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Department of Climate Change, Energy, the Environment and Water
https://consult.dcceew.gov.au/consultation-proposed-approach-carbon-leakage-risk-as-part-of-the-carbon-leakage-review
12 December 2023

Dear Minister

Re: Economic modelling of Australia's potential emissions reduction pathways

The Australian Aluminium Council (the 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. Aluminium is Australia's highest earning manufacturing export. The industry directly employs more than 19,000 people, including 6,600 full time equivalent contractors. It also indirectly supports around 60,000 families, predominantly in regional Australia.

The Council welcomes the opportunity to respond to the Carbon Leakage Review Consultation Paper (the Paper), as a first step in the Government's consultation on matters relating to carbon leakage risks in Australia to inform consideration of additional policy options to address any carbon leakage, including an Australian Carbon Border Adjustment Mechanism (CBAM). The Council notes that this is the first of two rounds of consultation, and the Review will report to Government by 30 September 2024.

Australia has a large resource and industrial base and has great potential to expand zero- and low-emissions industrial production including for export, with economic benefits to match. While industrial production is a major contributor to Australia's overall emissions, including through production for export, Australia's green industry ambition is linked to opportunities created by the global transition to net zero. The Paper defines carbon leakage as the production of emissions intensive trade exposed goods and commodities shifting from countries with more ambitious emissions reduction policies to those with weaker (or no) emissions reduction policies solely because of different policy settings.

When considering leakage risk, it is worth separating the Australian aluminium industry into five sectors:

1 Bauxite, low emissions intensity, export exposed to investment risk;
2 Alumina, high emission intensity, export exposed to trade and investment risk;
3 Primary Aluminium, high emission intensity, export exposed to trade and investment risk;
   a) Primary Aluminium Billet, high emission intensity, import and export exposed to trade and investment risk; and
4 Aluminium Extrusions, low emissions intensity, import exposed to trade and investment risk.

However, the integrated nature of bauxite mining, alumina refining, aluminium smelting and extrusion processes in Australia means that efficient and effective regulatory processes for each step is critically important to the ongoing operation of the overall system.

In addition to this covering letter, this submission includes three parts:

A. Feedback on the Carbon Leakage Review Consultation Paper.
B. Global Aluminium Industry Context; and
C. Aluminium Industry Decarbonisation Pathways.

Australia is one of the very few countries which has bauxite mining, alumina refining, aluminium smelting and aluminium extrusion, making aluminium one of only two commodities in which the raw materials are mined and are processed all the way to a consumer product right here in Australia. The value chain in Australia is unique in a global context and this unique integration must be considered in the Review.

The Council does not believe that a CBAM would effectively mitigate the risk of carbon leakage for bauxite, alumina or primary aluminium, which are primarily export exposed. While a CBAM may be a useful policy on aluminium extrusion and billet, the more near-term policy need is a review of Australia's trade remedies framework, particularly the Anti-dumping provisions to ensure aluminium extrusions are not imported at pricing levels which cause material injury to the value-add Australian aluminium extrusion industry.

The capacity of the current policy settings of the Safeguard Mechanism to mitigate carbon leakage risk in the future are yet to be fully tested. Facilities do not yet have confidence as to whether they will receive Trade Exposed Baseline Adjusted (TEBA) baselines; prices of ACCUs have yet to be fully tested in the market and the outcomes of the 2026/27 review will impact facilities within the investment timeframes to 2030. The Carbon Leakage review needs to consider the lack of certainty over current policy implications.

Australia must be sufficiently competitive to be able to attract global decarbonisation investment. Recent analysis by the Council compared policy industry policy measures in Australia with other key aluminium and alumina producing jurisdictions[1]. The Council supports the use of targeted public investment in decarbonisation as an important step in reducing long-term carbon exposure de-risking investment decisions and accelerating technology cost reductions through deployment and learning. The single biggest opportunity to decarbonise the energy intensive, vertically integrated Australian aluminium industry is through the combination of electrification of existing processes and decarbonisation of the electricity supply. This should be combined with Production Tax Credits and a Transformational Infrastructure and Technology Fund to enable Australia to be sufficiently competitive to be able to attract global decarbonisation investment. The Council believes there is also an opportunity to better magnify and extend the co-commitments of abatement funding, similar to schemes in other jurisdictions such as Quebec.

The Council notes that critical to the transition will be a future where Australia's world class energy resources are translated into internationally competitive, low emissions, reliable energy to ensure industrial production, emissions and jobs are not exported to other countries. The Council seeks a national climate and energy policy framework which is transparent, stable and predictable, while maintaining the economic health of the nation including vital import and export competing industries. The Council looks forward to continuing constructive dialogue with during the Review. The Council is happy to provide further information on any of the issues raised in this submission.

Kind regards,

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[1] https://aluminium.org.au/wp-content/uploads/2023/11/Aluminium-Critical-Mineral-Report-Nov23.pdf

A. Feedback on the Carbon Leakage Review Consultation Paper

Members of the Council may also have made submissions directly to this consultation, highlighting specific issues. As each aluminium smelter, alumina refinery and bauxite mine has unique circumstances and contractual arrangements, the Council will present high level comments on the Paper. This Council submission should be considered alongside the direct input from our members.

1.1 Carbon leakage

The Paper articulates that "Importantly, the falling costs of renewable electricity have made it increasingly competitive". While the Council agrees that the cost of variable renewable energy generation has fallen dramatically, the delivered (including transmission and distribution) cost of firmed electricity has not fallen. The cost of firming renewable energy supply is likely to be one of the largest differentiators of Australia's future competitiveness for electricity-intensive industries. There is no transition without transmission and in both the National Electricity Market (NEM) and the South West Interconnected System (SWIS) effort is needed to continue to progress future state transmissions networks, to support the large volume of renewable energy required to offset not only existing coal fired generation but also increased demand for facilities to electrify once this technology becomes viable.

Is the description of carbon leakage appropriate for the purpose of this Review?

The Council recognises that while many other countries are also stepping up efforts to tackle climate change, not only does the level of ambition and the policies through which it is pursued differ between jurisdictions; but the relative importance of those jurisdictions in terms of the competitiveness of each commodity differs. For example, while the European Union has a high degree of ambition and a Carbon Border Adjustment Mechanism, it constitutes only around 4% of global production of aluminium. As shown in Figure 2 of the Paper, China, which produces >58% of global alumina and aluminium production has much lower carbon price than competitor nations. Additionally, Figure 2 assumes an ACCU price in Australia of A$30, which the Council believes is unlikely to be maintained once the compliance periods commence.

In considering the definition of carbon leakage, all parts of the Australian aluminium industry are highly exposed to both trade and investment leakage. Capital follows the strongest investment signals and Australia's industry policy signals are currently too weak to attract globally relevant industrial abatement and manufacturing investment. Australia's industry must also be able to attract the capital, to be able to make this transition while remaining competitive.

1.2 The Safeguard Mechanism

The Paper articulates that Safeguard facilities are incentivised to reduce the emissions intensity of production at the market price for emissions credits. However, it then implies that facilities that *choose not* to reduce on-site emissions are foregoing the opportunity to earn and sell Safeguard Mechanism Credits (SMCs). The Council would argue, that with such a substantial incentive in place as the Safeguard Mechanism, it is unlikely that facilities would "choose not" to reduce emissions, were an alternative technically and commercially viable. The Australian aluminium and alumina industries are investing significant resources to identify, develop and commercialise complex new technologies that will enable fossil fuels to be phased out of operations as soon as commercially possible. The timeline for these reductions depends on time taken to successfully identify, develop and commercialise these processes, and to integrate into existing facilities accordingly.

