuring the successful delivery of Australia's aluminium from mine to PV needs not only programs such as Solar Sunshot[6] but also ensuring Australia's manufacturers operate under free and fair trade to be able to compete. While the supply chain exists in Australia, meeting growing demand would require investment to increase capacity within Australia's supply chain. This would apply to both extrusions and supply of billet from smelters to the domestic market.

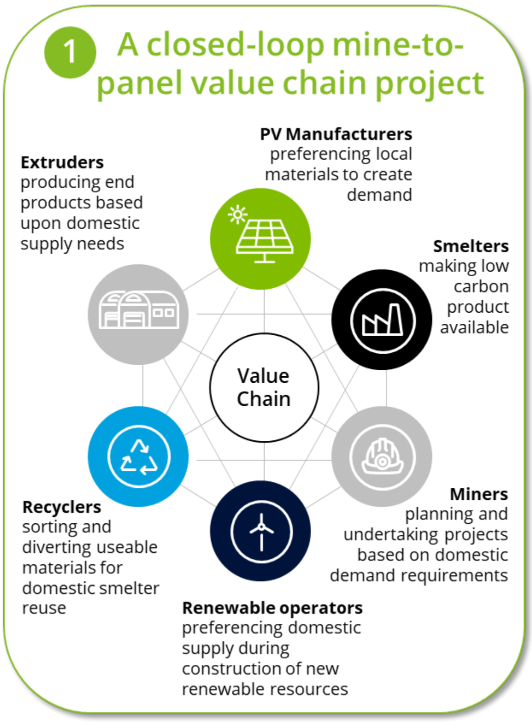

Figure 1. Opportunities for a Closed Loop Mine to Panel System[7]

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

Globally, PV installations are growing rapidly as governments pursue decarbonisation and low - cost electricity. Global installed capacity exceeded 2.2 TW in 2024, with almost 600 GW added in a single year, making solar the largest source of new power generation. In 2024, an estimated 8 million tonnes of aluminium was used in the manufacture of PV systems, representing 10% of all production. Consequently, scaling and advances in aluminium recycling infrastructure are needed globally to extract, aggregate, process and recycle this aluminium at end - of- life which is estimated to be nearly 9 Mt per year by 2050 (Figure 2). The trend within Australia is expected to mirror this global trend, given the high uptake of solar at both grid and small scale.

However, this rapid expansion creates an emerging challenge: early distributed and utility -scale projects are beginning to reach end - of- life, accelerating rapidly by 2040, while recycling infrastructure remains underdeveloped in most markets. Over time, as existing PV installations reach end - of- life, aluminium scrap from the PV sector will grow rapidly. Aluminium is integral to both distributed and utility -scale systems, with 6 -series aluminium serving as a primary structural material in module frames as well as racking systems for distributed systems (Figure 3). This is of particular relevance in Australia where extrusion manufacturing of 6-series aluminium is one of the remaining downstream capabilities. It is also where Australia has a key focus in terms of potential future closed loop recycling, which could be extended to solar panel recycling, making a closed loop value chain.

[6] https://arena.gov.au/funding/solar-sunshot/

[7] https://aluminium.org.au/wp-content/uploads/2022/11/Cast-Anew-Summary-for-Website.pdf

