

Cast Anew:

*Opportunities to bring
aluminium to life through
manufacturing & recycling*

**A discussion paper for the Australian
Aluminium Council**

September 2022



About this report

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The data reflected in the report was collected from a range of open sources. It's applicability to the exact purpose must be considered by the individual user before any action is taken based on these results. If the underlying data is incorrect, the results may vary. All open source data used to generate outputs and subsequent analysis was accurate at a point in time. This data is subject to change at any point. The currency of the presented information should be verified before being acted upon.

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01. Executive Summary

Executive Summary

The long term fundamentals for global aluminium demand are promising...but Australia mine-to-market production ecosystem is at risk of falling behind without a coordinated response from both government and industry

A defining decade for the planet and global economy...

Globally the race is on to bring human activity back within planetary boundaries as cracks appear in environmental and social systems. In response, this decade will see the convergence of 3 key mega-trends; global decarbonisation, automation and digitisation. The resulting structural adjustment will see a fundamental shift in the way business is done and will change business relationships and material flows.

Crucially, driven by the need to curb growth, to protect environmental and social systems, there will be shift in the economic paradigm from linear systems (take, make, waste), to circular systems. This will see the vast resources currently in existence in our economy re-valued and re-deployed.

It is within this period of profound and dynamic change that the Australian aluminium sector must navigate its path.

Decision making in such uncertain times will be anchored through deep coalition building and a shift in mindset that puts environmental restoration and social value at the heart of decision making.

...has created a window of opportunity for the industry...

By 2030, global demand for aluminium is expected to rise by 33Mt or 38.6% over 2020 levels.¹ This will significantly increase the demand for key Australian exports such as bauxite, alumina, and aluminium.

Other markets are responding to these demand-side signals with significant investments in new smelting and production capacity. Despite this, Australia's high cost base has discouraged investment over the last decade. Furthermore, a global supply imbalance driven by Asia has resulted in dumped goods in Australia, constraining competitiveness of the downstream valued added industry – particularly extrusion.

(1) Source: International Aluminium Institute
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In parallel, growing environmental, social and governance (ESG) pressures are reverberating across the value chain, with carbon, water, waste, and biodiversity emerging as ticket to play issues. Bauxite miners face growing biodiversity and waste challenges. Alumina refiners, although currently ahead of the global curve on emissions intensity, face decarbonisation pressures, and primary aluminium production has a higher emissions intensity than that produced in some other regions. This has increased pressure on extruders now facing demands for low carbon product from their first- and second-tier customers.

As a result, Australia's value-added mine-to-market production ecosystem is at risk of falling behind. However, this moment could also represent a decisive opportunity for the sector.

Seizing this moment is a challenge that can be embraced by both industry and government. It represents a pathway to demonstrate that industry policy can accelerate decarbonisation while increasing domestic metals processing and manufacturing. In so doing, it could create a blueprint to apply to other sectors.

...and Australia's aluminium sector can play a critical role

The energy transition could revive Australia's aluminium value chain by reshaping its cost base. Increasing evidence highlights the competitive benefits bestowed on materials production, brought about by Australia's emergence as a renewable energy superpower.

Firmed renewable electricity supplies before 2030 will be required to ensure the industry can respond to green product demand. Getting on the front foot will ensure that competitors co-located with hydropower and existing recycling capabilities do not have the opportunity to satisfy Australian demand for low carbon products instead.

Executive Summary

Significant opportunities in manufacturing and recycling can be unlocked by cross-value chain coordination, and underpinned by an industry roadmap to support collaboration

There are clear opportunities for value-added manufacturing enabled by the aluminium industry

Three flagship projects were identified for further consideration and development by the Australian Aluminium Council¹:

1. A closed-loop mine-to-panel solar value chain project: there are clear government and industry aspirations to grow solar panel manufacturing capability. Aluminium is the second largest input by weight, and domestic extruders already have the capability to produce frame and rail for the sector. In addition, the upstream industry has a growing demand for renewables, which could catalyse demand for manufacturing. While this project would only look at a narrow value chain, it has the potential to unearth challenges and opportunities that could be more broadly applied.

2. Green caustic soda production project: caustic is a critical input into alumina refining, but is currently 100% imported in Australia – at an indicative value of around \$A300m per annum². Given the electricity intensity of caustic production, it may be viable in a low cost renewables environment. Defining a pathway for domestic caustic production also offers a focal point for government and industry cooperation, to capture new manufacturing while increasing sovereign capability.

3. Increase recycling capacity project: global demand for recycled aluminium is growing rapidly, driven by emerging minimum content requirements from governments and corporate demand for low carbon products. The economics of scrap recycling have turned positive in many markets, enabled by new technologies that bring novel approaches to recycling capability which lower both costs and risks for pre- and post-consumer scrap reprocessing. Australia has an opportunity to invest in recycling capability to create a domestic supply of low carbon product by 2025. An initial assessment of possible sources of recyclable material suggest **there is more than enough scrap to support two dedicated remelters in Australia.**

1. South32 is currently working with COREO to understand the circular economy opportunity for process waste. The Sustainable Minerals Institute (SMI) is also investigating opportunities for the reuse of mine wastes. More information on this research is available [here](#).
2. Indicative data based on Deloitte analysis of imported products by a selection of companies. The total addressable market is likely higher as this estimate is only based on data readily available to Deloitte.

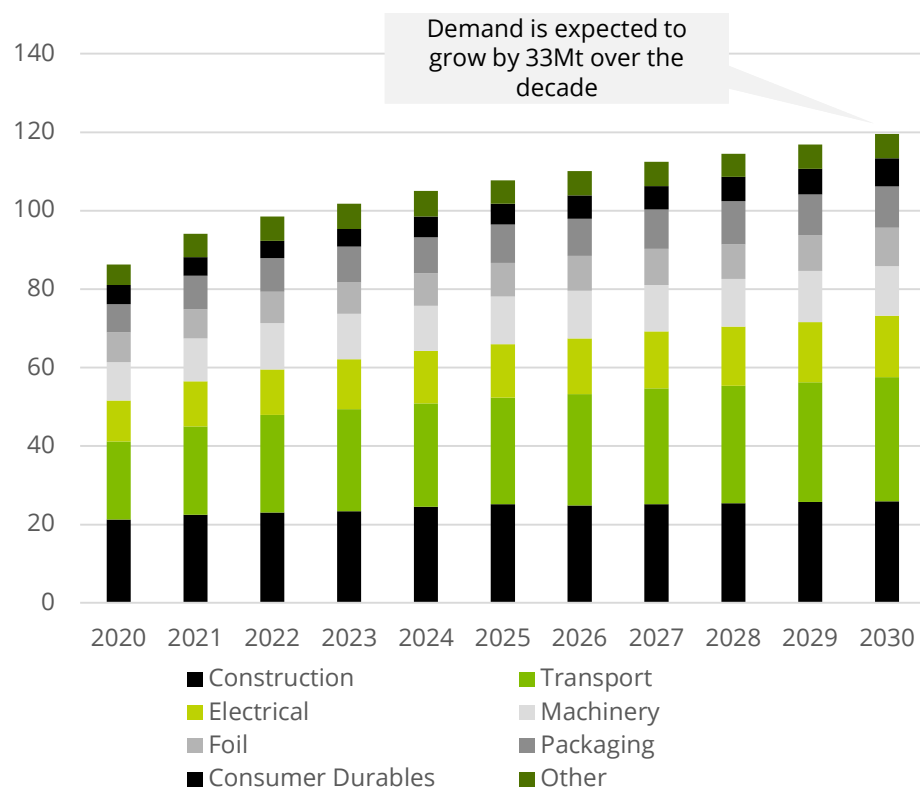


02. Macroeconomic conditions for Australian Aluminium

The global aluminium market is entering a phase of structural growth...

Demand for aluminium is expected to rise by 40% by 2030

Estimated Global Aluminium Demand by End Use Sector¹



An orderly net zero transition depends on aluminium



Solar PV generation is expected to double over the next 4 years.² Aluminium makes up 85% of the material used in solar panels by weight.