The biggest single opportunity to decarbonise the vertically integrated domestic aluminium industry is via decarbonisation of the electricity supply, which assists with both direct electrification and other potential pathways, such as hydrogen. Decarbonising the electricity supply needs to be combined with technology availability for the facilities to enable transformation. Both are long-term, complex endeavours, which need to move together. However, in some cases it is the supply and availability of competitively priced zero emissions electricity which may be the rate limiting step. For example, the SWIS does not have the generation nor transmission capacity to electrify one alumina refinery, let alone four.

If Australia is to maintain a sustainable alumina and aluminium industry through the transition and deliver decarbonisation goals, the industry must be globally competitive. The fundamental pillar of global competitiveness is low-cost renewable energy, firming and transmission. Despite recent announcements, such as the expansion of the Capacity Investment Scheme (CIS)[2], the scale of the investment by the Government at this stage does not match the scale of investment of Australia's competitors, such as in the US.

The Mission Possible Partnership[3] highlighted that a global investment of approximately US$1 trillion will be required for the aluminium sector transition. Considering the size of the Australian aluminium industry (~3% of the global industry), an investment of US$30bn would be necessary to deliver the same outcome. Australia must be able to compete to attract the necessary capital and investment to undertake the transition.

While the Council welcomes the expansion of the CIS to support additional renewable generation, additional Commonwealth support is required to assist States and Territories with electricity transmission network enhancements and expansion – arguably where the economic and social licence bottleneck is developing.

The Council appreciates the creation of a dedicated Powering the Regions Fund (PRF) stream for the cement, lime, alumina, aluminium and steel sectors in addition to access to other funding within the PRF to capitalise on new generation, the program is currently two orders of magnitude smaller (relative to GDP) than similar programs in other jurisdictions like Canada, Europe and Japan. It is also important that projects which are funded will deliver maximum abatement at least cost as well as in a timely manner. The current design seems to favour timing over abatement. The scale and timing range must be significantly increased, with a fixed commitment to co-fund 50% of all green industrial capital investment across existing and new assets for both on and off-site investment. This will allow industry to then cost efficiently and competitively demonstrate technological innovation and deliver regional infrastructure upgrades, such as transmission. This would be particularly relevant for the alumina industry, where the principal barriers to decarbonisation are:

- the capital cost of on-site transformation to low carbon production methods; and
- the need to upgrade regional electricity infrastructure to deliver the requisite energy to the sites in a low margin mid-stream industry.

Non-financial means of support – particularly the streamlining of regulatory approvals – are also critical to lowering barriers.

What is your view on how your business or industry could be affected by carbon leakage?

While the Paper recognises that the out-of-pocket cost is less than it would otherwise have been, it is worth noting that challenging market conditions currently facing the industry, including the Safeguard Mechanism costs and the capital requirements for decarbonisation have led to the impairment of two Australian

[2] https://minister.dcceew.gov.au/bowen/media-releases/delivering-more-reliable-energy-all-australians
[3] https://missionpossiblepartnership.org/wp-content/uploads/2022/10/Making-1.5-Aligned-Aluminium-possible.pdf

alumina refineries[4]. A third is under cost pressures[5]. That said, there remains a focus on pursuing decarbonisation of the value chain at these facilities[6]. The bauxite, alumina, aluminium supply chain is becoming increasingly vulnerable and its survival in Australia is at risk, even with the positive global demand outlook.

2.1 Relevant goods and commodities

Are there other goods or commodities beyond those identified as trade exposed under the Safeguard Mechanism that should be included in the assessment?

The Terms of Reference for the Review include a focus on steel and cement, which were identified by stakeholders during the Safeguard reforms as sectors at particular risk of carbon leakage. The Council believes that this is a misrepresentation, of the level of risk of carbon leakage. These sectors were identified based on trade exposure from imports (i.e., import rather than export exposed) and therefore there may be suitable for the application of a CBAM; not that their overall risk of carbon leakage was higher.

The Council believes the export data shown for aluminium in Figure 4 of the Paper is incomplete. The Council publishes this data annually for the Australian market and of the 1.5 Mt of aluminium smelted annually, around 95% is exported[7].

When considering leakage risk, it is worth separating the Australian aluminium industry into five sectors:

1 Bauxite, low emissions intensity, export exposed to investment risk;
2 Alumina, high emission intensity, export exposed to trade and investment risk;
3 Primary Aluminium, high emission intensity, export exposed to trade and investment risk;
   a) Primary Aluminium Billet, high emission intensity, import and export exposed to trade and investment risk; and
4 Aluminium Extrusions, low emissions intensity, import exposed to trade and investment risk.

Of these, most but not all bauxite mines are covered by the Safeguard Mechanism. Aluminium Extrusions are not covered by the Safeguard Mechanism.

The Council believes that the Australian aluminium industry is highly exposed to carbon leakage from an export, rather than import-competition frame. As it is partially vertically integrated, the viability of any given subsector impacts the viability of other parts of the industry. For example, bauxite from South Western Australia is used 100% for domestic refining purposes, therefore the viability of the four refineries in WA impacts the viability of the associated bauxite mines. This vertical integration also results in incremental additional impacts on aluminium compared with other minerals and sectors, as carbon pricing is added throughout the production process on top of the key inputs, particularly energy.

2.2 Assessing impacts of carbon leakage and policy instruments

The Council recognises the variations in emission intensity by facility can be masked by averaging (Paper Figures 5 and 6), however it is worth noting that these variations, which often largely relate to legacy energy sources, can also be addressed within domestic policy. This is the case in Australia where the Safeguard Mechanism converges to the industry average, as well as declining baselines, over the period to 2030.

[4]2023 Half Year Results - https://www.riotinto.com/en/invest/financial-news-performance/results
[5] https://news.alcoa.com/press-releases/press-release-details/2023/Alcoa-Corporation-Reports-Third-Quarter-2023-Results/default.aspx
[6] https://www.riotinto.com/en/news/releases/2023/rio-tinto-and-sumitomo-to-build-gladstone-hydrogen-pilot-plant-to-trial-lower-carbon-alumina-refining
[7] https://aluminium.org.au/australian-industry/statistics-trade/ and https://aluminium.org.au/sustainability/

Is this characterisation of the potential impacts of carbon leakage and instruments to address it appropriate for the purpose? Are there other aspects that should be considered?
The Paper asserts that policies to address leakage by jurisdictions with strong climate policies are expected to reduce global emissions. The Council would only argue that this is the case it if the jurisdiction with the strong policy is also a large producer of those goods, which in the case of the aluminium industry for example the EU is not.

2.3 Prior analysis on carbon leakage
Again, the Council would argue that assessment of carbon leakage from the EU ETS are a poor comparison for Australian industry which has a very different resource base. In recent years, high energy costs in Europe have crippled the aluminium industry, masking impacts.

2.4 Analytical approach
What domestic economic effects from carbon leakage and policy approaches to address it are of particular importance for analysis and modelling? Would the analysis benefit from an assessment of impacts on bilateral trading partners and net global emissions?
The Council would encourage the Review to consider the sector as the 5 sub-sectors previously outlined as the impacts are different for each. The Council would also encourage the Review to then consider inter-sector analysis. For example, while Australia exports most of the primary aluminium it produces, around 120,000 tonnes is further manufactured domestically. This is an important market for billet from Australian smelters. Every tonne of imported extrusion material impacts on the Australian portfolio and ultimately their cash margin.

When considering international economic analysis, this should focus on not only the competitors by sector, but the degree to which the policies have similar applications. For example, even in the EU ETS, the breadth of application to both alumina and aluminium (Scope 1) is quite different to the application of NGER and Safeguard.

The analysis should also consider other distortions[8] in the market, where a carbon price may be applied but then a discount provided on other tariffs or taxes which may not initially appear to be directly related.

3 Policy options to address carbon leakage risks
Are there additional policy options that should be considered alone or as part of a portfolio of approaches to address carbon leakage?
The Council believes there is an opportunity to better magnify and extend the co-commitments of abatement funding. For example, in Quebec, Canada, the revenues from the carbon pricing scheme are allocated as funds for decarbonisation projects. The facility's compliance costs may be given back as allowance to the facility to be strictly used to fund its decarbonisation projects[9]. The Council encourages further consideration of this model in Australia, particularly for manufacturing sectors such as aluminium.

