SEPTEMBER 2024

VULNERABILITIES AND OPPORTUNITIES IN AUSTRALIA'S UPSTREAM ALUMINIUM SECTORS

A REPORT PREPARED BY CM GROUP FOR THE AUSTRALIAN ALUMINIUM COUNCIL

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1 Executive Summary

Global aluminium demand growth is forecast to remain strong for at least the next two decades and Australia's attractive bauxite reserves and existing bauxite mining and alumina refining sectors position the country well to take advantage of the opportunities this will present.

However, the existing policy framework within which these sectors currently operate has been haphazard in its evolution and inconsistent in its application, resulting in the gradual erosion of the international competitiveness of both.

While many of Australia's resources and environmental compliance policies are considered world class, compliance costs (high amongst global peers) are magnified by the absence of consistent, clear and timely decision-making by governments and by industry, ultimately eroding competitiveness. Consequently, this regulatory mismanagement poses a major threat to the future of both industries over the long-term.

From a practical perspective, working within the current environmental approval and resources framework requires operators to dedicate significant resources, amplified considerably by government indecision and fluid compliance guidelines. Knock-on effects stretch well-beyond additional resourcing requirements, with strategic decision-making such as the deployment of major capital being deferred, or even cancelled, bringing into question the viability of both industries and undermining the attractiveness of new projects.

A constructive environmental approval and resources policy framework, one characterised by discrete components, agreed timeframes and clear integration with other major policy goals, would reduce capital and operating costs, as well as reducing industry carbon emissions. Furthermore, a constructive framework would provide the necessary assurances for existing operators to invest for the long-term, while sending a strong signal to the world that Australia's aluminium sector is open for business and positioned strongly to play its role in the clean energy transition.

A destructive (or directionless) policy framework, insufficiently attuned to the financial impact on existing operations, would result in major cost escalations, reduced margins for bauxite exporters and unsustainably high refining costs. Under this scenario, bauxite mines could be forced to close, triggering an immediate knock-on closure of Australia's alumina refining sector, given the insurmountable technical and economic barriers associated with processing imported bauxite through existing refineries.

Alumina refining capacity displaced from Australia would likely migrate to lower-cost jurisdictions such as Indonesia and Guinea, where policies are framed to attract, retain and grow mining and downstream minerals processing industries over decades. Somewhat ironically, displacing bauxite mining and alumina refining to other jurisdictions could result in global emissions intensity levels increasing, given Australia's emission intensity is currently around half the global average.

Key Points

- Unclear, ambiguous and inconsistently-applied resources policy exposes Australia's upstream aluminium sectors to unsustainably higher costs. CM's analysis concludes that, on their current cost trajectory, existing Western Australian refineries would be displaced from the first quartile of the global cost curve, while existing Queensland refineries would be pushed toward the fourth quartile.
- Australia's domestic bauxite and alumina industries operate under a vertically integrated, mine-mouth-to-refinery (MMTR) business model, which relies on predictable and uninterrupted local bauxite supply to alumina refineries designed specifically to process local bauxite.
- The MMTR business model is undermined by a failure to guarantee the uninterrupted supply of local, design-grade bauxite, the absence of which would force refiners to adopt a 'merchant' refining model, whereby bauxite is sourced from the global third-party traded bauxite market.
- A directionless policy framework puts at risk the consistent supply of local design-grade bauxite to refineries and, therefore, the future of the MMTR model in Australia and, by extension, the future of Australia's alumina refining sector.

  Lengthy delays in approvals processes are forecast to be the single largest contributor to additional refining costs over the next five years.
- Australia's alumina refining sector plays a vital role in world alumina supply. Should it be forced to close, replacement capacity would be essential. The most likely location for replacement capacity would be Indonesia, given (1) its sizeable bauxite reserves, (2) lower energy costs (currently coal-based) (3) lower cost of capital, (4) lower labour costs (5) geographical location relative to China and (6) favourable regulatory environment.
- Considered in isolation, many of Australia's biodiversity, rehabilitation and other environmental compliance policies are considered world-class. That said, compliance costs, which are high amongst global peers, are magnified by the absence of consistent, clear and timely decision-making by governments and by industry, ultimately eroding competitiveness.
- Global bauxite markets have rallied over the past ten years and, although Australia has benefitted to some degree, other countries, notably Guinea, have taken full advantage of the opportunity. Guinea has become the world's largest bauxite exporting country and would stand to benefit significantly should Australia be forced to pull back from the bauxite export market.

We conclude that the future of Australia's upstream aluminium sectors now rests in the hands of policymakers. They face a critical decision: to chart a path toward prosperity and sustainable growth or to neglect their responsibilities, allowing these industries to decline further, as their competitive advantages gradually diminish.

2 Introduction & Purpose

This report was commissioned by the Australian Aluminium Council in June 2024. The purpose of the report was to measure Australia's bauxite mining and alumina refining competitiveness against selected international peers, in the context of existing national and international policy frameworks and a rapidly changing global landscape.

Bauxite, alumina and aluminium are not currently listed as critical minerals in Australia, with the rationale that supply is not sufficiently vulnerable or at risk within Australia. This report sets out two sources of risk and supply chain vulnerability - delayed environmental approval decisions and the emerging industry policies of competing nations - to outline why it is timely to revisit the listing decision.

3 Source Data & Industry Statistics

Data presented in this report is sourced mainly from public documents, which include

- Company reports
- Trade statistics
- News articles
- Government agencies
- Industry associations
- Industry contacts

Additional data is sourced from CM's proprietary aluminium industry databases.

Data, including estimates of operating costs and costs of regulatory impacts, may differ from those of individual facilities or companies.