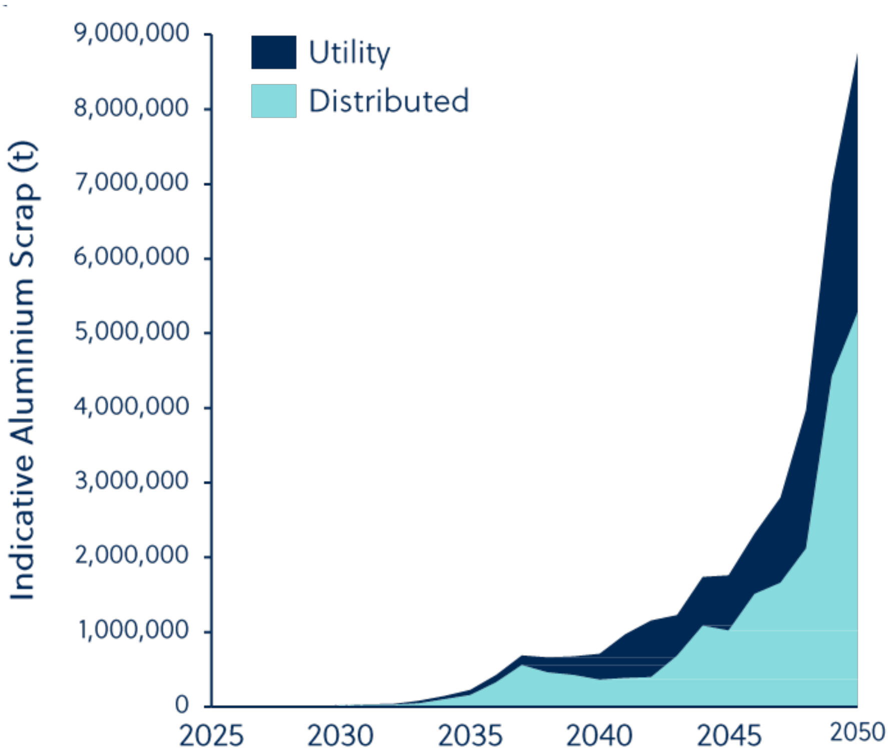

Figure 2. Indicative PV Aluminium Scrap Based on 25 Year Life[8]

Installation Type	Component	Aluminium Type	Key Properties
Distributed	Frame	6063-T5/T6	Light weight, ease of extrudability, corrosion resistant
	Racking (rooftop)	6063-T5/T6 6061-T6 6005-T5	Light weight, stiffness, malleability
	Other (e.g. Inverters)	6063 6062	High thermal conductivity, extrudability, corrosion resistant
Utility	Frame	6063-T6 6061-T6	Structural stability/strength, corrosion resistant, good weldability
	Racking (ground-mounted tracker)	6061-T6	High tensile and yield strength, fatigue resistant, corrosion resistant*
	Other (e.g. Inverters)	6063 6062	High thermal conductivity, extrudability, corrosion resistant

Figure 3. Aluminium Material Intensity by PV Scale[8]

[8] https://aluminium.org.au/wp-content/uploads/2026/01/Aluminating-the-Path-Driving-Aluminium-Circularity-in-the-Solar-Photovoltaic-Sector-1.pdf

b. Current disposal practices and trends

Upstream material selection and design decisions create barriers for end - of-life PV aluminium circularity. Decisions made upstream at the manufacturing, project development and installation phase can drive downstream circular outcomes for aluminium. PV manufacturers are facing a race to the bottom on cost and are considering cheaper alternative materials to aluminium. Module sale prices have fallen 90 per cent since 2010 (US $2.44/W to US $$0.26/W), pushing manufacturers to explore cheaper alternatives like polycarbonate and composites. These alternatives present significant end - of- life challenges as they are difficult to recycle. Conversely, aluminium's superior mechanical and circular proprieties are likely to ensure it remains the dominant material selected.

Design decisions around frame connections are influential in the ease of recyclability. Mechanical fasteners support end - of- life recovery, while adhesives and composites often preclude economic separation for recyclers. Upstream players are driven by material suitability, aesthetic and cost requirements of customers, with limited consideration on end - of- life outcomes. Surface coatings play an equally important role with clear anodised finishes being simpler to recycle, while thick powder and PVDF coatings, chosen for aesthetics or extended durability, hamper scrap quality and increase downstream processing costs.

Some aluminium components, particularly distributed racking systems, demonstrate longevity beyond module life and can deliver secondary applications. Scaling reuse requires supply chain standardisation and certification infrastructure that remains nascent globally. Industry stakeholders acknowledge that reuse pathways, though valuable, cannot adequately address the looming volumes of systems approaching genuine end - of- life. Recycling can be both closed and open loop within the aluminium supply chain, with open loop likely the most viable pathway owing to the geographic concentration of PV manufacture. Regardless of pathway, unlocking aluminium recycling offers significant opportunity for value capture and emissions avoidance, with an estimated reduction of 97%.