3.1 Existing measures under the Safeguard Mechanism
What is the capacity of current policy settings of the Safeguard Mechanism to mitigate carbon leakage risk into the future?
The capacity of the current policy settings of the Safeguard Mechanism to mitigate carbon leakage risk in the future are yet to be fully tested as facilities do not yet have confidence as to whether they will receive Trade Exposed Baseline Adjusted (TEBA) baselines; prices of ACCUs have yet to be fully tested in the market and the outcomes of the 2026/27 review will impact facilities within the investment timeframes to 2030. However, the current settings of the Safeguard Mechanism have already contributed to the impairment of two Australian alumina refineries.

[8] https://one.oecd.org/document/TAD/TC(2018)5/FINAL/En/pdf
[9] https://www.environnement.gouv.qc.ca/changements/carbone/allocation-gratuite/presentation-en.htm

3.2 Australian carbon border adjustment mechanism

While the Paper notes that a CBAM can include adjustments affecting both imports, exports or both; there is no precedent for its application in a largely export driven economy such as Australia. The reverse to a CBAM, i.e., 'selling the Safeguard' and other domestic emissions reduction policies to Australian export markets is an important pillar of CBAM work that does not appear to be contemplated yet.

Is an Australian carbon border adjustment mechanism desirable? If so, which design features should be considered?

The Council notes that the while there is support for a CBAM, it is largely from those interested in effective functioning markets – and agrees it could be a useful policy tool in a perfect global carbon market. However, in an imperfect world, in which this policy would effectively sit, it is not as useful as other policies which can more directly address the risk of Australian carbon leakage.

It is unclear if the Australian Government is considering an import only or import and export CBAM. As noted in the Paper, the EU CBAM applies to imports of aluminium – however only to a subset of the emissions included in NGER Scope 1 (for example carbon dioxide emissions from baked anode production and all methane and nitrous oxide are excluded in the EU CBAM calculation). One of the biggest areas of risk for the aluminium industry in terms of carbon leakage, is exposure to variable energy prices which can be seen as a proxy for Scope 2 emissions, which are not included in the EU CBAM.

One of the major risks of a CBAM is that it allows countries which produce goods with very variable emissions intensities (for example primary aluminium compared to recycled aluminium) to choose the destination of that material based on policy, resulting in no net reduction in global emissions but potentially still causing domestic carbon leakage. The Council believes this is a real risk for primary aluminium, billet and extrusions.

The Council does not believe that a CBAM would effectively mitigate the risk of carbon leakage for bauxite, alumina or primary aluminium, which are primarily export exposed and where this policy is deemed to be not as effective as other measures outlined.

The Paper does present the option of a refund on export and discusses some of the issues associated with that, however, the Council believes this would be difficult to apply in practice.

While a CBAM may be a useful policy on aluminium extrusion and billet, the more near-term policy need is a review of Australia's trade remedies framework, particularly the Anti-dumping provisions to ensure aluminium extrusions are not imported at dumped pricing levels which cause material injury to the value-add Australian aluminium extrusion industry. A better framework is required to ensure free and fair trade to enable industry growth. This may be a more effective tool at mitigating carbon leakage in this sector than a CBAM.

3.3 Emissions product standards

What is the appropriate role for emissions product standards to mitigate carbon leakage?

It is important that if introduced, mandatory product standards (MPS) are internationally consistent to facilitate efficient international trade and enables informed choice for customers of commodities, including alumina and aluminium. Within the industry, the Aluminium Stewardship Initiative (ASI) provides a global certification scheme which includes not just carbon content, but the full range of material Environmental, Social, and Governance (ESG) issues for all parts of the value chain[10]. Many of Australia's mines, refineries, smelters and chains of custody supply chains are certified. The global aluminium industry is also

[10] https://aluminium-stewardship.org/asi-standards/performance-standard

differentiating products based on the carbon credentials[11] and uses blockchain technology to provide provenance traceability and transparency[12].

The Paper notes that the EU and US signed the Global Arrangement on Sustainable Steel and Aluminium (GASSA) in 2021, however, as of November 2023 these discussions are ongoing and have not yet reached agreement. The Paper also notes that these negotiations have the potential to set an internationally recognised definition of green aluminium, however, it is worth noting in this context that methodologies between not only the EU and US must be aligned on Scope, but also that these jurisdictions are not themselves large producers of aluminium and therefore have limited data sets. The Council believes that while these discussions should be monitored, they do not offer an effective carbon leakage mitigation for the Australian bauxite, alumina or aluminium sectors.

More broadly product standards require alignment in carbon accounting methodologies and approaches (e.g., location-based or market-based, boundaries etc) and this in itself would require considerable effort before offering any leakage protection.

3.4 Targeted public investment in firms' decarbonisation

What is the appropriate role for public investment measures to mitigate carbon leakage?

As previously articulated, Australia must be sufficiently competitive to be able to attract global decarbonisation investment. Recent analysis by the Council compared industry policy measures in Australia with other key aluminium and alumina producing jurisdictions[13]. The Council supports the use of targeted public investment in decarbonisation as an important step in reducing the long-term carbon exposure, de-risk investment decisions and accelerate technology cost reductions through deployment and learning. The Council's Members have considerable experience with funding through ARENA and are currently exploring opportunities within the PRF. These policies need to take into account the time that is required to develop a detailed project proposal and to deliver the projects in the timeframes for funding application and completion.

However, capital follows the strongest investment signals and Australia's signals are currently too weak to attract globally relevant industrial and manufacturing investment. As previously articulated, considering the size of the Australian aluminium industry (~3% of the global industry), US$30bn is estimated cost (including transmission) for the industry.

Industry needs two key policies in to be an attractive destination for industrial abatement to take place:

1. Production Credits. This policy pathway is being used effectively in a range of jurisdictions, including the US, China, India and Europe, to incentivise production of low carbon products and inputs into the clean energy supply chain. The credits are typically priced in a manner that bridges the relevant regional or global green production premium, through an implied cost of carbon required to support investment. The policy should be specifically relevant to aluminium metal production and could be doubly incentivised into domestic downstream manufacturing, such as extrusion; solar panel production etc.
2. Transformational Infrastructure and Technology Funding. The Government's existing grant funding through the PRF is currently two orders of magnitude smaller (relative to GDP) than similar programs in other jurisdictions like Canada, Europe and Japan. The scale being offered must be significantly increased with a fixed commitment to co-fund 50% of all green industrial capital investment across existing and new assets for both on and off-site investment. This will allow industry to then cost

[11] For example: https://www.riotinto.com/-/media/Content/Documents/Products/Aluminium/RT-Aluminium-RenewAl-fact-sheet.pdf?rev=f89b8d105e15400fa053d58a364c3be8, https://www.alcoa.com/sustainability/en/pdf/EcoSource.pdf

[12] https://www.startresponsible.com/

[13] https://aluminium.org.au/wp-content/uploads/2023/11/Aluminium-Critical-Mineral-Report-Nov23.pdf

efficiently and competitively demonstrate technological innovation and deliver regional infrastructure upgrades, such as transmission.

This would be particularly relevant for the alumina industry, where the principal barriers to decarbonisation are:

- the capital cost of on-site transformation to low carbon production methods; and
- the need to upgrade regional electricity infrastructure to deliver the requisite energy to the sites in a low margin mid-stream industry.

3.5 Multilateral and plurilateral initiatives

What is the appropriate role for multilateral and plurilateral initiatives to help to mitigate carbon leakage, and the impact of unilateral measures taken to address carbon leakage?

While the Council supports development multilateral and plurilateral initiatives, alone, they are unlikely to result in material reduction in carbon leakage risk.