While only making up 4% of the materials used, wind turbines will require 35 million tons of aluminium per year by 2050.³



The rise of EV's will see the car industry go increase its global aluminium consumption by 60% to 31.7Mt in 2030.⁴



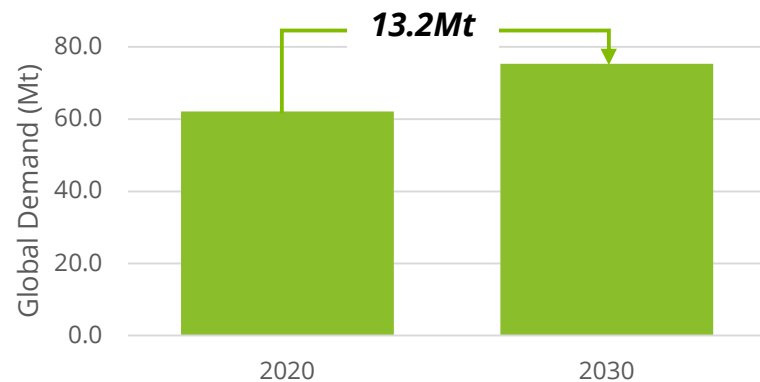
Transitioning the world towards green energy sources will require 50% more aluminium than the electricity sector consumes today.⁵

Note: (1) Data is from CRU (2021), Opportunities for Aluminium in a Post-Covid Economy (2)Source: [iea.org](https://www.iea.org) (3) [World Bank Report](https://www.worldbank.org) (4) CRU Report (5) Ibid

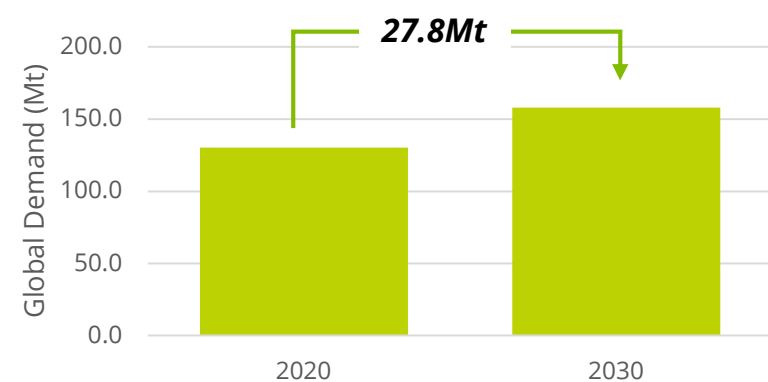
...which will increase demand for Australian aluminium

But growing demand for recycled product highlights the influence of ESG considerations on purchase decisions

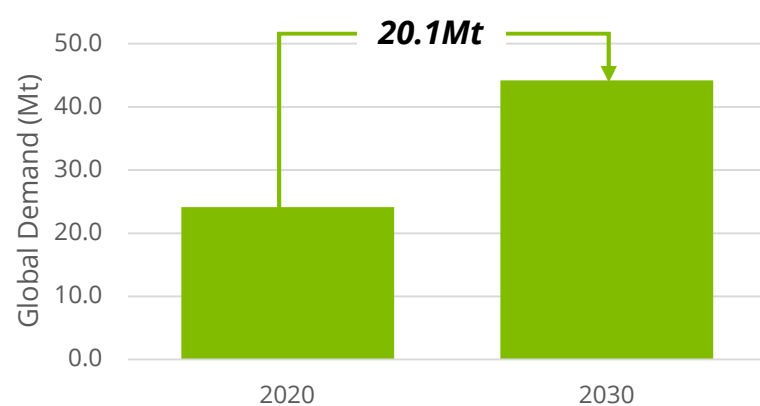
Implied Change in Primary Aluminium Demand by 2030¹



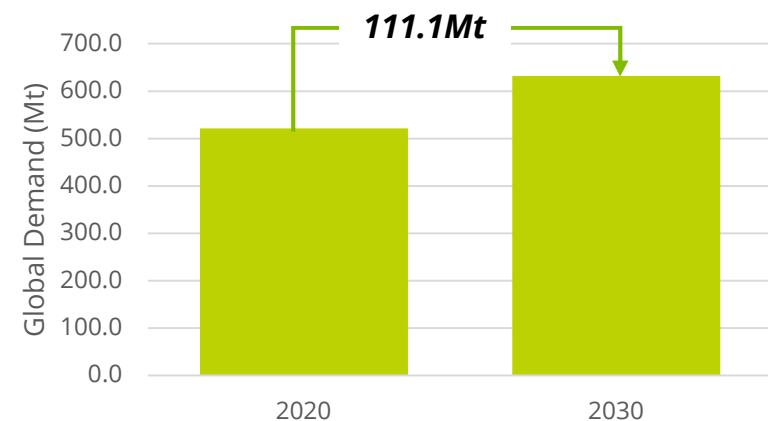
Implied Change in Alumina Demand by 2030²



Implied Change in Recycled Aluminium Demand by 2030¹



Implied Change in Bauxite Demand by 2030³

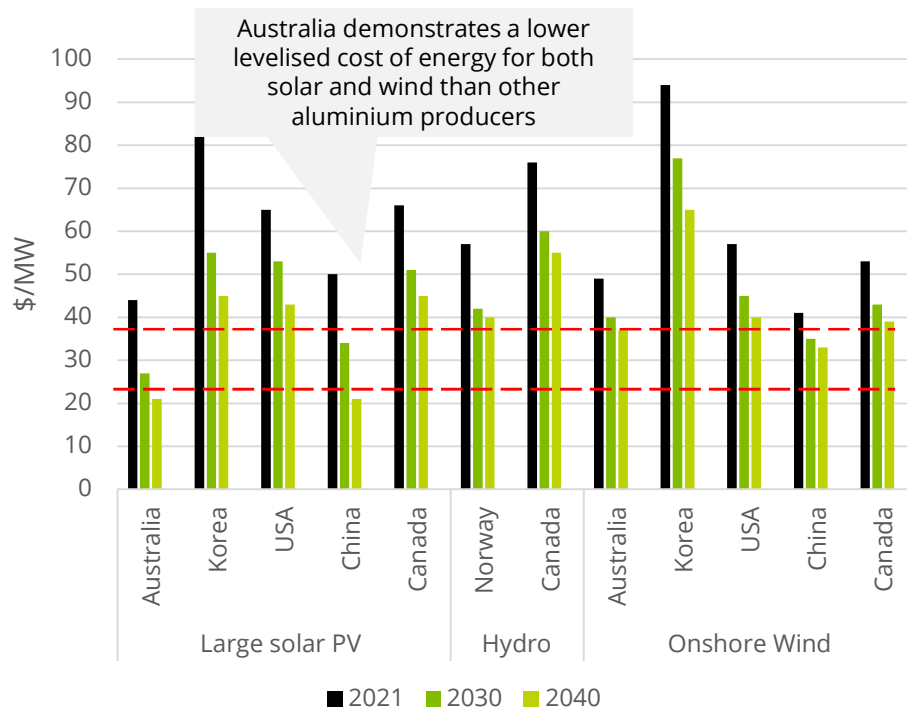


Note: (1) Estimated based on CRU (2021). Assumes global recycled aluminium was 28% in 2020 and reaches 37% by 2030 (CRU 2022); (2) 2.1 tonnes of alumina to 1 tonne of aluminium; (3) assumes 4 tonnes of bauxite to 1 tonne of alumina.

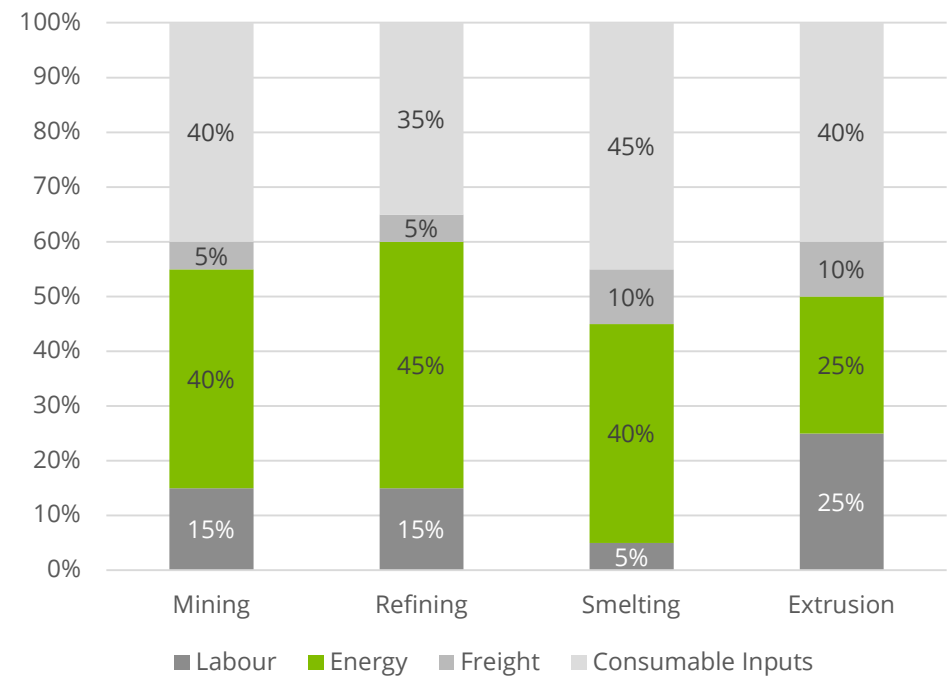
The energy transition could revive Australia's mine-to-market value chain by reshaping its cost base...