While Australia is a global leader in bauxite mining, alumina refining and primary aluminium production, yet almost all aluminium scrap generated domestically — around 440 kilotonnes (kt) each year — is exported for remelting offshore. Establishing domestic recycling and remelting capability is therefore not about fixing a waste problem — it is instead about capturing economic value, strengthening sovereign capability, reducing emissions intensity and meeting growing customer demand for lower-carbon, recycled materials. It is a significant unrealised opportunity for Australia.

c. Comparative costs of reuse, recycling and landfill disposal (including landfill valuation processes)

In the case of aluminium, the comparative case is not with landfill, but with the value of scrap when exported.

Australia’s aluminium sector increasingly recognises recycling as a critical pathway to reducing energy use, carbon intensity and dependence on imported metal containing recycled content. Recycling aluminium makes intuitive sense — when properly sorted and managed, it can be recycled indefinitely, and remelting scrap requires only about 5% of the energy used in primary production. Nevertheless, the domestic recycling infrastructure remains underdeveloped: since its rolling-mill closures in 2014, Australia has exported around 95% of its aluminium scrap rather than remelting it locally. A 2024 market-sounding exercise conducted for the Council estimated that Australia exports on the order of 440 kt of aluminium scrap annually, including 43 kt of pre-consumer extrusion scrap. While the pre-consumer scrap is well documented and known, the rest is not well documented in terms of alloy types or source location (Figure 4).

The global London Metal Exchange (LME) price for primary aluminium typically ranges between US$1,800 and US$3,000 per tonne, and scrap aluminium is priced at a small discount to that benchmark. Industry participants report that it is common to receive more than 90% of the LME price for pre-consumer scrap today. This can be even higher when regional premiums and product premiums are included. This means that aluminium scrap is a valuable traded commodity, not a waste product, and it is almost always recovered and reused (particularly once separated and traded). Unlike lower-value or contaminated waste streams such as mixed plastics, where weak economics and poor traceability have led to environmental and social concerns overseas, aluminium scrap is consistently handled through established global supply chains and remelted responsibly offshore.

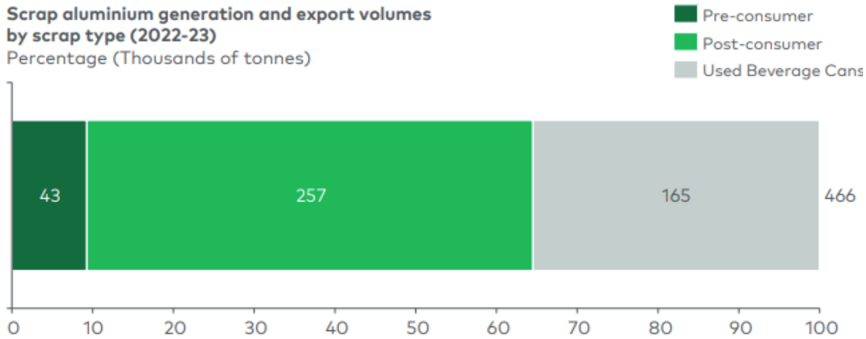

Figure 4. Total Australian volumes of aluminium scrap by type[9]

In recent years, industry players have begun pilot and early-stage closed-loop recycling initiatives. For example, Capral Aluminium, G.James Aluminium Products, Alspex Extrusions, Sims Metal and Rio Tinto, have launched a programme in which post-production scrap from these extruders is processed by Sims Metal and remelted at Rio Tinto's Boyne Smelters to produce billet containing a minimum of 20% recycled content, which is then returned for extrusion. While still at trial scale, the project represents the first integrated, scalable model for closed-loop aluminium recycling in Australia and highlights how cooperation between extruders, recyclers and smelters can enable a future onshore circular aluminium economy.

d. Potential benefits of expanding onshore reuse and recycling

The strategic case is clear. Recycling aluminium uses only 5% of the energy required for primary production and offers strong stewardship benefits. A domestic recycling and remelting industry could support more than 1,000 skilled and blue-collar jobs, reinforce Australia's industrial resilience, and complete the existing value chain from mining through to finished products with a recycled option, ensuring more of the value currently exported is retained locally. Demand signals are already emerging from manufacturers, builders and brand owners seeking verified recycled content.