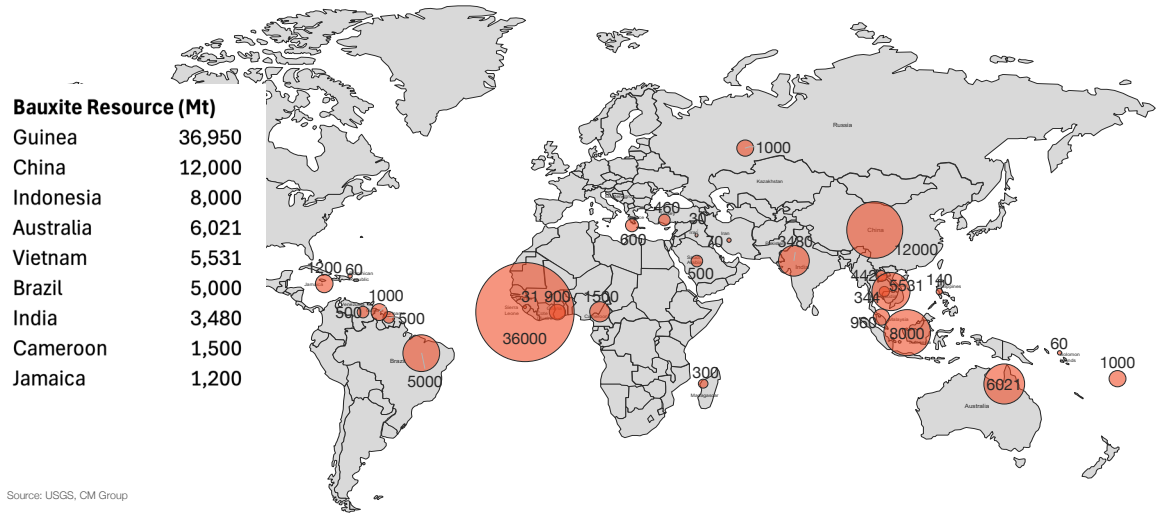
4 Bauxite and Alumina – Industry Overview

4.1 Bauxite

Bauxite is a general term that refers to three different naturally occurring aluminium ores, namely gibbsite, boehmite and diaspore. Gibbsite and boehmite are both mined commercially in Australia.

Substantial differences exist between all three in terms of grade, chemistry, contaminants, impurities and mineralogy. Alumina refineries, which process bauxite into alumina, are rarely able to substitute different bauxite minerals for one another because different processing parameters and specialised equipment are often required to process different bauxites.

Figure 4-1 Global Bauxite Resources by Country, (mln tonnes)



Source: CM Group, China MLR, USGS

Guinea is home to the world's largest bauxite deposits, estimated at around 36 billion tonnes. Australia is ranked in the top five, although Guinea's total is larger than the cumulative total of the other four.

Bauxite is mined in large volumes every year. Approximately 400 million tonnes were mined worldwide in 2023, including around 100 million tonnes in Australia. Most of the bauxite mined is subsequently processed through alumina refineries using the Bayer process into aluminium oxide, also called alumina, a white crystalline powder. Alumina is subsequently smelted into primary aluminium metal using the electrolytic Hall-Heroult process. Depending on grade, around 4-6 tonnes of bauxite are required to produce two tonnes of alumina and two tonnes of alumina is required to produce one tonne of primary aluminium.

Although volumes of bauxite mined globally are large, bauxite is not a fungible commodity because grade, mineralogy and quality vary substantially, both within and between bauxite deposits. When comparing bauxites;

- **Grade** refers to the content of and type of alumina containing minerals in the bauxite
- **Quality** refers to the level of impurities in the bauxite, including silica, moisture, iron, amongst others, and
- **Mineralogy** refers to the chemical structure of the bauxite minerals.

For example, bauxites originating from, and commercially processed into alumina in Australia, can be gibbsitic or boehmitic and can vary in available alumina content from 33% to 55%, while reacting silica levels can vary from 1% to 13%.

Figure 4-2 Australian, Chinese and Guinean Bauxites

North Australia, Boehmitic

China, Diasporic

Guinea, Gibbsitic

Source: CM Group

Guinean bauxites are mostly gibbsitic, although some contain boehmite. Available alumina content of Guinean bauxites can vary from 35% to 45%, while reacting silica can vary from 1.2% to 2.5%. Figure 4-2 illustrates the enormous physical differences between bauxites from different countries.

Table 4-1 Typical Bauxite Grades in WA, QLD and Other Regions

Country	Total Alumina	Available Alumina*	Mono-hydrate Alumina	Total Silica	Reactive Silica*	Moisture	Organics
Nth Qld	52%	39%	8%	10%	7%	10%	High
SW WA	38%	32%	-	20%	1%	8%	Very High
Guinea	45%	40%	3%	2%	1%	10%	Moderate
Brazil	54%	48%	1%	6%	5%	13%	Low
Indonesia	48%	44%	1%	8%	4%	15%	Moderate
Turkey	56%	5%	50%	6%	-	5%	Low
Vietnam	53%	3%	47%	5%	-	5%	Low

** Low temperature*

Source: CM Group

Due to the substantial differences in grade, morphology and quality of different bauxites, alumina refineries tend to be designed and operated to process a specific grade and quality of bauxite. This means that refineries are unlikely to be able to physically process other types

of bauxite or can do so only if significant equipment modifications are made and operating parameters are changed. This is why bauxite is not freely traded:

- Most bauxite mined historically has been processed into alumina on the basis of an integrated mine-mouth-to-refinery (MMTR) operating model. This means that, once mined, bauxite of a specific grade and quality is transported directly to an alumina refinery which has been designed and built specifically to process the bauxite from that mine i.e. the 'design bauxite', which is of a known grade and quality.
- Any variation in grade and/or quality from the design bauxite can significantly impact the performance of the refinery and the stability of the refinery operation, resulting in higher costs, lower productivity, and, in some cases, potentially damaging equipment and stopping the operations altogether.
- As such, most bauxite is supplied to refineries on either
    - A vertically integrated ownership basis (integrated mine and refinery), meaning both the mine and refinery are owned by the same group or groups, or
    - On a long-term contractual basis, where supply agreements can be greater than ten years in duration. The objective is always to minimise variations in grade and quality on an operational basis, therefore promoting stable operation, maximising productivity, and minimising costs.
- While it may be possible for a refinery to process bauxites with similar grades and qualities to the 'design bauxite', such instances are rare because they entail a risk of lower productivity and necessitate costly equipment modifications and/or changes to operating parameters.
- A common means of treating 'non-design' bauxite is to blend it with existing bauxite at a blend rate that is sufficiently low so as not to destabilise the process or significantly increase production costs.