Lower energy prices would enhance the competitiveness of manufacturing and aluminium production

After 2030, Australia is forecast to have a comparative energy advantage over other aluminium producers¹



A reduction in energy costs would have a significant impact across the value chain²



Note: (1) Based on the CSIRO Gencost Report 2021, IEA 2018 & 2020, IRENA 2021 (2) Order of magnitude estimates based on Deloitte market research and publicly available company reports; (3) <https://international-aluminium.org/resource/aluminium-recycling-fact-sheet/>

An industry roadmap could demonstrate Australia's credentials as a green metals player

An industry roadmap is needed to engineer a green, manufacturing-led revival of the mine-to-market value chain

The industry needs to increase domestic value-added production to support growth of the manufacturing sector

- Development of the domestic manufacturing sector is a key focus of the Federal Government, backstopped by the \$15bn National Reconstruction Fund. In addition, state governments are coupling local procurement strategies with incentives and capability increases to support industry growth.
- Despite the aluminium industry offering one of the few mine-to-market products, imports of aluminium by domestic manufacturers are rising.
- With ESG pressures rising, it will be increasingly difficult to support an export-only upstream industry.
- Coordination is needed across the value chain to agree and pursue priority initiatives to support domestic aluminium use in domestic manufacturing.

In parallel, the industry needs to turn to recycling to provide low carbon product before 2030

- Domestic aluminium production is more emissions intensive than international alternatives. While hydro-powered Bell Bay has potential to produce low carbon aluminium, it does not make billet and therefore is not an option for extruders.
- With limited firm renewable electricity supplies until 2030, there is a clear gap where domestic aluminium producers will be increasingly unable to supply domestic demand for low carbon products. This will gather pace from 2025 onwards, meaning imports of low carbon aluminium could be expected to increase.
- Recycled aluminium products (e.g., billet) would have a lower emissions footprint, and could be a viable bridge product to sustain the value chain while the complexities of variable renewables are resolved.
- However, Australia currently has limited domestic recycling capability for aluminium. The majority of current scrap aluminium is exported.
- A coordinated approach is needed to address the clear mismatch between supply and demand expectations, a shift which could be enabled by intentional industry action supported by focused industry policy including a framework for fair and free trade.



03. Opportunities for manufacturing across the value chain

Policy settings and market demand are creating a rare window for domestic manufacturing growth

A resurgence in domestic manufacturing is a platform for an uptick in aluminium use

Selected media headlines¹

Mining | Lithium | Markets

MinRes boss reveals battery manufacturing plans for WA

Australia News > Politics



Stuart McKinnon | The West
Mon, 29 August 2022 7:00PM

'Real opportunities': Energy Minister Chris Bowen pushes for more solar panels to be manufactured in Australia

Australia should be manufacturing more solar panels given it is at the forefront of the world's supply of minerals, says Energy Minister Chris Bowen.

Exclusive Carbon challenge

NSW inundated with \$35b offshore wind plans for Illawarra

NSW receives interest from offshore wind developers to build more than \$35 billion worth of projects in the Illawarra as energy transition accelerates.

Aug 29, 2022 | Colin Packham



Business

Aussie lithium battery giga-factory online

Marion Rae | AAP
Thu, 1 September 2022 3:32AM

Address to the National Press Club

29 June 2022

Exporting clean energy, energy intensive industrial products like green steel and aluminium, and other products like solar cells, electrolyzers and batteries - will help power the clean energy economies of our region, strengthening supply chains and bolstering energy security.

A rare investment environment for manufacturing

There are several factors that are occurring concurrently within the Australian market that are catalysing this resurgence including:

- **Supply chain risks** exacerbated by COVID-19
- Heightened awareness of **sovereign manufacturing capability** brought about by increasing geopolitical tension
- The **rise of technology** that relies upon the production of hardware such as electric vehicles and associated components

There are early signs that there is both government and industry action in response to these factors:



The QLD government recently announcing an investment of \$7.1b to develop a train manufacturing program



The NSW government beginning to investigate the possibility of building wind turbines in the Illawarra



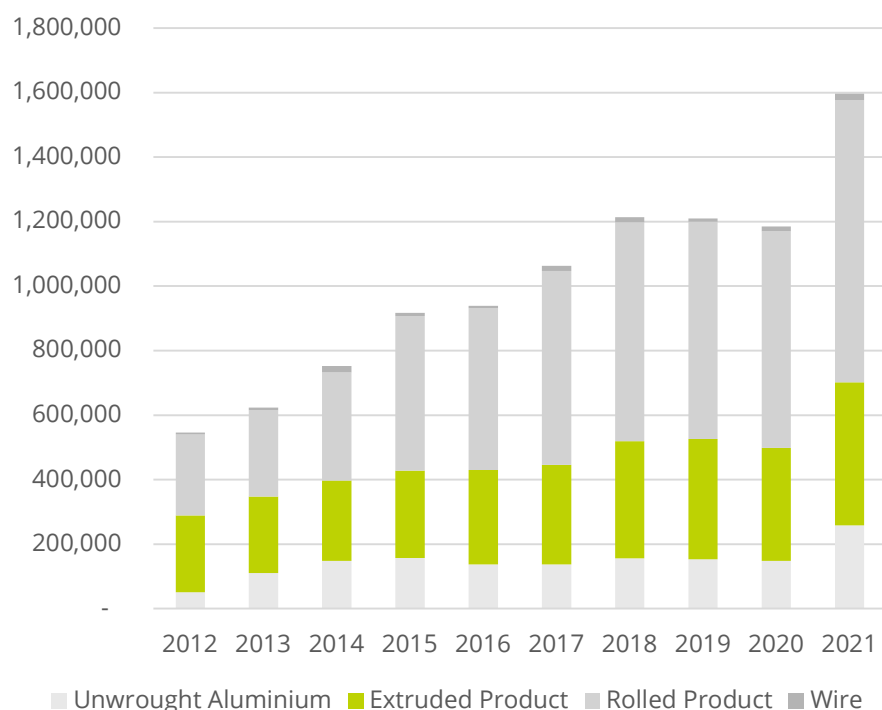
The Commonwealth government providing \$50m in funding to BlueScope to safeguard steel supplies

Note: (1) Data was extracted from AFR, The West Australian, Sky News Australia, Department of Climate Change, Energy, the Environment and Water, ABC News, and <https://www.minister.industry.gov.au/ministers/bowen/speeches/address-national-press-club>

...domestic manufactures are increasingly relying on imported aluminium

Australian extruders import a third of their product, nearly double the volume of a decade ago

Australia's aluminium imports have tripled over the past decade...¹



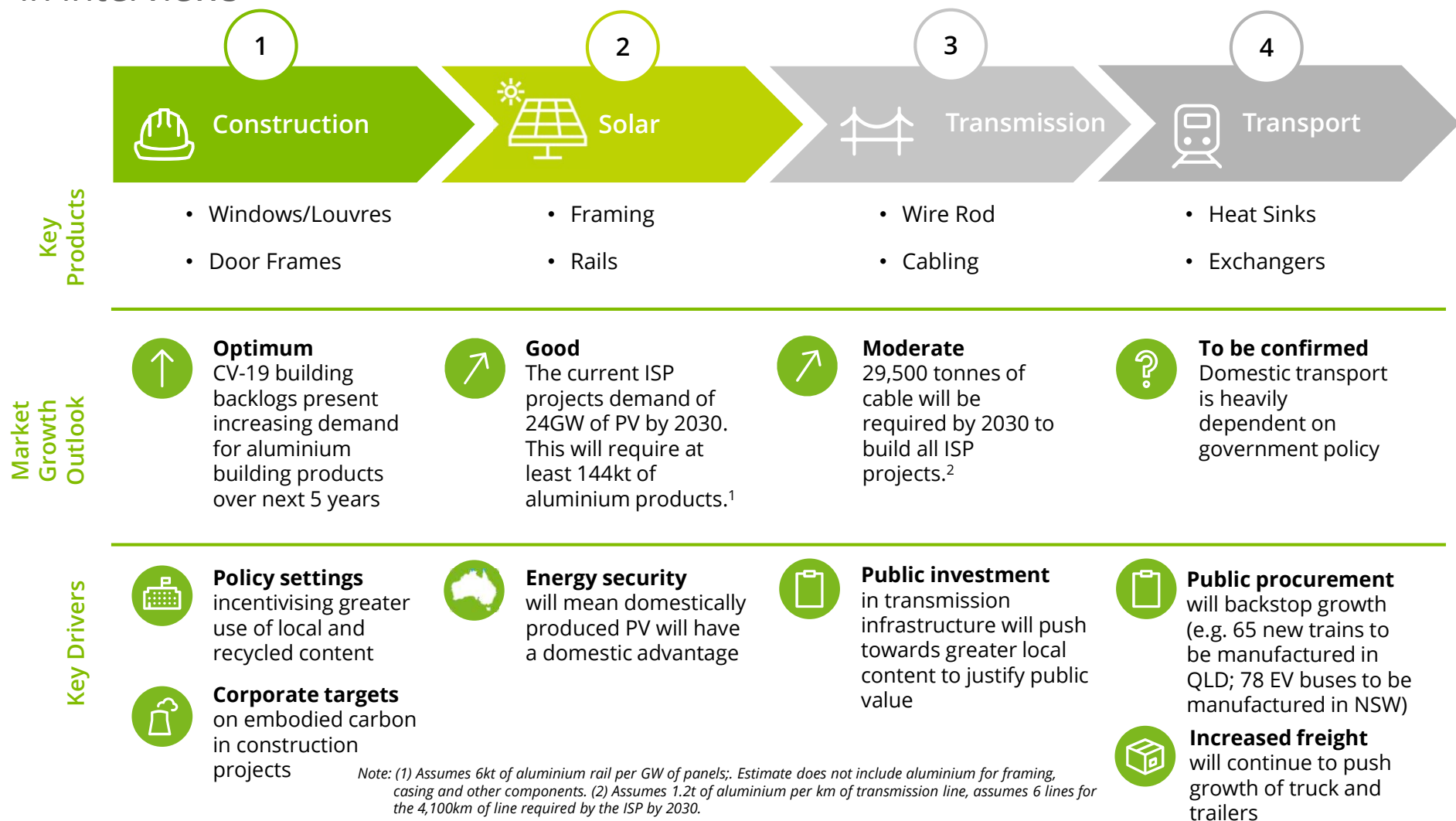
...and it's expected to accelerate by 2025 driven by demand for low carbon product