4 Feasibility of policy options

What principles should guide Australian policies to prevent carbon leakage?

Should other factors be considered to assess the feasibility of potential policies?

As carbon legislation continues to evolve in both Australia and Internationally it will be critical that the policy is forward looking and adaptable. The 2026-2027 Safeguard Mechanism review may provide better insights into the potential impact of carbon leakage on Australian industry and how the existing mechanisms, require calibration to ensure Australis's industry is not exposed.

The policy will need to evaluate impacts at a product level as the challenges, including decarbonisation technology readiness and costs, the ability to pass on costs, will leave some sectors more vulnerable to carbon leakage than others.

Australia's carbon leakage policy should ensure there is no disadvantage to Australian industry (vertical integration, between sectors, between importers and exporters, among policies) and that policies minimise further cost imposts on Australian industry.

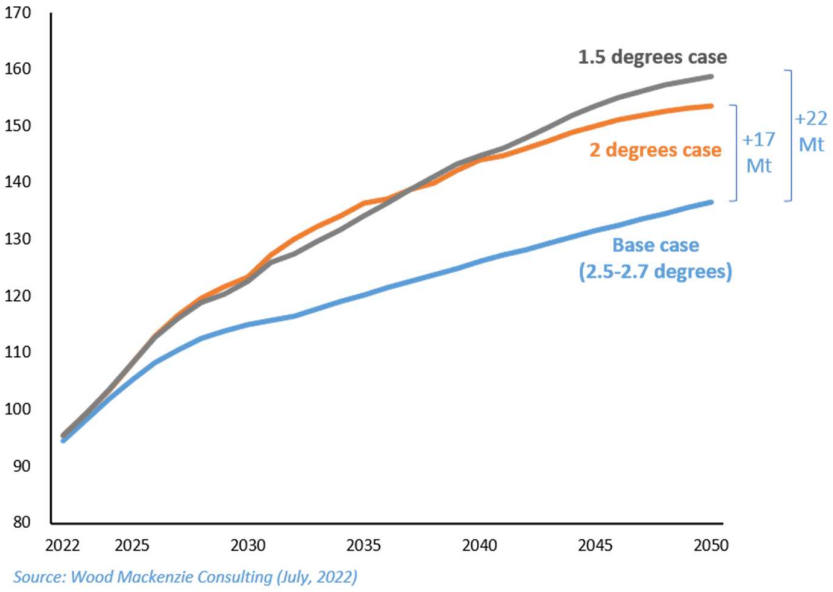
B. Global Aluminium Industry Context

This context provides the framing for the consideration of the global bauxite, alumina, aluminium and downstream manufacturing sectors, in the consideration of carbon leakage.

Aluminium – Part of the Clean Energy Transition

Aluminium is one of the commodities most widely used in the global transition to a clean energy future[14]. 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[15] (Figure 1). 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.

Figure 1. Aluminium Demand (Mt)[16]



Source: Wood Mackenzie Consulting (July, 2022)

Aluminium is strong, durable, flexible, impermeable, lightweight, corrosion resistant and 100% recyclable. Because of its versatility aluminium is used in the construction and building, defence, aerospace, electricity and transportation sectors, with demand increasing. As noted by the United States Geological Service (USGS)[17], aluminium is used in almost all sectors of the economy. Electrification of transport and deployment of renewable energy technologies will increase demand for primary aluminium. Although recycling aluminium is part of future supplies, the volume of secondary output will not be sufficient to meet rising demand for many decades, and indeed probably this century.

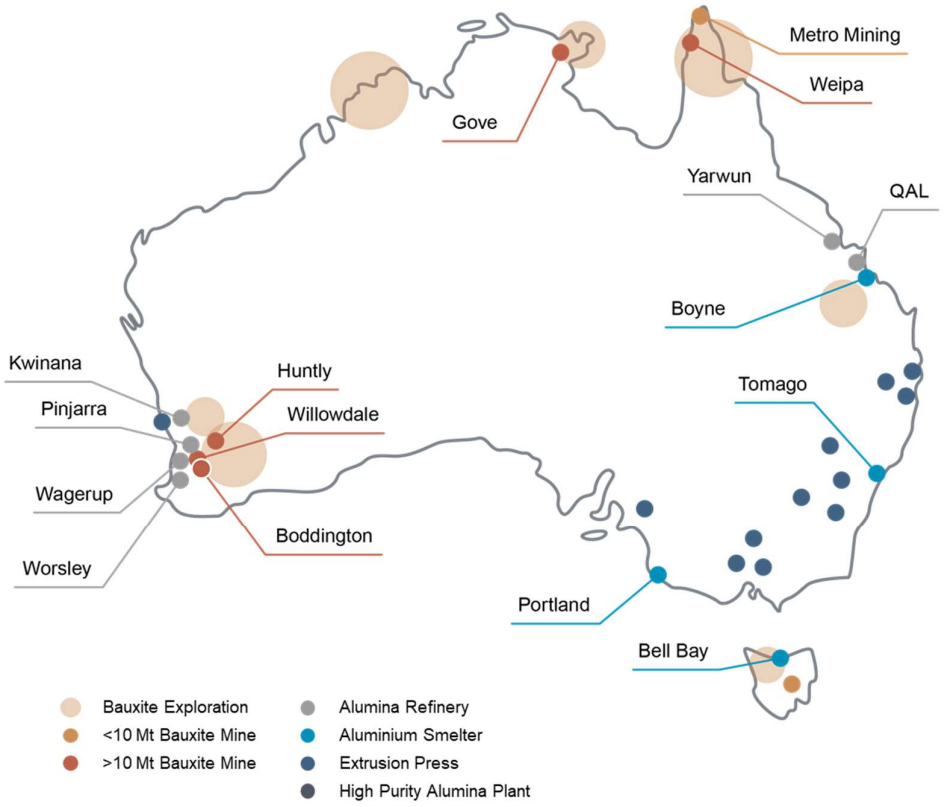
Australia's Bauxite, Alumina and Aluminium Production

Australia's industry (Figure 1) includes six mines which collectively produce over 100 Mt per annum making Australia the world's largest producer of bauxite. Australia is the world's largest exporter of alumina with six alumina refineries producing around 20 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.

[14] https://www.worldbank.org/en/topic/extractiveindustries/brief/climate-smart-mining-minerals-for-climate-action
[15] International Aluminium Institute High Substitution Scenario
[16] Alumina Limited, Sep 2022
[17] https://www.usgs.gov/news/national-news-release/us-geological-survey-releases-2022-list-critical-minerals

Of Australia's 100Mt bauxite production, around 60% is refined domestically and 40% is exported[18]. Of the 20 Mt of alumina produced, around 85% is exported and 15% is smelted domestically. And of the 1.5 Mt of aluminium smelted, around 95% is exported. The industry is therefore highly trade exposed, largely through exports. However, while Australia exports most of the primary aluminium it produces, around 120kt of it is further manufactured domestically. This is an important market for billet from Australian smelters. Every tonne of imported extrusion material impacts on the Australian portfolio and ultimately their cash margin. The Australian extrusion market in total is estimated at around 190kt tonnes. Australia's nine extruders have a nameplate capacity of 150,000 tonnes, however currently around 30,000 tonnes are idled. Both aluminium extrusion and primary aluminium billet are import exposed.

Figure 2. Australia's Bauxite, Alumina, Aluminium, Extrusion and Manufacturing Industry



Australia's aluminium industry contributes around $15B[19] a year to the economy in export value. 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 are processed all the way to a consumer product right here in Australia. However, there is an opportunity to leverage this existing industry further. The bauxite mined in Australia produces around 20 Mt of primary aluminium; more than 13 times Australia's current production. So, while the existing aluminium industry in Australia is a successful example of vertical integration, it is far from being at capacity and there is economic opportunity for Australia to be gained under the right policy conditions. Conversely, the current capacity remains vulnerable to carbon leakage and geopolitical risk.