4.2 Alumina

Alumina is aluminium oxide (chemical formula Al_2O_3) and is usually produced as a white crystalline powder. Approximately 95% of the world's refined alumina is smelted to produce primary aluminium metal in electrolytic aluminium smelters. The remaining alumina is used in a variety of other applications with significantly smaller markets, including refractories, abrasives, chemicals, batteries, lighting, fillers and cosmetics.

Figure 4-3 Alumina Being Loaded onto A Vessel for Export

Source: usage under iStock license, credit: Ngataringa

Bauxite is almost universally refined to alumina using the elevated temperature wet chemical Bayer process. This process is used at Australia's five operating alumina refineries.

The Bayer process is split into two broad categories: low temperature (LT), used by the three Western Australian refineries processing bauxite sourced from the Darling Ranges, and high temperature (HT), used by the two refineries processing bauxite sourced from northern Australia.

The amount and form of silica contained in bauxite is critical; typically for each weight percent of silica reacted, an equal weight of alumina and an equal weight of caustic soda is lost to the process. Thus, the amount of silica reacting in the process strongly affects refinery economics by way of alumina recovery and caustic soda consumption.

In LT refineries (WA), gibbsite is the prevalent aluminium oxide mineral which is usually present in low grades, along with low levels of LT reacting silica. In HT refineries (QLD), all

three bauxite minerals (gibbsite, boehmite and diaspore) can be present and they contain high silica levels, which react at high-temperature. Processing bauxite economically using a HT refinery is therefore strongly dependent on the form of aluminium ore and the amount of silica.

In other words, when it comes to alumina refining, you can't mix and match raw materials.

5 Australia's Bauxite and Alumina Industries

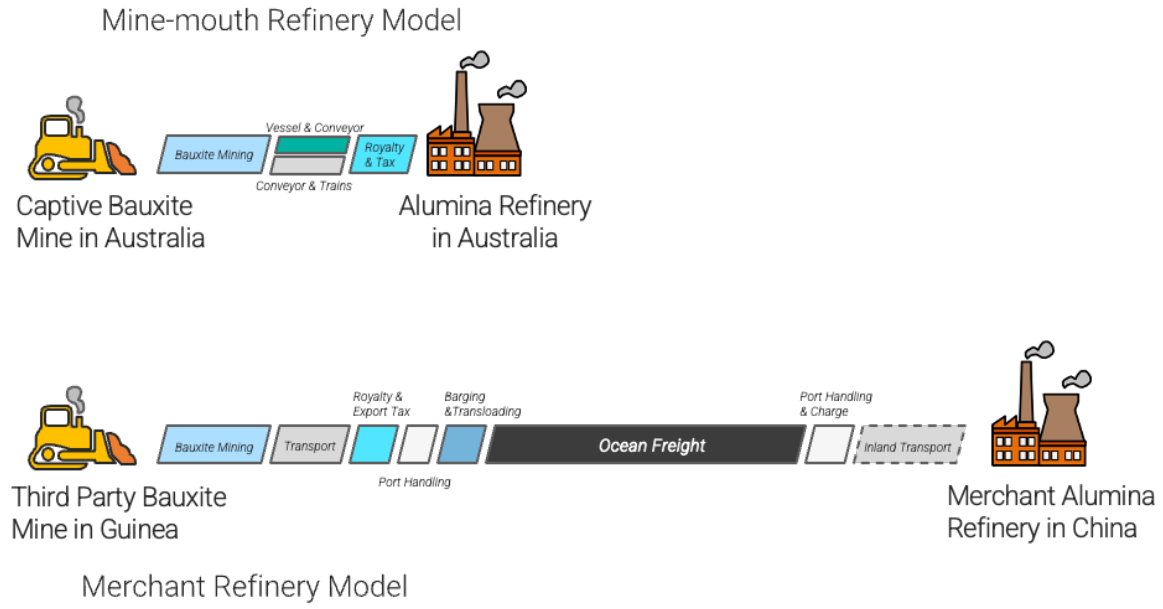
5.1 Overview

From inception almost 70 years ago, Australia's alumina refineries have operated on a model of vertical integration, whereby domestic bauxite is mined and processed through dedicated refineries built close to bauxite mines to produce alumina (MMTR model), which is subsequently smelted into primary aluminium.

More recently, some bauxite miners have taken advantage of China's growing bauxite import demand by increasing volumes specifically for export.

Under the MMTR model, alumina refineries are designed and operated to process a 'design bauxite'; minor departures from the design bauxite grade can result in significant increases in refining costs, while a major departure from the design bauxite grade could render a refinery uneconomic. As an example, HT bauxites, such as those mined in Far North Queensland, cannot be economically processed through an LT refinery, such as those operating in Western Australia, and vice versa.

Figure 5-1 Schematic of 'Mine Mouth to Refinery' Operating Model vs Merchant Refinery Operating Model



Source: CM Group

The MMTR vertical integration model sits at the core of Australia's international competitiveness. Under the MMTR model, locally-sourced bauxite is delivered at low cost to a dedicated alumina refinery, built in close proximity and with access to energy and other necessary infrastructure, which minimises operating costs.