- Anecdotal evidence suggests that aluminium imports may continue to increase in coming years, driven by growing demand for green product. This will be exacerbated by the current inability of the domestic industry to supply usable low carbon products.
- Examples raised during interviews included:
 - Availability of low carbon billet from the New Zealand Aluminium Smelter, at least until 2024.
 - Hydro CIRCAL 75, which is regarded as a benchmark recycled product.
- There is currently a lack of capacity within Australia to produce the recycled product to meet demand.

Note: (1) Calculated from HTISC import pivot tables: <https://www.dfat.gov.au/about-us/publications/trade-statistical-pivot-tables>

Domestic aluminium users have expressed a preference for local product, if competitively priced

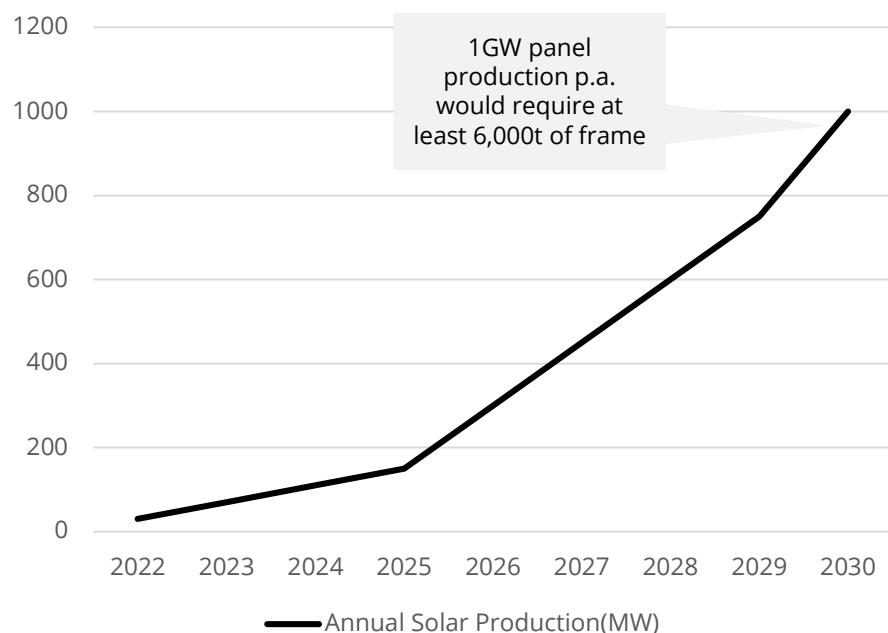
Four sectors were identified as prospective growth targets for mine-to-market aluminium in interviews



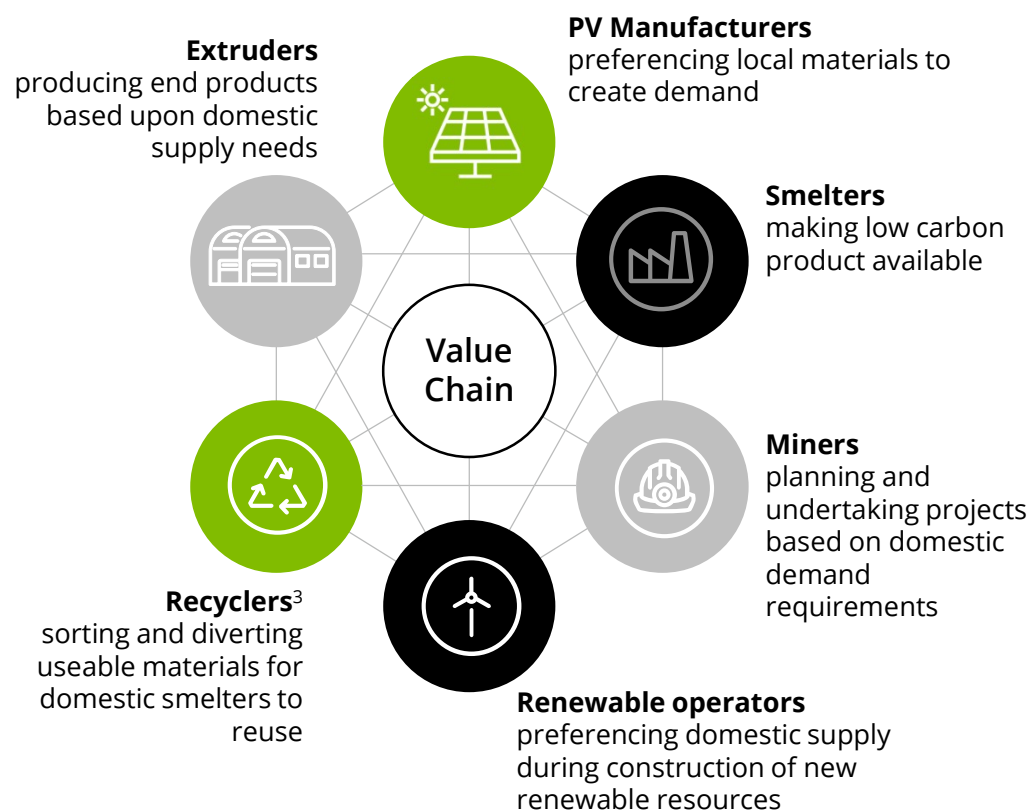
Developing a closed-loop mine-to-panel value chain could be an emblematic flagship initiative for the industry

The aluminium value chain could be both a demand driver and supplier of a domestic solar industry

Possible Trajectory for Domestic Solar Panel Production¹



Scaling domestic demand will require unprecedented coordination across the value chain²

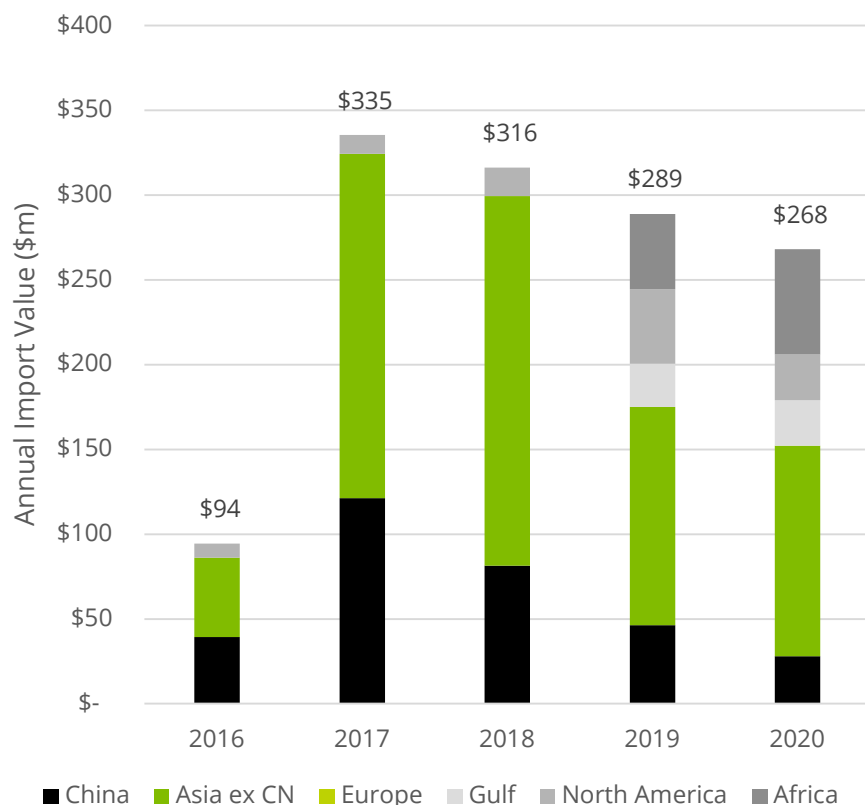


Note: (1) Model production pathway to reach 1GW panel production based on engagement with Tindo Solar; (2) The composition of solar panels suggest value chains outside aluminium will need to be involved in collection, disassembly, and recycling; (3) While recyclers are separated here reflecting the current value chain, it is possible that smelters could act as recyclers as happens in other geographies.