[18] https://aluminium.org.au/sustainability/, 2022 data
[19] https://www.industry.gov.au/publications/resources-and-energy-quarterly-june-2023

During previous periods of economic and climate policy uncertainty from 2012-2014 the industry saw the closure of two aluminium smelters, in the Hunter Valley and Geelong, one alumina refinery in the Northern Territory, and two aluminium rolling mills close.

Global Competition

While Australia is the world's largest producer of bauxite and second largest producer of alumina (Table 1), this static view does not show that, just over 20 years ago, Chinese domestic production was approximately 11% of global capacity (Figure 3, Figure 4) and was largely vertically integrated with their domestic bauxite supply and alumina production. One of the most significant consequences of the geographic shift in aluminium production is that supply is now highly concentrated in non-OECD nations, which comprise only 12% global production. This changing global dynamic is also articulated through the example of the USA which was only 25 years ago the world's largest producer of aluminium but today is no longer in the top 10 producing nations (Table 2). Concentrated supply chains increase the risks of vulnerability outside Australia's control, including carbon leakage as other jurisdictions have lower or less transparent carbon policies in place.

Table 1. Top 5 Bauxite, Alumina and Aluminium Production Rankings 2022 (%)[20]

Ranking	Bauxite	Alumina	Aluminium
1	Australia, 28%	China, 58%	China, 59%
2	Guinea, 24%	Australia, 13%	India, 6%
3	China, 20%	Brazil, 8%	Russia, 5%
4	Brazil, 9%	India, 5%	Canada, 4%
5	Indonesia, 6%	Russia, 2%	UAE, 4%

The growth in capacity in China was largely driven by the development of captive coal resources to produce and supply power, particularly in Western China, subsidising prices to the aluminium industry[21]. Today, China's domestic aluminium and alumina production represents 58% of the global industry. China also imports 83% of global bauxite exports, including 98% of Australia's bauxite exports and Guinea, as the world's largest exporter of bauxite, exports principally to China, including from some captive bauxite mines.

Table 2. Top Primary Aluminium Producing Countries at 5 Yearly Intervals (1997-2022)[22]

Rankings	1997	2002	2007	2012	2017	2022
1	USA	China	China	China	China	China
2	Russia	Russia	Russia	Russia	Russia	India
3	Canada	Canada	Canada	Canada	Canada	Russia
4	China	USA	USA	USA	India	Canada
5	*Australia*	*Australia*	*Australia*	*Australia*	UAE	UAE
6	Brazil	Brazil	Brazil	UAE	*Australia*	Bahrain
7	Norway	Norway	Norway	India	Norway	*Australia*
8	Venezuela	India	India	Brazil	Bahrain	Norway
9	Germany	Germany	UAE	Norway	Saudi Arabia	Malaysia
10	India	Venezuela	Bahrain	Bahrain	Brazil	Saudi Arabia

[20] Data supplied by Department of Science, Industry and Resources and presented in https://aluminium.org.au/wp-content/uploads/2023/04/230404-FACTSHEET-TRADE-AND-COMPETITIVENESS-UPDATE-MARCH-2023.pdf

[21] P23, https://www.antaike.com/uploadfiles/20120619/20120619154217370 61.pdf

[22] Data supplied by Department of Industry, Science and Resources

Increasingly in the future recycled aluminium will also be a key international measure of production and China already produces almost 40% of global recycled ingots (Figure 5). Oceania, which includes Australia and New Zealand, produces <0.1%. This also gives countries which have recycled aluminium, with a low carbon footprint, the opportunity to sell it to jurisdictions with carbon border adjustments in place; while still producing primary aluminium with a high carbon footprint but trading it to other nations.

Figure 3. Global Primary Aluminium Production 1973-2022[23]

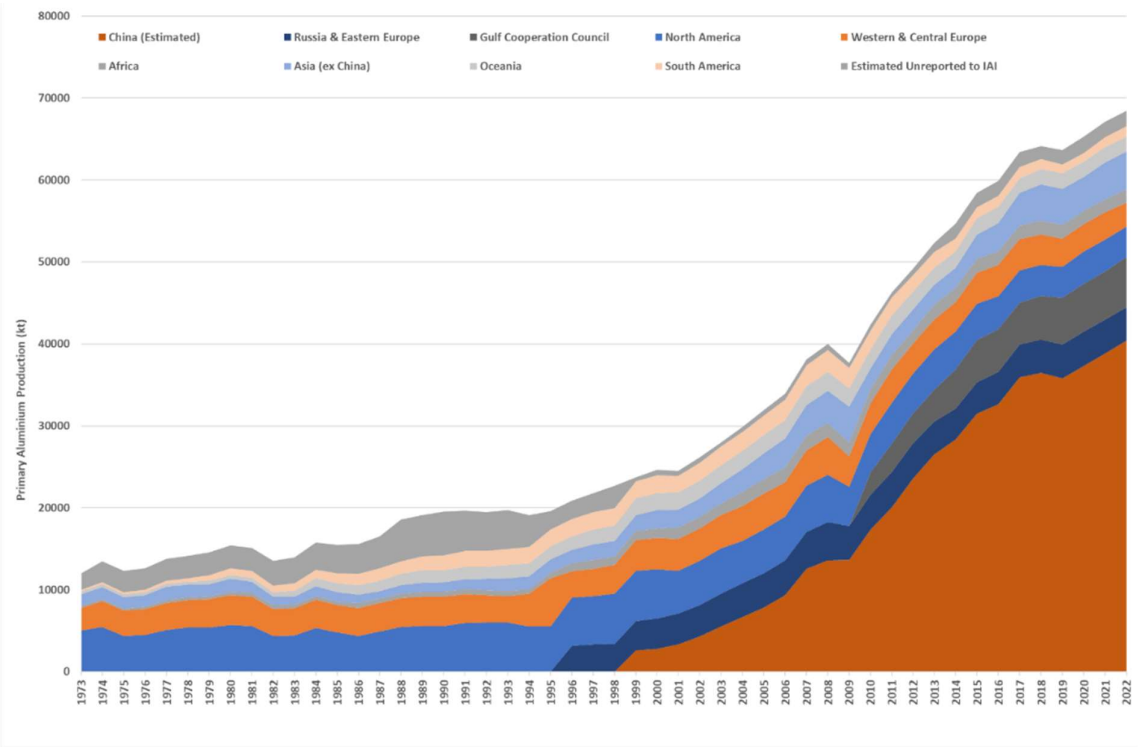


Figure 4. Global Alumina Production 1974-2022[24]

[23] https://international-aluminium.org/statistics/primary-aluminium-production/
[24] https://international-aluminium.org/statistics/alumina-production/