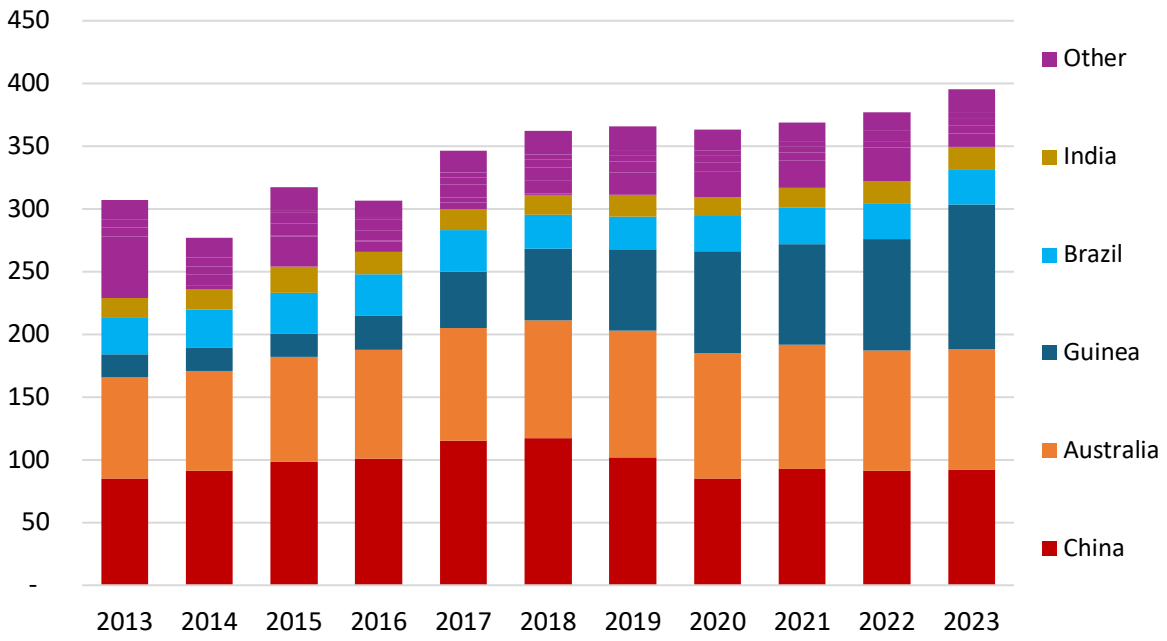
Disrupting supply from, or restricting access to, local design bauxite, breaks the MMTR model which, for many refineries, would result in immediate closure. A few refineries could

potentially adopt a 'merchant' refining model, whereby bauxite is procured from the third-party traded market. However, this introduces a number of major challenges, including the need for large, uninterrupted volumes over long periods, the unavoidable variations in bauxite grades and qualities sourced from different regions and the closed nature of bauxite trade, not to mention the assurance that a traded bauxite could be physically treated through the refinery, which is often not the case.

5.2 Bauxite Mining

Australia was for many years the world's largest bauxite mining country. In 2022, the title was lost to Guinea, as rapid development led to double digit export growth from 2015 to 2020.

Figure 5-2 Global Bauxite Mining by Country, (Mln Tonnes)

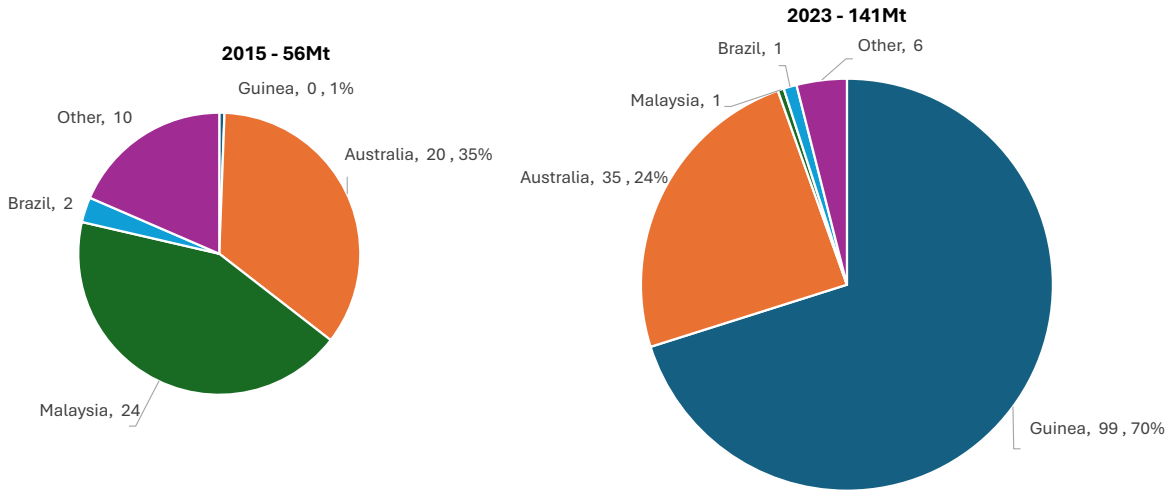


Source: CM Group

The rapid development of Guinea's bauxite exports was underpinned by China, which emerged as a major importer of bauxite, driven by strong primary aluminium demand and depletion of its domestic bauxite reserves.

Despite being well-positioned to take advantage of China's voracious appetite for bauxite, by end-2023 Australian bauxite miners had managed to capture only a small portion of the growth on offer, despite its strategic and geographic advantages.