Caustic manufacturing offers another development opportunity across the upstream value chain

Australia is currently highly dependent on imports for caustic soda – a key inputs in refining operations

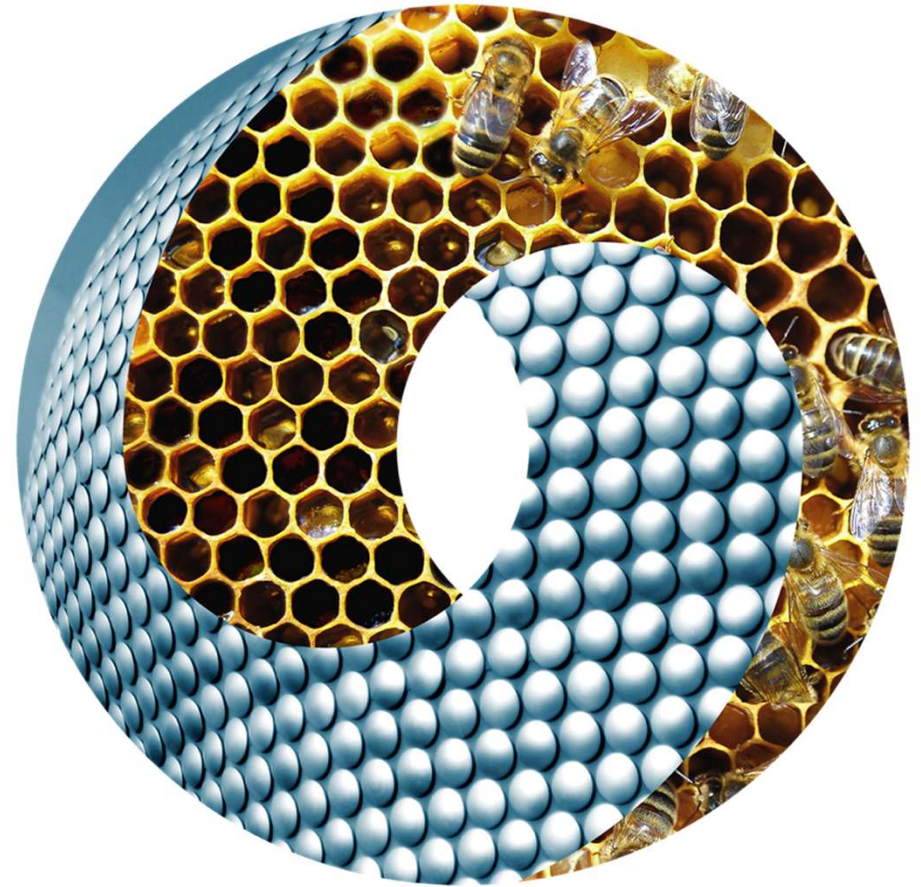
Preliminary estimates suggest at least \$1.3bn in caustic imports between 2016-2020



A rationale for domestic caustic manufacturing

- Caustic soda is vital to the alumina refining process as it is used to dissolve the aluminium found in bauxite, separating it from other impurities. A continuous supply of caustic soda is needed to form aluminium-containing slurry which is then heated.
- For example, Alumina Limited reported that elevated caustic prices were responsible for 27% of the increase in their cost base in the year to June 2022.²
- Caustic soda (NaOH) is commercially produced using electrolysis where large amounts of electricity are passed through a brine solution. Energy usage is one of the most important factors for caustic production and makes up a significant portion of the variable cost base.
- Due to its energy intensity and Australia's projected growth in renewables, Australia could be a viable production location for caustic soda. Using renewables would also reduce the scope 3 emissions involved in alumina refining.
- Defining a pathway for domestic caustic production also offers a focal point for government and industry cooperation to capture new manufacturing while increasing sovereign capability. However, further work will be required to assess the feasibility of this opportunity.

Note: (1) Indicative data based on Deloitte analysis of imported products by a selection of companies. The total addressable market is likely higher as this estimate is only based on data readily available to Deloitte; (2) Alumina Limited 2022 Half-Year Results

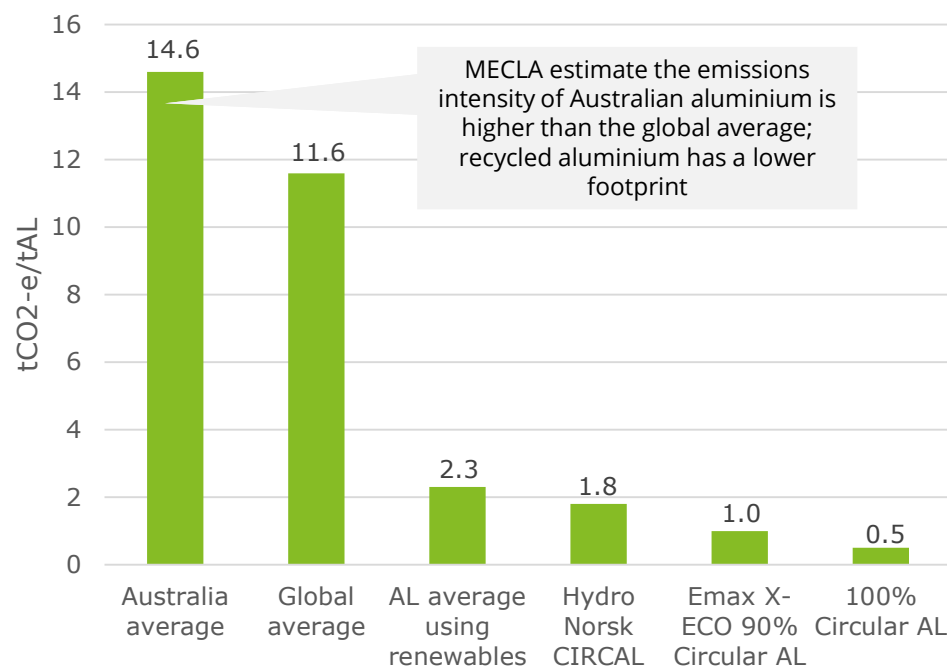


04. Recycled product as a low carbon imperative

Global demand for recycled aluminium is growing more than x2 faster than primary product...

...driven by regulation and corporate demand for low carbon products

Recycled content is a key pathway to lower carbon product...¹



And it is quickly becoming a market staple driven by...



Increasing adoption and enforcement of **minimum recycled content requirements**. For example Australia's packaging industry is committed to 50% recycled content in packaging by 2025.² The European Commission's proposed Regulation on Ecodesign for Sustainable Products contemplates minimum recycled content requirements for the construction and automotive sectors.³



Data availability on material provenance is becoming increasingly visible, accessible, and verifiable. This includes through the Aluminium Stewardship Initiative's Chain of Custody Standard⁴, and traceability platforms such as Everledger and Circular.