Developing domestic aluminium recycling and remelting capability is about building industrial resilience, sovereign capability and clean-manufacturing competitiveness for a low-carbon world. And the prize is significant: domestic recycling of just 40 kt of pre-consumer scrap (10% of Australian aluminium scrap arisings and the logical starting point for initial efforts) could directly support more than 130 jobs and as much as AU$300 million in economic value for the Australian economy.

Additionally, if Australia does not start to develop this capability in downstream recycling, then as recycled content is increasingly specified by consumers, this will be met by imports, further reducing the competitiveness of Australia's primary aluminium smelters; extruders; and metal fabricators.

e. State of development of Australia's capabilities, markets and policy frameworks

Policy maturity varies widely, but the opportunity is clear for product stewardship. Governments are taking divergent paths to PV end - of- life management. Europe's mandatory extended producer responsibility (EPR) regimes, supported by Waste Electrical and Electronic Equipment Act and EN 50625 standards, together with instruments such as landfill taxes and bans, have delivered declining landfill rates and aluminium recovery rates above 80 per cent by weight. 1,2China, despite lacking formal PV EPR legislation, could achieve EPR - like outcomes through the rigorous national standards and permitting mechanisms coming into force. 3 Most other markets (e.g. Australia, Canada, India and the United States) remain fragmented across jurisdictions, with inconsistent rules, unclear producer obligations and thin infrastructure, slowing the build - out of dedicated recycling capacity as volumes rise (Figure 5). Standards and design integration are lagging globally.

[9] https://aluminium.org.au/news/market-sounding-report-domestic-utilisation-of-australian-scrap-aluminium/

PV-specific design – for disassembly and material specifications exist only in Europe and parts of China. Elsewhere, modules are engineered for 25 - year durability but not for end - of- life recovery; alloys, coatings and treatment pathways are rarely chosen with recyclability in mind. Traceability is underdeveloped, with limited use of labelling, product passports or harmonised reporting of module composition. These gaps mean recyclers face variable feedstock quality, higher processing costs and limited ability to demonstrate high - quality secondary aluminium. Industry and recyclers are united on a path forward which develops markets for recycled product, provides policy certainty and delivers standards alignment.

	Australia	Europe	India	China	US	Canada
End-of-life Policy & Standards	Limited	Enforced EPR and design standards	Limited	Incoming EPR-like response	Limited	Limited
Recycling Rate (PV Modules)	Minimal	>80%	Minimal	Nascent	~10%	Limited
Aluminium recovery infrastructure	Export-centric	Developed	Developing	Developing	Developed	Developed
Barriers	Transport distances, low volume	Export drains local processing, varied enforcement	Lack of formalised recovery sector	Informal recovery sector	Lack of market incentive for recovery and state-based variance	Provincial fragmentation
Traceability	Voluntary	Environmental Product Declaration and reporting required	Limited	Voluntary	Voluntary	Environmental Product Declaration pilot

Advanced   Emerging   Limited

Figure 5.Comparison between regions across policy, recovery and infrastructure[8]

f. Barriers to scaling reuse and recycling in Australia

Developing domestic aluminium recycling and remelting capability in Australia is constrained by a combination of economic and technical barriers, each of which interacts to limit industry viability (Figure 6).

Economic Barriers – It Doesn't Stack Up Commercially

- **Global scrap prices high**: Scrap exports fetch ~94% of LME price → domestic processors can't compete.
- **Export orientation:** ~95% of aluminium scrap is exported (≈440 ktpa).
- **High energy & logistics costs:**
  - Transport uneconomic beyond ~500 km radius (volume-outs before weigh-outs).
  - Energy prices volatile and higher than peers.
- **No scale economies:** No large domestic remelter → no base load to justify investment.