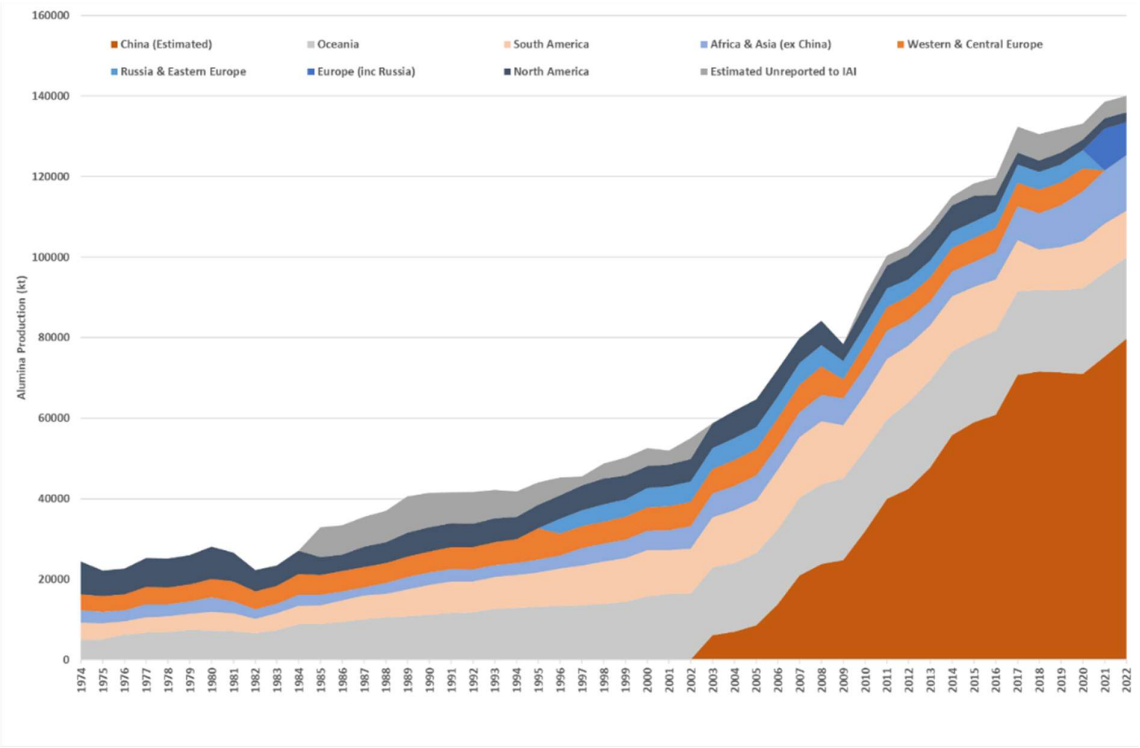
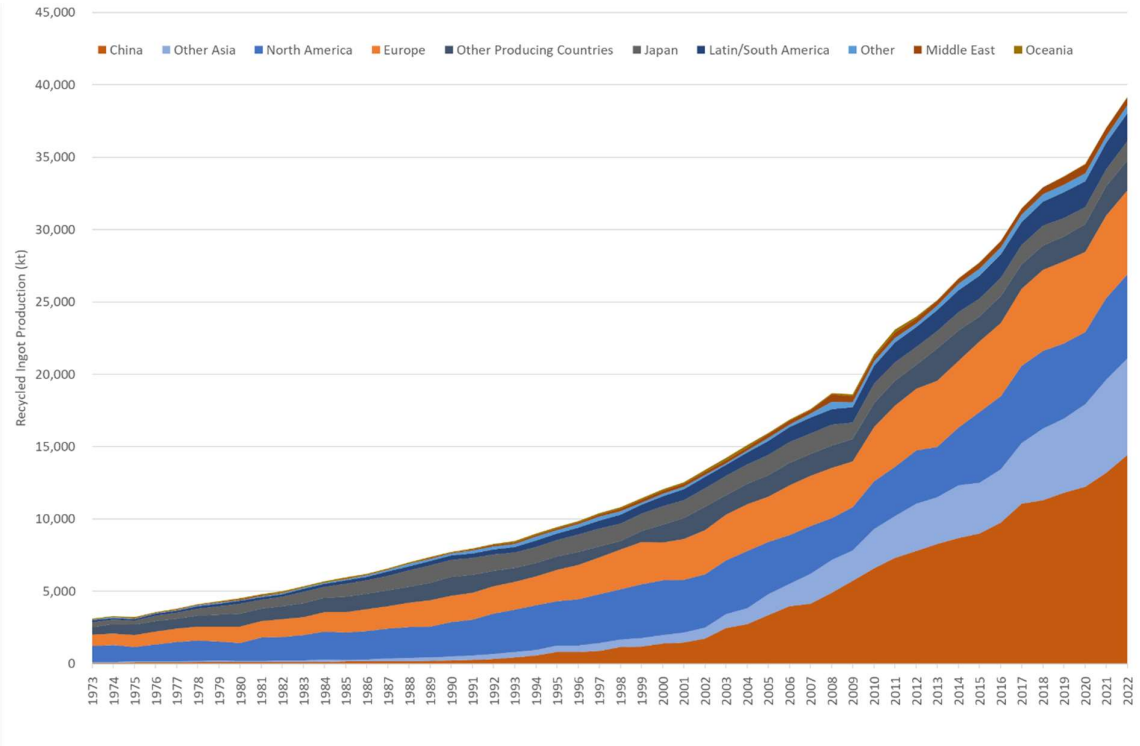


Figure 5. Global Recycled Ingot Production 1973-2022[25]



[25] Data supplied by International Aluminium Institute

Aluminium – The Original Critical Mineral

Since the second world war, governments around the world have understood the importance of the aluminium industry for national security. Aluminium is widely used in defence applications due to its strength to weight ratio, corrosion resistance, conductivity and application to many technologies. The *Australian Aluminium Act* was passed in 1944 primarily to overcome the difficulties of importing aluminium during wartime. What is now known as the Bell Bay aluminium smelter in Tasmania commenced production, as the first smelter in the southern hemisphere, under the name the Australian Aluminium Production Commission in 1955. The US *Defense Production Act 1950* Title III recognises the role of critical inputs, such as aluminium, and was most recently invoked in 2022[26]. The 2022 ban on export of all aluminium ores from Australia to Russia was linked to Russian military use of aluminium in Ukraine[27].

While the vulnerability in the aluminium supply chain has been growing, this has increasingly been exposed since February 2022. Prior to the Russian invasion of Ukraine, the Ukraine was one of the world's largest producers and exporters of alumina[28] and Russia was a major importer of Australian alumina. Following the introduction of the Australian trade ban[29,] Russia now sources most of its alumina from China and is also planning to increase its own alumina refining capacity[30]. The new refinery will be supplied with bauxite from Russian owned mines in Guinea, the world's second largest producer of bauxite. The Russian invasion of Ukraine not only directly impacted supply chains, but also energy markets further disrupting global alumina and aluminium production, particularly those in Europe[31].

The changing nature of Australia's trade relationships can be seen by comparing the Council's annual Trade Factsheets from 2021[32] and 2022[33]. In 2021, around 8% of Australia's alumina exports were supplied directly to Russia which was replaced by increased trade to the Middle East in 2022.

[26] https://safe2020.wpenginepowered.com/wp-content/uploads/2023/05/SAFE_Legislative-Analysis_May-2023.pdf
[27] https://www.smh.com.au/national/foreign-minister-payne-accuses-russia-of-committing-war-crimes-20220320-p5a69o.html
[28] https://aluminium.org.au/wp-content/uploads/2022/09/221214-TRADE-AND-COMPETITIVENESS.pdf
[29] https://www.trademinister.gov.au/minister/dan-tehan/media-release/australia-impose-tariff-increases-all-imports-russia
[30] https://www.reuters.com/markets/commodities/russias-rusal-build-new-alumina-refinery-near-st-petersburg-kommersant-2023-06-15/
[31] https://www.usitc.gov/publications/332/executive_briefings/russia_and_aluminum_supply_chains.pdf
[32] https://aluminium.org.au/wp-content/uploads/2022/09/221214-TRADE-AND-COMPETITIVENESS.pdf
[33] https://aluminium.org.au/wp-content/uploads/2023/04/230404-FACTSHEET-TRADE-AND-COMPETITIVENESS-UPDATE-MARCH-2023.pdf