New technologies are lowering the net cost to recycle aluminium. For example, x-ray transmission enables alloy-based sortation based on spectroscopy⁵; dismantling robots are making significant efficiency gains, now eight times faster than manual labour.⁶

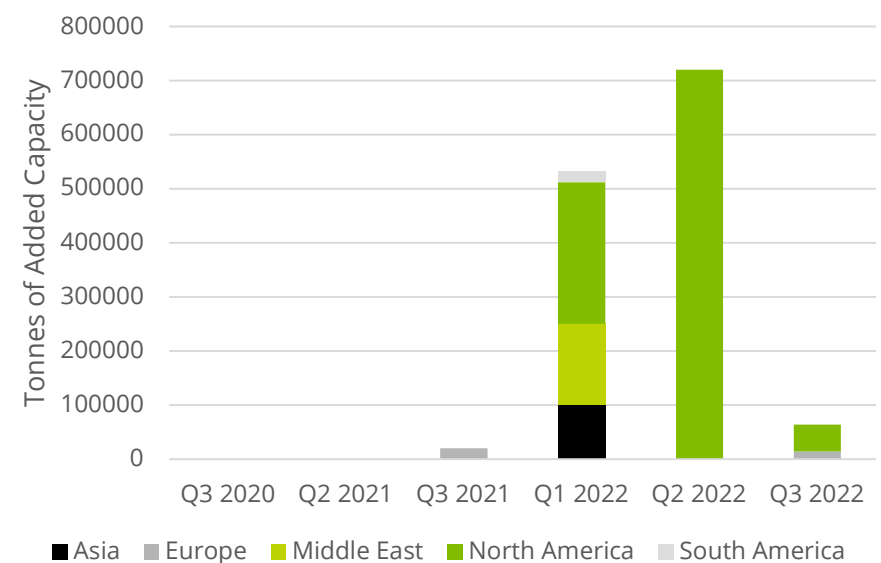
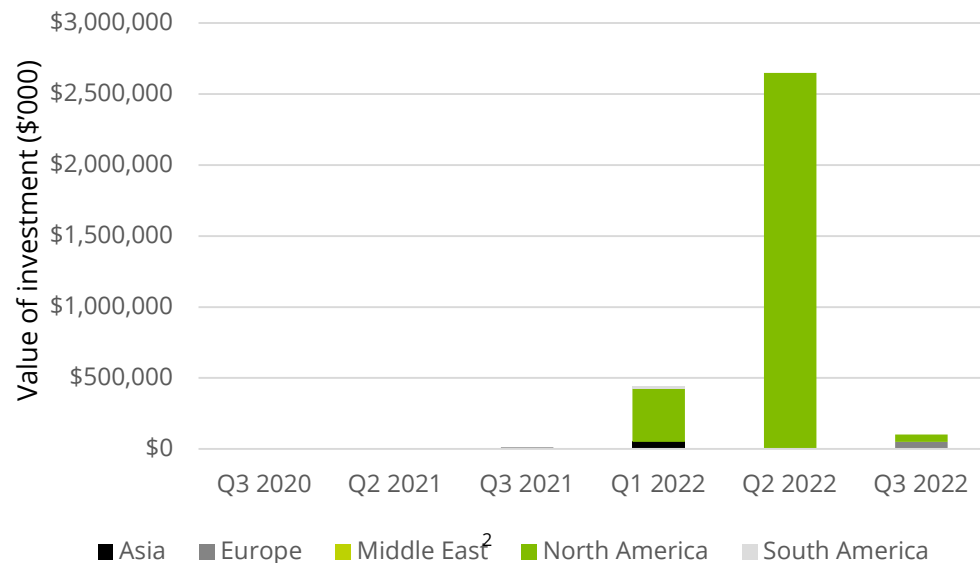
Note: (1) Based on MECLA (2022) Low Emissions Aluminium; (2) APCO, Australia's 2025 National Packaging Targets; (3) <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0140>; (4) <https://aluminium-stewardship.org/asi-standards/chain-of-custody-standard>; (5) <https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/metals/052422-copper-aluminum-recycling-opportunities-emerge-as-metals-demand-grows-bir>; (6) <https://newatlas.com/automotive/robot-ev-batteries-recycling-speed/>

Demand has triggered significant investments on the supply side

Significant recycling capacity has been added in regions where low carbon pressure is strongest

Over \$3.2bn USD was committed to new aluminium recycling facilities in the first half of 2022...¹

...adding 1.3Mt of capacity, largely in Europe and North America

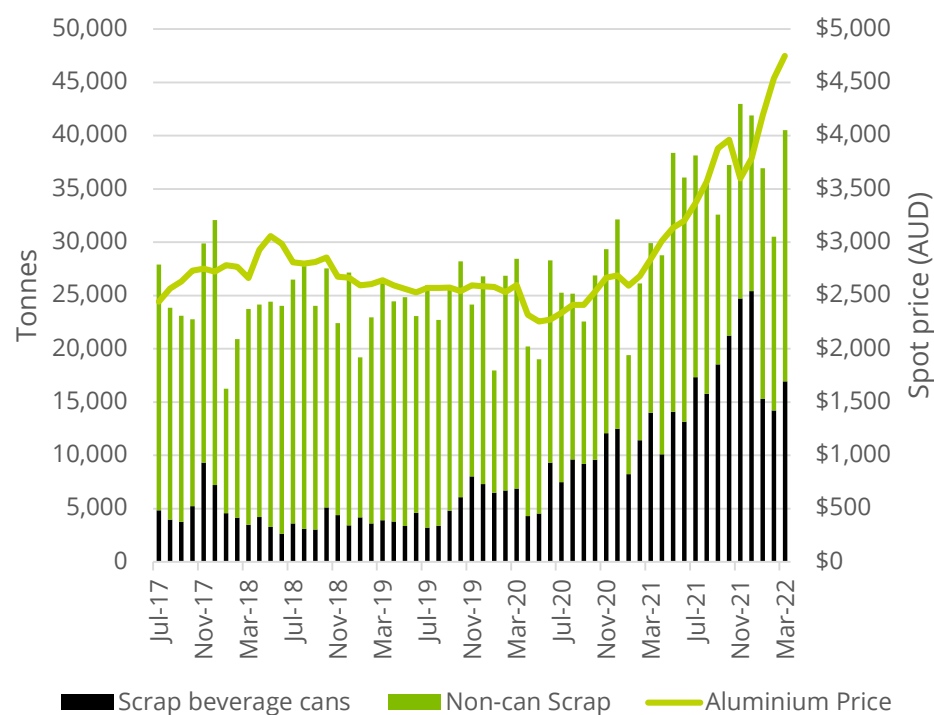


Note: (1) Based on Deloitte research; (2) EGA did not disclose a value for the recycling plant in the UAE announced in February 2022

Instead of fueling our demand for recycled product, Australia continues to export scrap aluminium...

Australia has exported around 300kt per year of scrap aluminium over the past five years

Australia's scrap exports have been rising...¹



...but this appears to be driven by rational market dynamics

- The value of aluminium scrap is determined as a percentage of the benchmark London Metals Exchange price, which has been rising over the past 3 years.
- ABS export data suggests this is correlated with rising exports of scrap cans. The quantity is far above the 20,000 tonnes per year collected by CDS schemes.
- With a lack of domestic recycling capacity Australia is missing out on a valuable opportunity to utilise this feedstock domestically to help decarbonise aluminium billet supply chains.

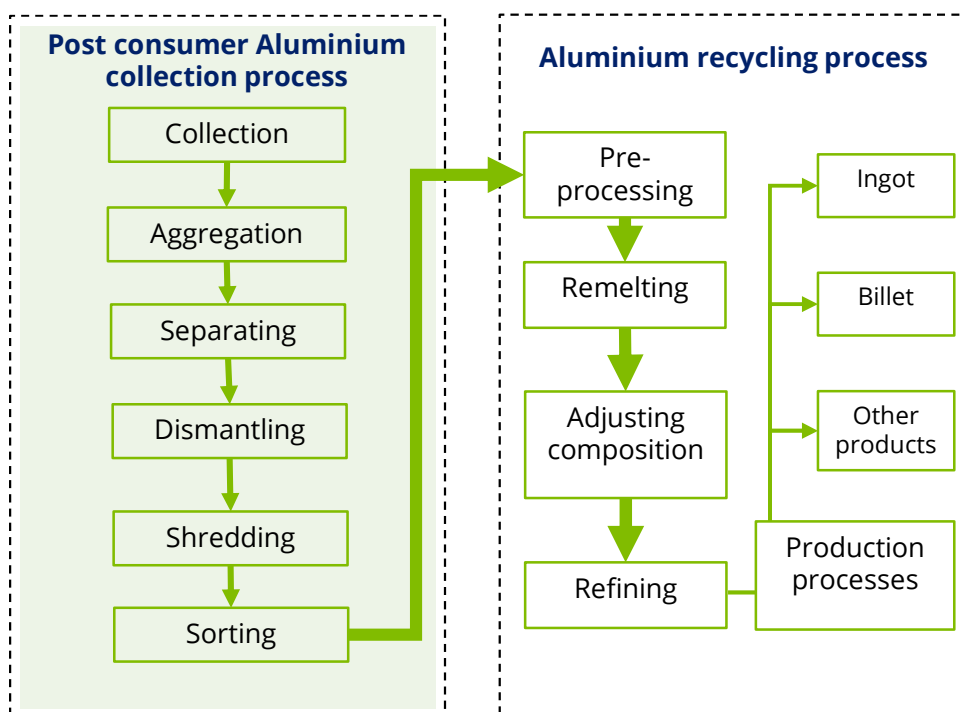
Note: (1) Scrap exports are taken from the National Waste Export Summary; aluminium price data is based on the World Bank Commodity price data time series

...Despite the economics of scrap recycling turning positive

Recent years have seen investments into 25-50kt remelters, previously considered uneconomical

Post consumer scrap reprocessing is technically complex...