Australia loses both the scrap and the value-add

Technical Barriers – Complex and Dispersed Scrap Streams

- **Mixed alloys:** Building and manufacturing scrap blends incompatible alloy series.
- **Contaminants:** Coatings, plastics, and fasteners require costly pre-treatment.
- **Limited domestic capability:**
  - Smelters (Tomago, Boyne, Bell Bay, Portland) can only handle small, clean scrap volumes.
  - No advanced melt purification or alloy sorting tech post–Yennora & Point Henry closures.

Remelt quality & scale demand new infrastructure and technology investment

Figure 6. Summary of barriers to developing recycling and remelting capability in Australia[10]

Economic constraints dominate: scrap prices sit above 90% of the LME benchmark, leaving limited margin for potential domestic remelters once transport and energy costs are factored in. Technical challenges — including mixed-alloy scrap and limited pre-treatment infrastructure — compound these pressures, while Australia's geography makes collection beyond 500 kilometres (km) uneconomic without support.

The economics of creating recycled aluminium are complex, but there are some clear factors that show why it is commercially challenging despite the advantages of reduced energy consumption. In the illustrative economics of primary vs recycled aluminium (Figure 7), there is a very clear benefit from remelting using 5% of the energy of making primary aluminium, but the sheer cost of scrap (more than 90% of LME for prime pre-consumer scrap) overwhelms the savings in energy and bauxite/alumina in this example[11].

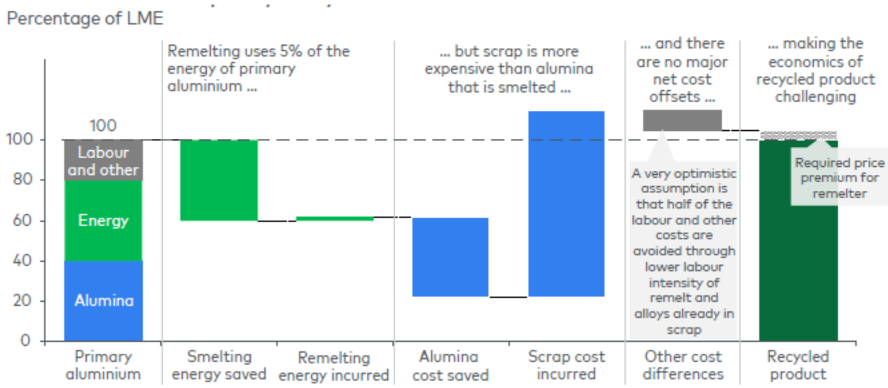

Figure 7.Illustrative economics of primary v recycled aluminium[10]

The remaining costs of both primary and recycled aluminium production are relatively small compared to these energy and input material costs, and costs avoided (for example, electrodes) can be offset by other impacts (for example, production rates). Importantly, the costs of moving scrap domestically around Australia are also higher than those of exporting — despite the shorter domestic distances involved — reflecting greater scale economies and competition in international logistics. Optimistically assuming half of the 'labour and other' costs from primary aluminium production could be avoided (for example, to reflect lower labour intensity and avoided costs of alloys, without including an increase to scrap vs exports), it is unlikely that recycled aluminium can be produced at a lower cost than primary aluminium[12]. The implication is that recycled product typically (and paradoxically) requires a price premium over new primary aluminium, and return on investment to build the infrastructure and capabilities is challenging.

Australia's aluminium industry cannot do this alone: there are significant commercial barriers to investing in new remelt and recycling capabilities in Australia, and, as Australia decarbonises its electricity system faster than the rest of the world, the industry today is facing high energy prices that are hindering its global competitiveness. With coordinated policy action, Australia can transform a lost opportunity into a national advantage — capturing the economic, environmental and strategic benefits of keeping circular aluminium value onshore and positioning itself as a leader in the global transition to lower-carbon materials.