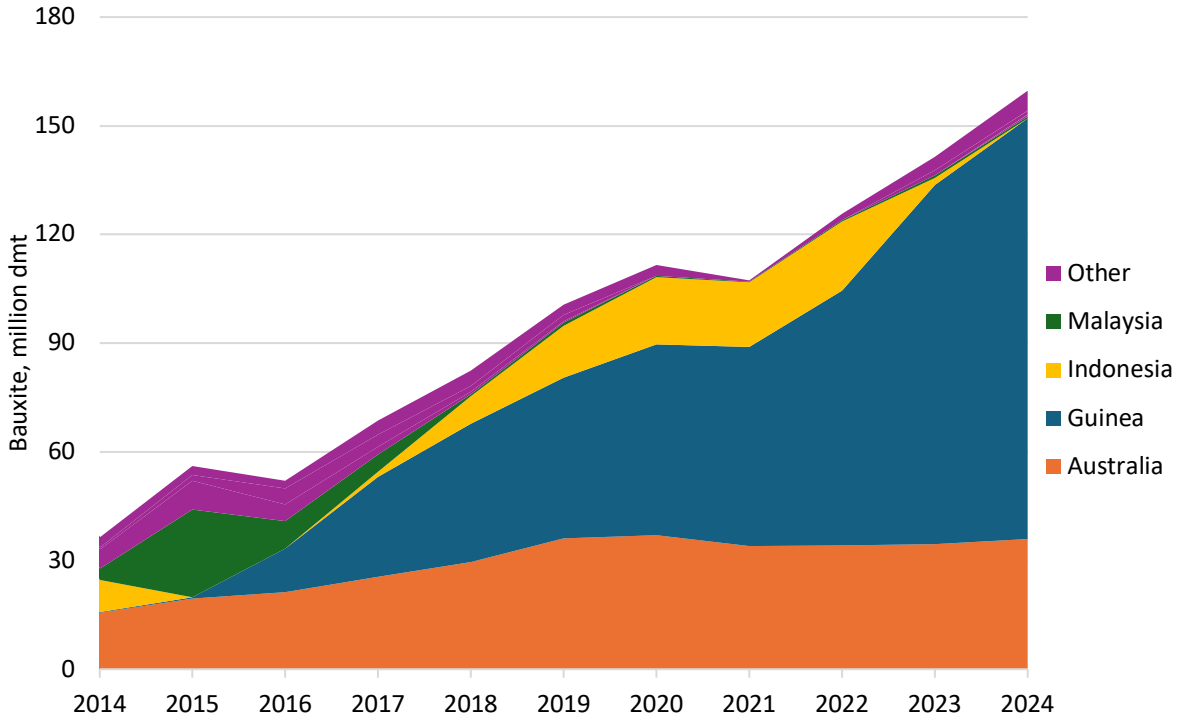
Figure 5-3 Bauxite Exports to China by Country, 2015 and 2023 (MTPY)



Source: CM Group, China Customs

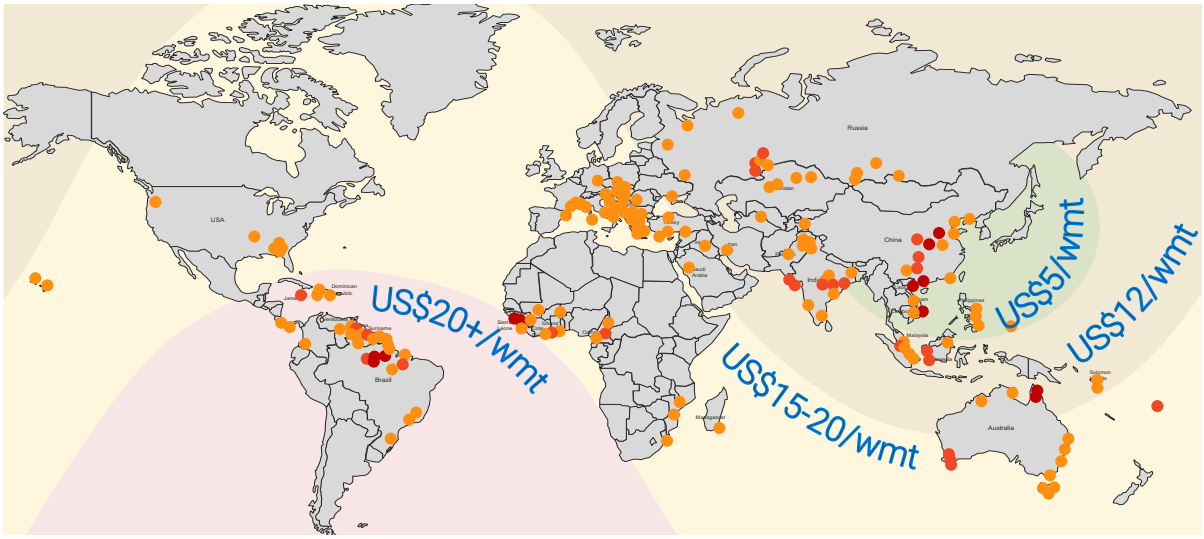
With demand for imported bauxite into China growing rapidly from 2009, Chinese refiners were eager to develop new supply options, including Australia. Although significant growth opportunities were evident in Australia, such as Aurukun, RTA's Weipa operations and Metro Mining (formerly Cape Alumina), Australia's response was slow, on account of elongated environmental approvals processes and unclear resources policies. This left the door ajar for other countries, including Indonesia, Malaysia and, eventually, Guinea to take advantage of the opportunity. China now sources around 70% of its bauxite imports from Guinea and 25% from Australia.

Figure 5-4 Historical Bauxite Import into China by Country



Source: CM Group, China Customs

Figure 5-5 Global Bauxite Deposit and Distances to China Measured by Freight Rate



Source: USGS World Bauxite Resources Paper 1076-B, CM Group

The attractiveness of high-grade Guinean bauxite to Chinese refiners is an obvious drawcard, however the vast shipping distance is a sizeable penalty. Despite the distance (freight rates to China from Guinea are around double those from Australia) and the additional carbon emissions associated with freight, Guinea has become the clear winner in the race to supply the Chinese bauxite import market.