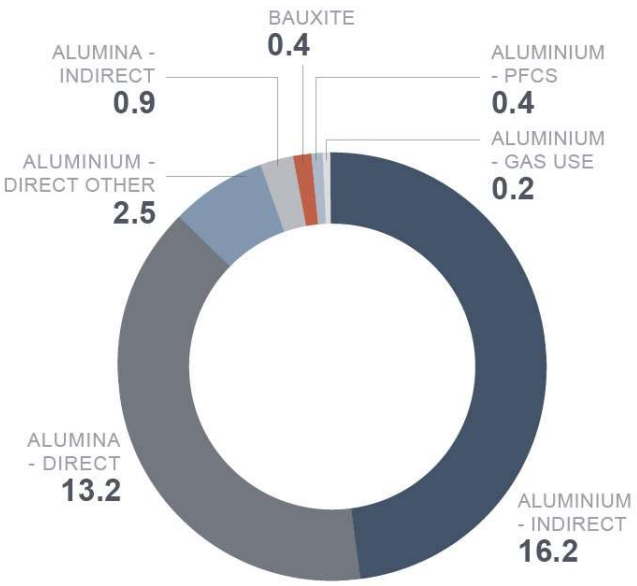
C. **Aluminium Industry Decarbonisation Pathways**

The Mission Possible Partnership, in collaboration with the International Aluminium Institute, recently released Making Net Zero Aluminium Possible: A Transition Strategy for a 1.5°C-compliant Aluminium Sector[34] (the Strategy). The release of the Strategy was supported by the Council and its members. This work brought together companies across the global industry, including those operating across the value chain in Australia. The Strategy recognised that it is possible to meet rising aluminium demand, reduce emissions from the sector to net zero by 2050, and align with a 1.5°C target. The Strategy also highlighted that a global investment of approximately US$1 trillion will be required for the aluminium sector transition, including significant investment to supply the required zero-emissions electricity. It outlined not only actions the industry needs to take, but also actions required by Governments to support this. In particular, developing policy, which is predictable, stable and transparent to enable businesses to confidently plan for this substantial investment. Governments also have a vital role to play designing electricity markets to support the transition and minimising the risks of carbon leakage.

The Australian Renewable Energy Agency (ARENA), in consultation with Alcoa, Rio Tinto and South32 has published a Roadmap for Decarbonising Australian Alumina[35]. The Roadmap identifies four key themes for decarbonisation that could transform the way alumina refineries consume and use energy by enabling the uptake of renewables and removing the use of fossil fuels. It also provides a framework for future policy and investment decisions and serves as a call to action to collaboratively transition the sector into an industry at the forefront of the transition to net zero.

In 2022, Scope 1 and 2 emissions from Australia's integrated aluminium industry (bauxite, alumina, aluminium) were about 33.7Mt CO2-e, which was 7% of Australia's national emissions. (Figure 6). As such, the industry has a long history of reporting under the National Greenhouse and Energy Reporting (NGER) scheme, through the relevant liable entity. Corporations in this sector also have stated emission reduction targets and aspirations (see also Table 4).

Figure 6. 2022 Industry Emissions (Mt CO_2-e)



Additionally, most of the large bauxite mines, all six alumina refineries plus all four aluminium smelters are covered facilities under the Safeguard Mechanism. About 16.1 Mt CO_2-e of this was Scope 1 emissions from

[34] https://missionpossiblepartnership.org/wp-content/uploads/2022/10/Making-1.5-Aligned-Aluminium-possible.pdf
[35] https://arena.gov.au/assets/2022/11/roadmap-for-decarbonising-australian-alumina-refining-report.pdf

Safeguard facilities, representing 12% of Safeguard emissions for the 2021/22 reporting year. Energy typically accounts for 30-40% of the industries cost base, and therefore energy efficiency is a key focus of for these processes.

Globally, there is a focus across industry to find solutions for the technology challenges required to decarbonise, including hydrogen technologies. There is an opportunity for Australia to lead the world in development and implementation of these technologies, capitalising on Australia's national advantages, providing jobs and value to the economy. The Council has produced a series of five factsheets to help articulate the technology pathways:

1. Australia's role in a global aluminium decarbonisation pathway;
2. How Australian bauxite will help meet global demand for aluminium;
3. Australia's role in developing low carbon alumina refining technologies for the world;
4. The role of Australia's aluminium smelters in providing baseload stability in a decarbonising grid; and
5. Decarbonisation of Australia's electricity supply, which the Council sees as the single biggest opportunity to decarbonise the vertically integrated domestic aluminium industry.

The Council updates these factsheets annually; reflecting not only progress in decarbonisation in the industry; but also updating the industry's views of the evolution of decarbonisation technologies, based on research undertaken in Australia and through global partnerships. The single biggest opportunity to decarbonise the energy intensive Australian vertically integrated aluminium industry is through the combination of electrification of existing processes and decarbonisation of the electricity supply. A summary of key Australian Aluminium industry initiatives is provided in Table 3.

Corporate Ambitions

The major operators and joint venture participants in Australia's aluminium industry have the common ambition of net zero by 2050, supported by interim goals (Table 4). However, when comparing these targets with performance within Australia or at a facility level, it is worth noting that corporate ambitions are set at levels that are in line with their policies and subject to their accounting and transparency rules. All the Council's members' interim ambitions are for *both* Scope 1 and Scope 2, and the application of known technologies such as increasing renewable energy supply will be the major pathways for these to be achieved. In the case of the Council's members:

- Corporate targets can be set on ownership, operational control or equity share basis which is different to Safeguard / National Greenhouse and Energy Reporting (NGER) data at the controlling corporation level.
- Corporate targets are frequently set at a multinational level to ensure those facilities in their international portfolio that provide the cost-effective and low-risk emission reductions are actioned first. Therefore, local facility targets may differ from corporate targets, and these may not align with Australian NGER data.
- Corporate and end-market requirements can be Scope 1, Scope 1 plus Scope 2, intensity based, or may include Scope 3. While these are accepted greenhouse gas emissions accounting procedures, they may not align with NGER data.
- Targets may be reported on calendar or financial years (and financial years vary by corporation) which may not align with NGER data.
- Target setting relies on Government/regulator forecasts of substantial grid electricity decarbonisation by 2030; and additionally,
- Targets are generally set as long-term ambition supported by interim goals. This considers the temporal nature of targets (i.e., short, medium and long-term), and a non-annual approach to ensure businesses do not chase short-term and short-sighted annual reductions, but rather focus on long-term success.

Table 3 Key Australian Aluminium Industry Initiatives

Activity	Link
Electric Calcination Study	https://arena.gov.au/projects/alcoa-renewable-powered-electric-calcination-pilot/
Gladstone Renewable Request for Proposals	https://www.riotinto.com/news/releases/2022/Rio-Tinto-calls-for-proposals-for-large-scale-wind-and-solar-power-in-Queensland
Hydrogen Calcination Study	https://arena.gov.au/projects/rio-tinto-pacific-operations-hydrogen-program/
Hydrogen Pilot Plant	https://www.riotinto.com/news/releases/2021/Rio-Tinto-and-Sumitomo-to-assess-hydrogen-pilot-plant-at-Gladstones-Yarwun-alumina-refinery
Yarwun Hydrogen Calcination Pilot Demonstration Program	https://www.riotinto.com/en/news/releases/2023/rio-tinto-and-sumitomo-to-build-gladstone-hydrogen-pilot-plant-to-trial-lower-carbon-alumina-refining https://arena.gov.au/projects/yarwun-hydrogen-calcination-pilot-demonstration-program/
Mechanical Vapour Recompression Study	https://arena.gov.au/projects/mechanical-vapour-recompression-for-low-carbon-alumina-refining/
Memorandum of Understanding between Tasmania and Rio Tinto	https://www.stategrowth.tas.gov.au/__data/assets/pdf_file/0010/334558/TAS-RIO_TINTO_MOU_Feb_2022.pdf
Refinery of the Future	https://www.alcoa.com/global/en/stories/releases?id=2021/11/alcoa-to-design-an-alumina-refinery-of-the-future
Rio Tinto and GMG	https://graphenemg.com/gmg-riotinto-energysavings-battery/
Spinifex Wind Farm (Portland)	https://arena.gov.au/news/offshore-wind-could-power-portland-aluminium-smelter/ https://www.spinifexoffshore.com.au/#/
Tomago Aluminium Renewable Future	https://www.tomago.com.au/tomago-aluminium-future-renewable-energy-needs/
Weipa Solar and Battery Capacity	https://www.riotinto.com/news/releases/2021/Rio-Tinto-to-triple-Weipa-solar-capacity-and-add-battery-storage-to-help-power-operations
Mission Possible Partnership	https://missionpossiblepartnership.org/wp-content/uploads/2022/10/Making-1.5-Aligned-Aluminium-possible.pdf
ARENA Roadmap for Alumina	https://arena.gov.au/knowledge-bank/a-roadmap-for-decarbonising-australian-alumina-refining/
HILT CRC	Heavy Industry Low-carbon Transition Cooperative Research Centre https://hiltcrc.com.au/
Affreightment Carbon Reduction	https://www.combinationcarriers.com/insights-and-news/2022/1/4/kcc-and-south32-conclude-first-sustainability-linked-contract-of-affreightment