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[10] https://aluminium.org.au/wp-content/uploads/2026/02/260305-Enabling-Development-of-Aluminium-Recycling-Capability-in-Australia.pdf

[11] These simplified economics represent a smelter that is producing non alloyed primary (P1020). The economics would vary depending the product mix and a range of other factors including but not limited to customer mix and available inputs. A standalone remelt facility would also have substantially different economics.

[12] While it may be possible to reduce the raw cost of scrap (for example, by purchasing post-consumer scrap), this would necessitate more direct participation in scrap by a remelter and/or other costs being incurred to enable production of high-quality aluminium that can achieve at least 100% LME, further increasing the commercial challenges involved.

g. Alternative policy options for governments

International experience shows that scrap-retention policies and recycled-content mandates are unlikely to build sustainable recycling industries. Successful regions — Europe, North America and parts of Asia — use direct government co-investment to fund remelt plants, casthouse upgrades and new technologies. In Australia, policy support remains fragmented: the Powering the Regions Industrial Transformation Stream would be inaccessible due to emissions thresholds, the Recycling Modernisation Fund excludes aluminium, and the National Reconstruction Fund (NRF) and Clean Energy Finance Corporation (CEFC) require commercial returns that remelting cannot yet meet. The Future Made in Australia Innovation Fund is the most relevant mechanism but is insufficient on its own.

To unlock investment, three coordinated policy shifts are needed (Figure 8):

- First, preserve the competitiveness of existing smelters, which underpin the capabilities and workforce needed for future aluminium recycling.
- Second, mobilise capital for first-generation remelt plants through blended finance — combining Innovation Fund grants with concessional NRF or Export Finance Australia debt — and introduce investment credits or accelerated depreciation for low-emissions recycling technology.
- Third, build confidence in domestic markets and feedstock certainty through adjustment of thresholds in ReMade in Australia to reflect leading levels of recycled aluminium content, alignment with recycled content standards, procurement requirements for recycled content as a domestic industry emerges, improved scrap transparency, and targeted freight or logistics support.

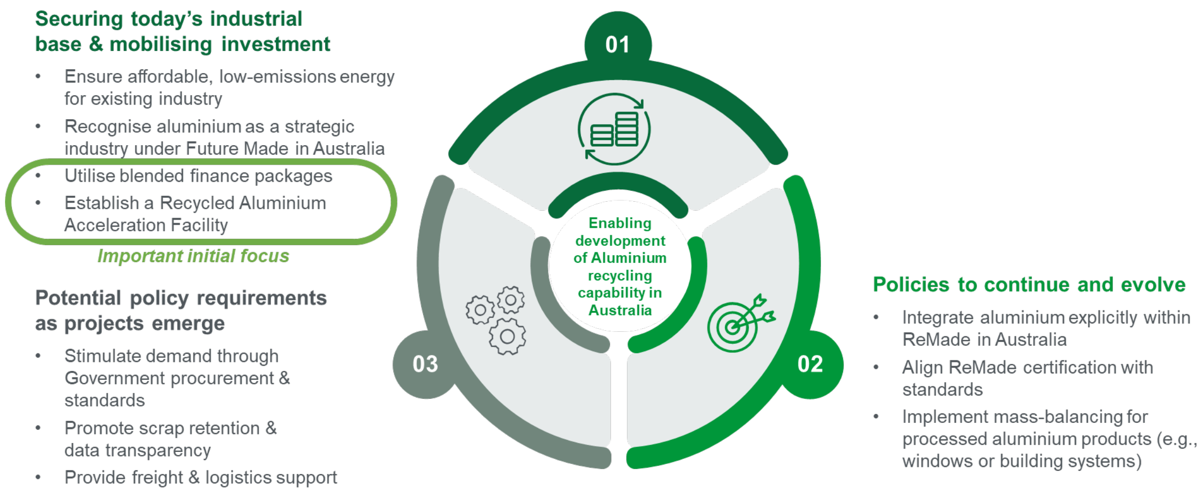

Figure 8. Coordinated policy shifts needed to unlock investment[10]