5.3 Alumina Refining

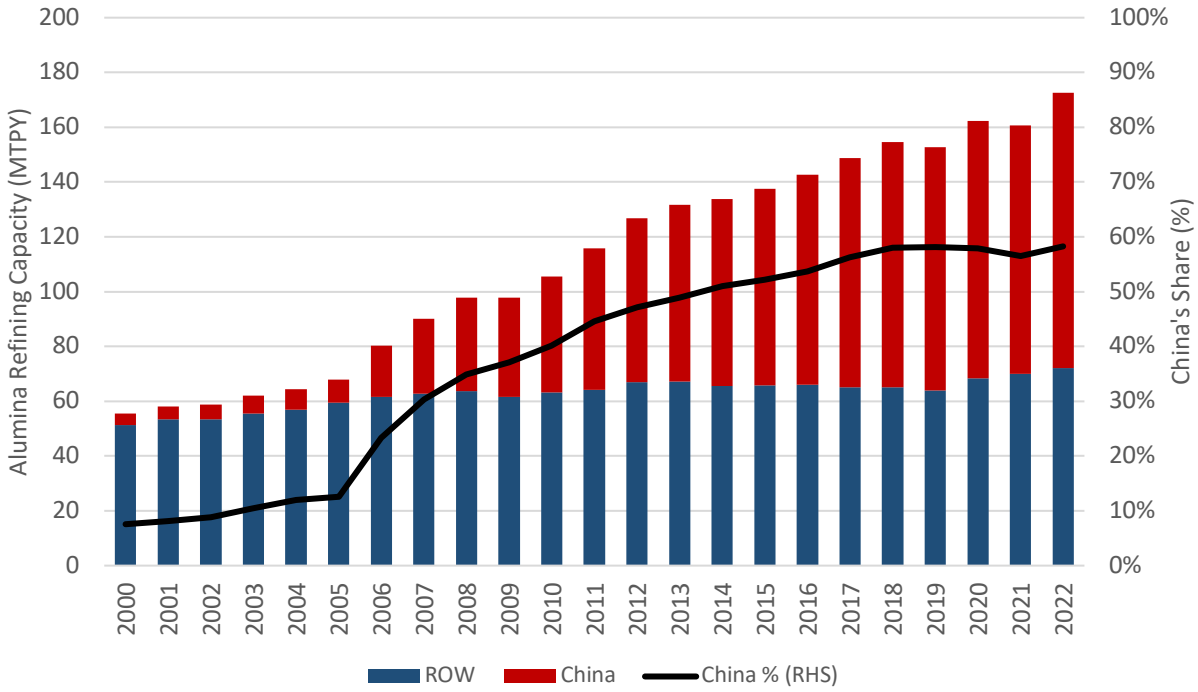
Approximately 143 million tonnes of alumina (chemical and metallurgical grade) was produced globally in 2023, while 2024 world alumina capacity was estimated at 182 MTPY.

China is the largest alumina-producing country at approximately 83 million tonnes in 2023, accounting for 59% of the world total. Australia ran a distant second, at approximately 20 million tonnes, with the third largest producing country being Brazil at over 10 million tonnes. Together, these three countries accounted for approximately 80% of the world's 2023 production.

Over the past decade, China had consolidated its dominant position as the world's #1 alumina producer, by steadily growing its domestic capacity; in 2014, China's total refining capacity accounted for over half the world's total for the first time, and its proportion has been increasing ever since.

Over the same period, Australia's alumina refining capacity has barely grown, with an expansion at the South32-owned Worsley Alumina Refinery in the mid 2010's being negated by the closure of the Gove alumina refinery in 2012 and the curtailment of Alcoa's Kwinana refinery in 2024.

Figure 5-6 World Alumina Capacity by Region 2005-2021



Source CM Group, IAI

Given the general consistency in the quality and physical properties of alumina produced globally using the Bayer process and supported by the high levels of global trading activity, alumina is considered to be a fungible material, although minor variations in grades and physical attributes between sources do exist.