...but new technologies are lowering recycling costs



One of the largest producers of secondary aluminium alloys in Brazil and have produced over 400,000 metric tons of the metal since 2002. The Alux facility will expand its recycled aluminium capacity by 20%, part of a long term strategy to producing low-carbon aluminium.¹

Provides raw material inputs in the form of custom shredded and blended aluminium scrap that can be used as feedstock in either reverb or rotary furnaces to the aluminium industry.²



Utilise artificial intelligence (AI) imagery, data analytics and advanced sensors to produce aluminium packages from shredded automobiles. Novelis has recently partnered with Sortera Alloys to utilise its technology to re-use higher amounts of both automotive post-production and post-consumer scrap.³

Tomra Sorting has developed the X-TRACT unit which enables the removal of aluminium-plastic compounds and magnesium from aluminium in products such as Zorba.⁴



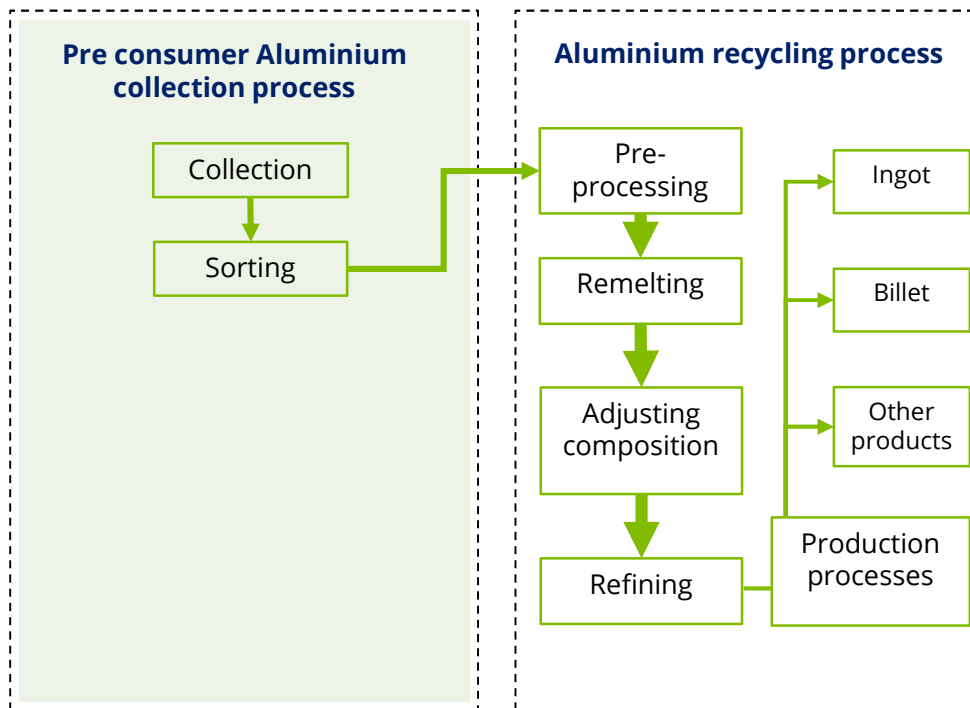
Note: (1) <https://www.alcicle.com/news/cba-inks-agreement-to-acquire-secondary-aluminium-alloy-producer-alux-do-brasil-71817>, <https://cba.com.br/en/imprensa/brazil-regulator-approves-alux-do-brasil-acquisition-by-cba/>, (2) <https://www.simsalumisource.com/about/>, (3) <https://investors.novelis.com/2022-07-19-Novelis-Announces-Partnership-with-Innovative-Recycling-Startup-Sortera-Alloys>, (4) <https://www.tomra.com/en/discover/waste-metal-recycling/news/2020/tomra-recycling-addressing-the-challenges-of-aluminium-recycling>

Pre consumer scrap offers a simpler, more cost-efficient feedstock for recycled billet product

The production process of aluminum and its alloys creates high quality pre-consumer scrap that can be more easily recycled.

Recycling pre consumer scrap offers an entry point for the industry to start producing recycled product...

...minimising value leakage from the manufacturing process

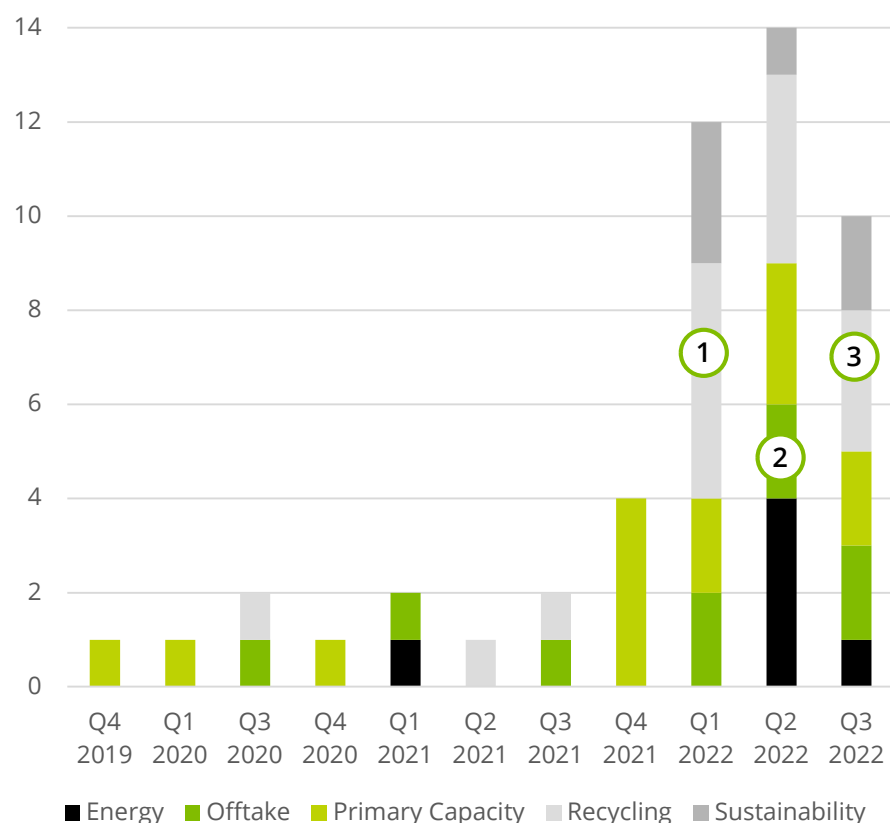


- Pre consumer scrap provides a source of feedstock that can often be directly recirculated into remelters to then be resued to produce recycled billets and improve efficiency.
- As pre consumer scrap comes directly from fabricator the quality and alloy is often known and very little pre-processing is required.
- To further improve process efficiency the objective is generally to reduce pre-consumer scrap generation where possible.

Our research suggests three strategies have been used to make scrap recycling viable

Market leaders are securing feedstock, offtake, and going modular

Aluminium industry sustainability announcements by quarter¹



Securing the scrap supply chain is key to viable recycled product

International leaders in aluminium recycling have taken three consistent measures to ensure they can provide quality and reliable recycled products.