Table 4.Summary of Corporate Ambitions[36]

Company	Interim Goal (s)	Net Zero Ambition
Alcoa	30% reduction in scope 1 & 2 emission intensity by 2025 50% reduction in scope 1 & 2 emissions emission intensity by 2030 from 2015 baseline	Net zero by 2050
Rio Tinto	15% reduction in scope 1 & 2 emissions by 2025 50% reduction in scope 1 & 2 emissions by 2030 From a 2018 baseline (equity basis)	Net zero by 2050
South32	50% reduction in operational carbon emissions (Scope 1 & 2) by 2035 from FY21 baseline	Net zero by 2050
Alumina Ltd[37]	45% reduction in scope 1 and 2 emissions by 2030 (from a 2010 baseline)	Net zero by 2050
Hydro[38]	Reduction of 30% by 2030	Net zero by 2050

International Carbon Comparisons

As articulated in Figure 6, the main emitting processes in the mine to market production of aluminium are primarily the emissions associated with the consumption of electricity in aluminium smelting (Scope 2), secondly the emissions associated the production of alumina (largely Scope 1), and thirdly the emissions associated with the consumption of carbon anodes in aluminium smelting (Scope 1, this is the predominate source associated with the category Aluminium – direct other). In considering this in the context of carbon leakage it is worth noting that:

1. The two largest producing aluminium regions globally, China and Gulf Cooperation Council[39], use primarily thermal power sources for their aluminium smelting production (Figure 7). While data for Oceania does include in New Zealand, this comprises only around 17% of the energy use.
2. Australia's alumina already has some of the lowest emissions in the world, with an average scope 1 and 2 emissions intensity for alumina of <0.7 t CO_2-e/t compared to the global industry average of 1.3 t CO_2-e/t. (see also Paper Figure 5). For the most efficient alumina refineries abatement opportunities are also limited by the development of step change technology and/or the availability of low emissions, competitively priced, firmed electricity. Key decarbonisation technologies for refining are not expected to be available for commercial roll out until around 2030 or later[21].
3. For all smelters globally, more than 95% of Scope 1 emissions could be eliminated with conversion to inert anodes and the industry has been working on inert anode technology development for many decades at a research scale. As highlighted in the Paper, Elysis[40], a joint venture between Alcoa, Rio Tinto, Apple and the Quebec Government has been developing this technology which will be trialled for commercialisation in 2024[41]. The technology has the potential to be used at both new and existing smelters, including those in Australia. However, as articulated in the September 2022 Mission Possible

[36]Sources: https://www.riotinto.com/en/sustainability/climate-change; https://www.alcoa.com/global/en/stories/releases?id=2021/10/advancing-sustainably-alcoas-2050-net-zero-ambition; https://www.south32.net/docs/default-source/exchange-releases/2021-south32-sustainability-briefing.pdf?sfvrsn=d8a76a71_2; https://www.hydro.com/en/media/news/2021/hydro-capital-markets-day-2021-sustainable-value-creation/

[37] Alumina Ltd are a JV participant in Alcoa World Alumina and Chemicals, which operate two mines and three refineries in Western Australia and has equity in the Portland Aluminium Smelter.

[38] Hydro is a JV participant in Tomago Aluminium Company.

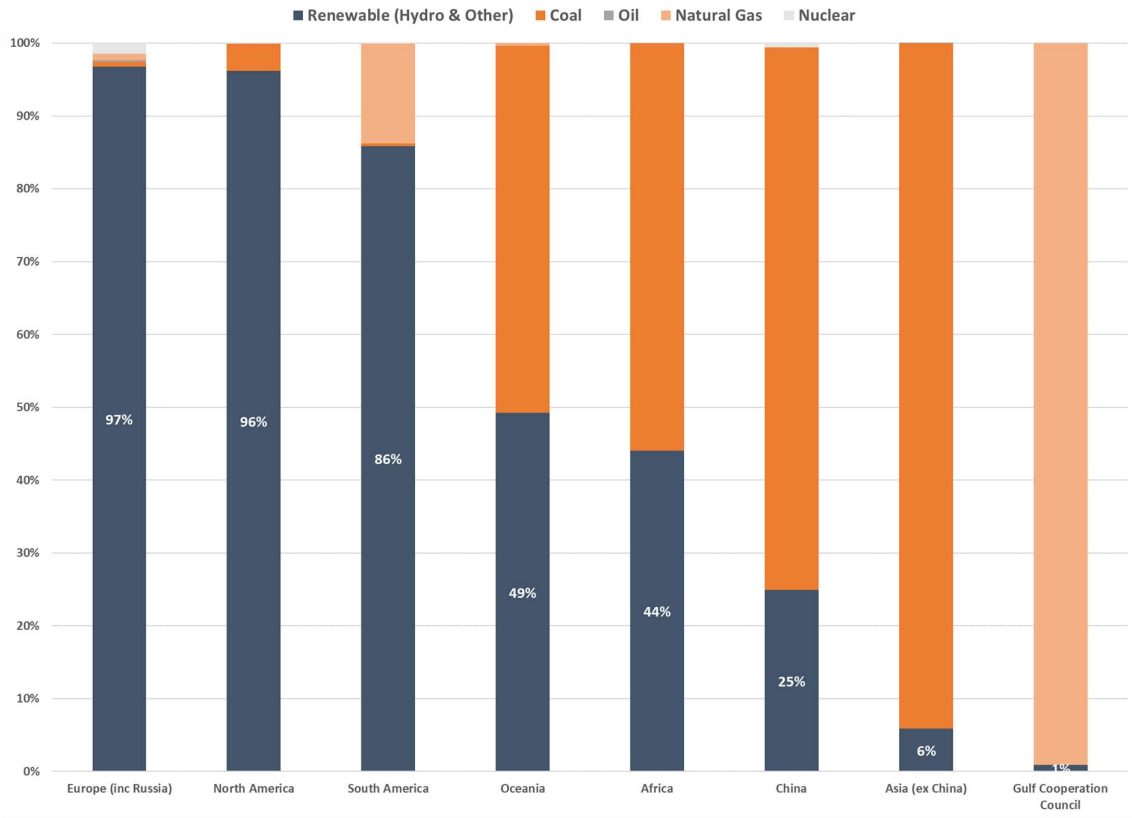
[39] https://international-aluminium.org/statistics/primary-aluminium-production/

[40] https://www.elysis.com/

[41] Based on current smelter practices, it could be assumed that the timescale for conversion of a smelter would be 5-6 years. Conversion would also only be possible when combined with an internationally competitive, low emissions electricity contract.

Partnership report, the global rollout of inert anode technology is not anticipated to be widescale until post 2030[21]. There are, therefore, limited abatement opportunities (<5%) for smelters until this technology is deployed.

Figure 7. Primary Aluminium Smelting Power Consumption by Source 2022[42]



[42] https://international-aluminium.org/statistics/primary-aluminium-smelting-power-consumption/