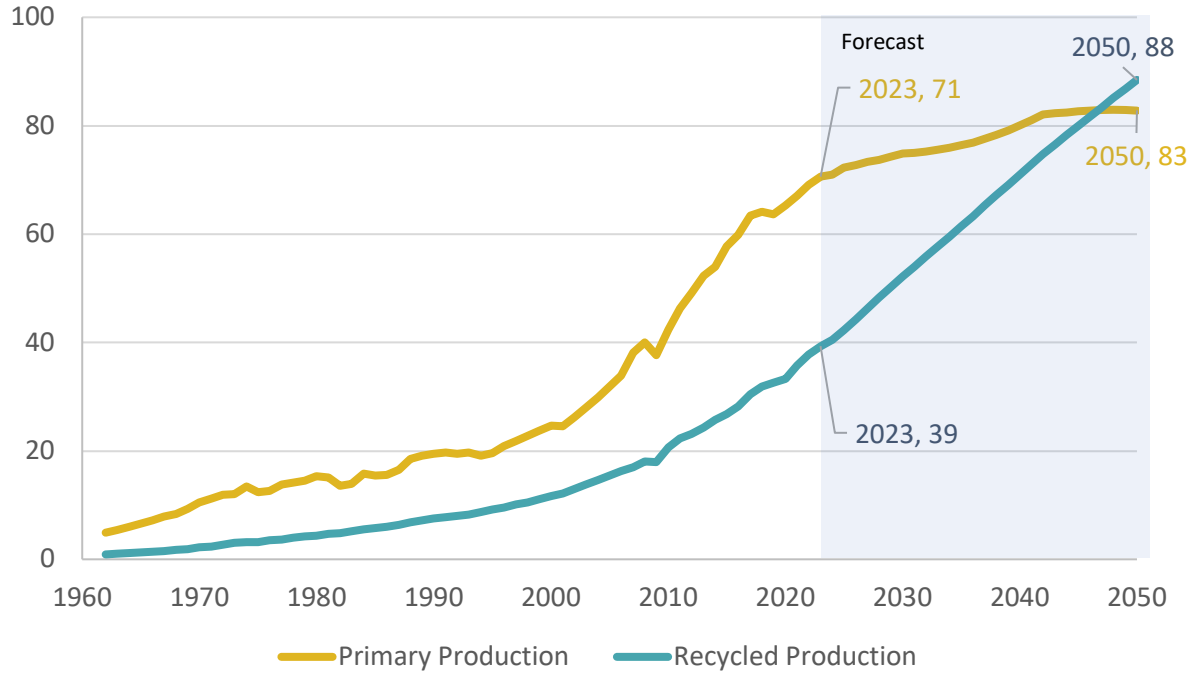
5.4 Outlook For Global Aluminium Demand

According to projections by the International Aluminium Institute (IAI), global aluminium demand growth is forecast to remain strong over the next two decades, resulting in significant opportunities for bauxite miners, alumina refiners and smelters.

Australia is well-positioned to take advantage of these opportunities, given the country's extensive bauxite reserves and close geographic proximity to the growth engines of China and South East Asia.

As China approaches its self-imposed cap on primary aluminium production of 45 MTPY, a rate likely to be hit later this year, alumina production will also hit a similar cap, of approximately 90 MTPY, meaning refineries and smelters of the future will not be built in China. As global demand for aluminium continues to grow, new opportunities for bauxite mining, alumina refining and primary aluminium smelting will therefore emerge in other jurisdictions.

Figure 5-7 Aluminium Sector Production Forecast (Mln tonne)*



Source: IAI Alucylce (IAI, 2024) – 2024 Reference Scenario

Primary Aluminium* - aluminium tapped from electrolytic cells, **Recycled Aluminium – Production from scrap ex alloying elements*

Australia's upstream aluminium sectors can position themselves to prosper in this environment by utilising the country's natural geological and geographical advantages. Critically, investment decisions taken today will either commit companies to substantial investments in Australia for decades to come or likely see them exit the sectors.

Their choices will be made based on the policies developed and implemented by the governments of today, not the governments of the future.

Approaching the end of Q3, 2024, there were no new approved projects in Australia specifically targeting opportunities presented in the upstream aluminium sectors. Rather, these industries appear to be in a state of suspended animation, as they await approvals and more clarity in policy direction. Positive policy signals from state and federal governments could see these projects move ahead quickly, positioning Australia strongly to take advantage of the opportunities.

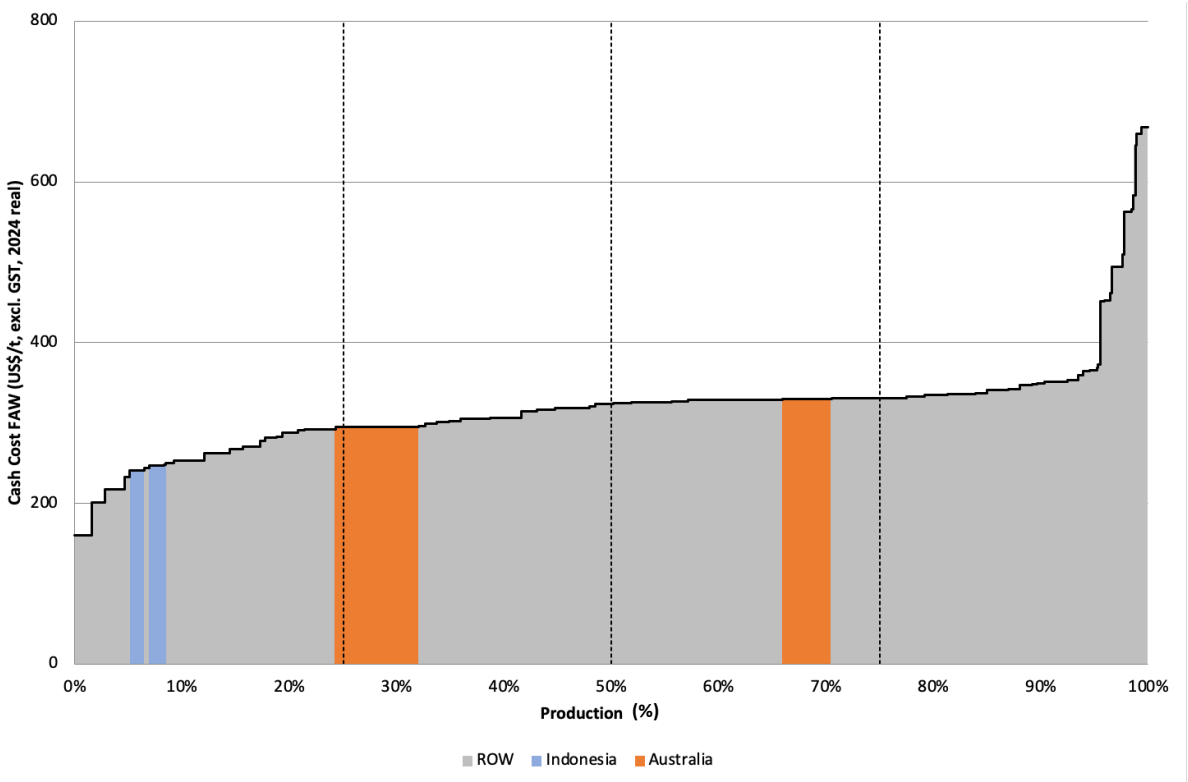
6 Competitiveness of Australia's Alumina Refining Sector

CM Group analysis confirms Australia's competitive position on the global alumina refining cost curve varies significantly between west and east coast. Alumina refineries in Western Australia are positioned in the second quartile of the global alumina smelter grade alumina (SGA) cost curve, whilst producers in Queensland are positioned in the third quartile.