- ① **Securing high quality scrap feedstock supplies.** For example, by employing new leasing business models to collect and recycle products such as aluminium window frames employed by Norsk,² or acquisitions of specialist metal recyclers such as Alux which CBA Brazil recently completed for USD \$21m.³
- ② **Securing offtake agreements with large manufactures for recycled products.** For example, Novelis North America is developing closed loop agreements with automotive clients.⁴
- ③ **Embracing modular capacity to co-locate recycling capability with supply of scrap.** Demonstrated by Norsk's \$51m investment in their Eastern Pennsylvania plant⁵ and Rio Tinto's \$29m expansion of its Arvida Smelter to add new aluminium scrap recycling capacity.⁶

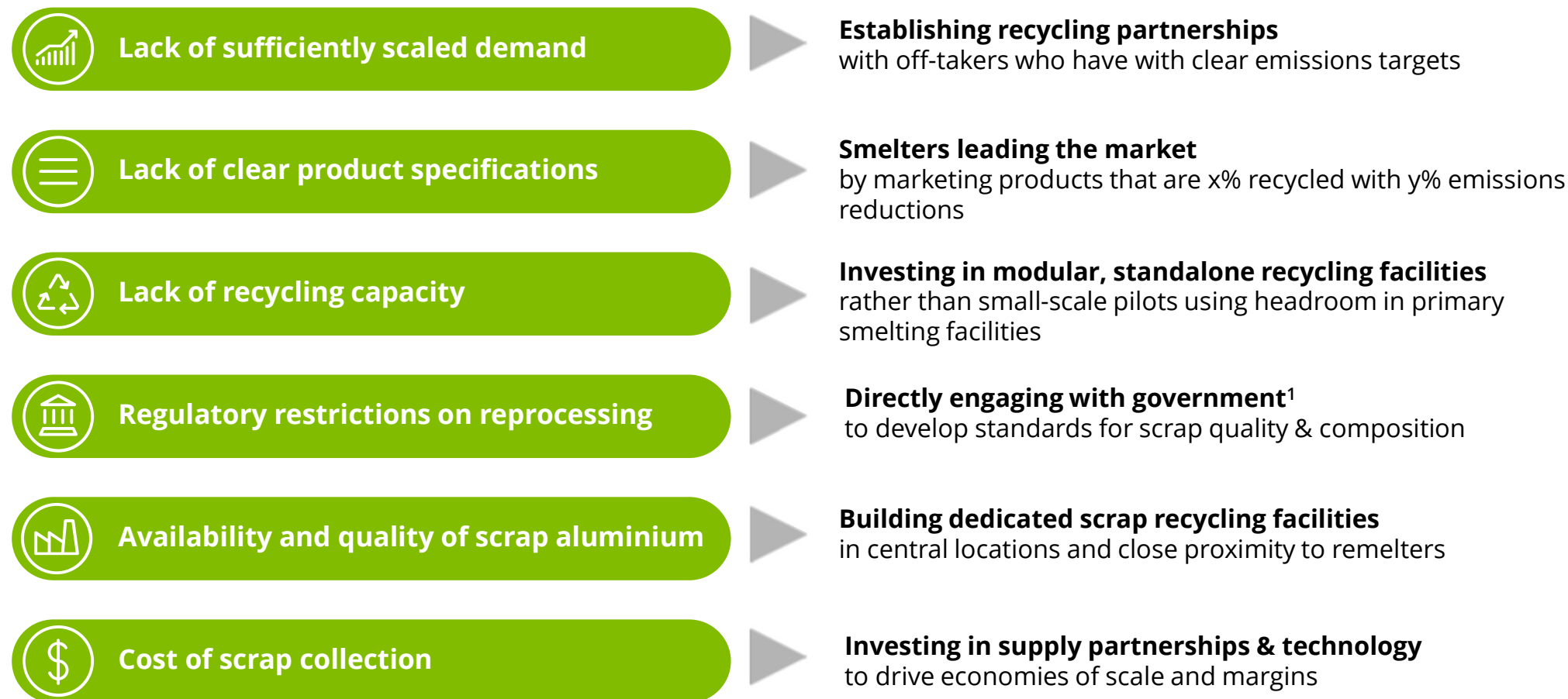
Note: (1) Based on Deloitte market research; (2) Interview; (3) <https://cba.com.br/en/imprensa/cba-conclui-processo-de-aquisicao-de-80-da-alux-e-amplia-capacidade-produtiva-de-aluminio-reciclado/>; (4) <https://www.recyclingtoday.com/article/transportation-difficulties-localized-nonferrous-scrap-sales/>; (5) <https://aluminiuminsider.com/norsk-hydro-to-add-new-aluminium-scrap-recycling-capacity-to-eastern-pennsylvania-plant/>; (6) <https://www.riotinto.com/news/releases/2022/Rio-Tinto-invests-in-a-new-aluminium-recycling-centre-in-Arvida->

Australia has a short window of opportunity to invest in recycling capability...

...but shared industry ambition and coordination is required...

Six key barriers must be addressed in Australia...

...and have all been overcome in other markets

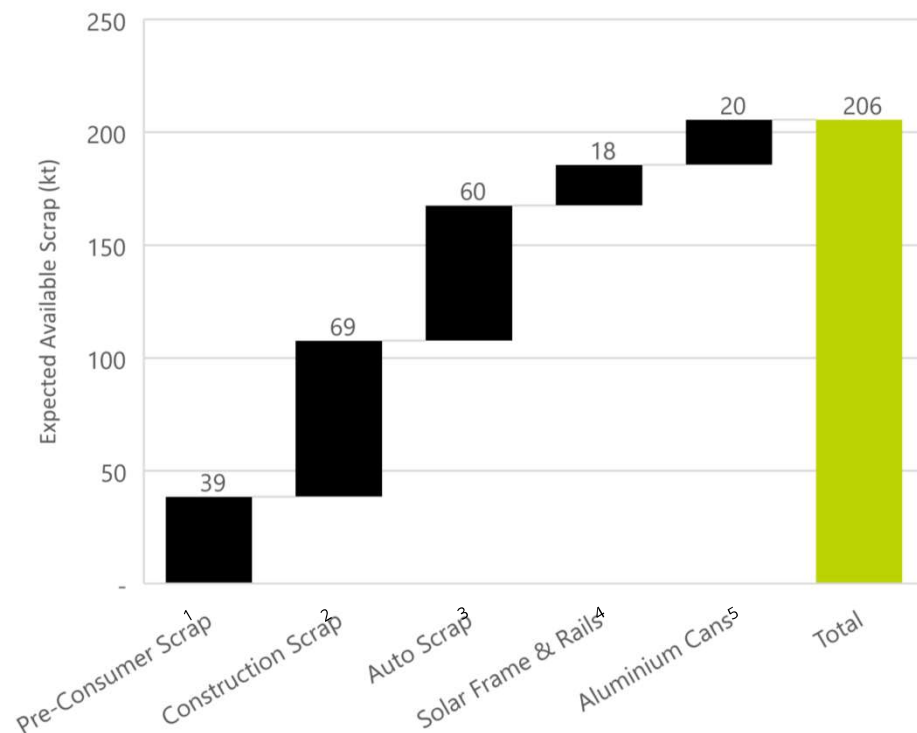


Note: (1) such as the involvement the European Aluminium Association (EAA) and the Organisation of European Aluminium Refiners and Remelters (OEA) have had in shaping EU-25 scrap standards

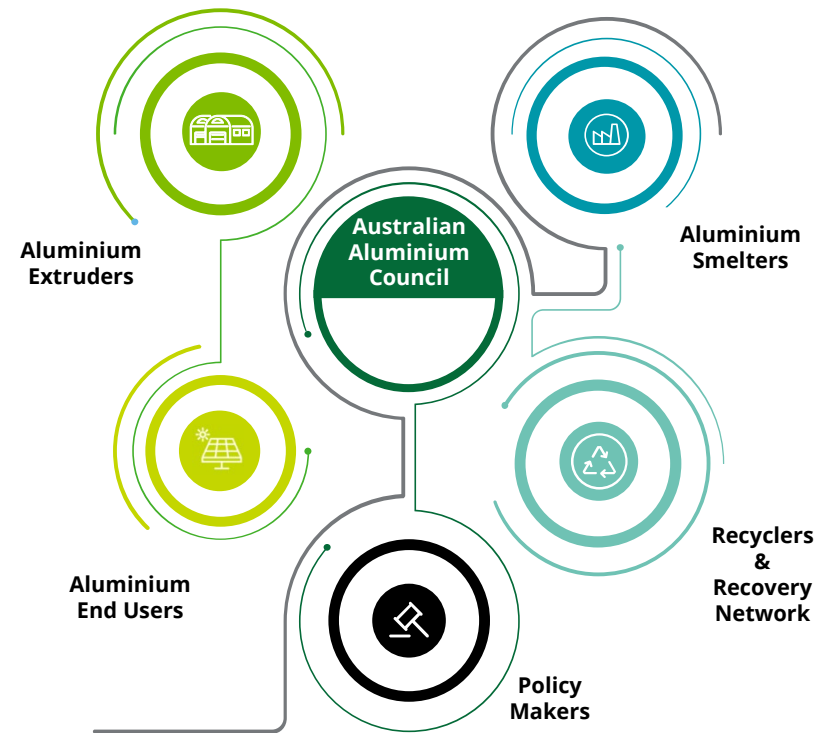
...and there is more than enough high quality scrap to support at least two dedicated remelters

Solving domestic scrap reprocessing will require collaboration both with government and across the value chain

200kt of scrap is produced annually, mostly post-consumer



Collaboration would need to focus across the value chain and incorporate government and end users



Note: (1) Assumes 17.5% of 220kt extrusion billet ends up as scrap; (2) National Waste Database 2020; (3) Assumes 150kg aluminium content per recycled vehicle, and 50% of Australia's 800,000 landfilled vehicles are recycled; (4) Assumes 3GW panels recycled per year; (5) Based on annual reports from container deposit scheme operators, could rise to 30kt by 2030 as collection rates rise.