The differences in the respective cost positions are attributed mostly to differences in bauxite grades, freight costs (Queensland bauxite must be shipped from Weipa to Gladstone), scale, energy prices and the age and scale of each individual refinery.

Two of the world's youngest alumina refineries are currently operating in Indonesia, processing local Indonesian bauxite. These refineries have been constructed in response to Indonesia's minerals export ban, which prohibits the export of bauxite in favour of the construction of domestic alumina refineries. They are also two of the world's lowest cost refineries (Figure 6-1), benefitting from low-cost local bauxite, low-cost energy (mostly coal-based) and low labour costs.

Figure 6-1 World Alumina Production Cost Curve 2024



Source CM Group

6.1 Western Australia

WA bauxite stands out amongst global bauxite deposits on account of its unusually low alumina grade, purely gibbsitic nature and low reacting silica content. Indeed, Darling Ranges bauxite grades are so low relative to other commercially mined bauxite deposits, that exports are considered un-economic.

Western Australian alumina refineries have always been considered competitive by world standards, in that they have been positioned in the first quartile of the 2024 cash cost curve until relatively recently.

Over the past five years, their competitive position has been eroded by the additional costs associated with processing lower grades of bauxite. Processing lower grades is a direct consequence of delayed mine relocations, which have impeded refiners from accessing higher-grade deposits, instead forcing them to remine old mining leases, which in some cases had been fully revegetated.

Australia has a strong, internationally recognised history of environmental stewardship. Regulatory delays undermine the ability to maintain both social and environmental management. Environmental approvals underpin not only current operations but also future investment in both sustaining capital and investments in transformational abatement.

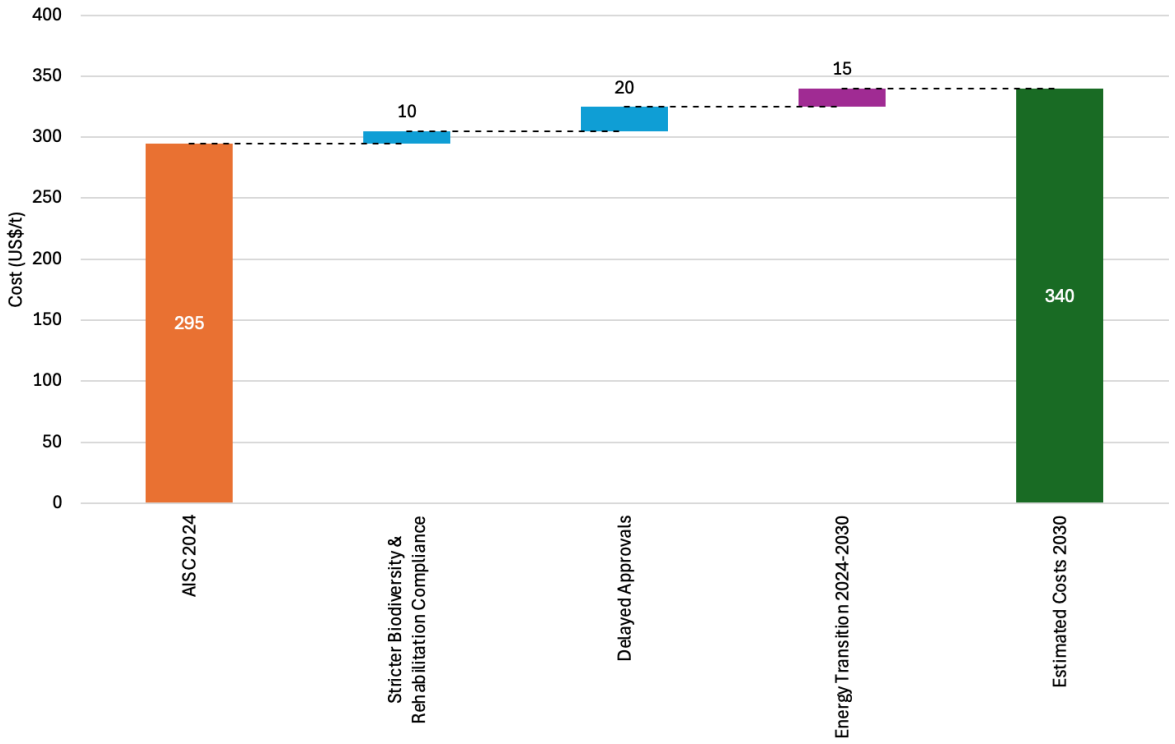
Based solely on reduced alumina output associated with processing lower grades of bauxite, CM alumina refinery modelling estimates Western Australian refiners would incur additional operating costs of approximately US$20 per tonne. This does not include costs associated with additional environmental compliance requirements, 'safeguard' costs or additional capital expenditure.

An increase in costs of this magnitude would be the largest single source of cost increase over the next five years. It excludes any longer-term costs associated with the likely impact of larger volumes of waste on red mud handling systems and dam storage capacity.

Similarly, based on data sourced directly from industry by CM, we estimate the costs associated with biodiversity and rehabilitation compliance to be approximately US$10/t alumina.

Looking to the future, as Australia transitions to its clean energy future, we expect energy prices to increase in real terms, which will have a direct impact on the operating costs of alumina refineries. Based on a 10 GJ/t base load for a typical alumina refinery and a notional increase in energy prices of A$3/GJ, we forecast refining costs to increase by approximately US$15-20/t alumina.

Figure 6-2 Increases to WA Refining Production Costs 2024-2030



Source CM Group

Should Western Australian alumina refineries be faced with the prospect of a total ban on local bauxite supply, sourcing from the third-party traded market would impose such a hefty increase in costs that the refineries would be rendered immediately uneconomic.

First, a substantial departure from a typical Western Australian bauxite grade would be an unavoidable consequence of sourcing from the third-party market, given the highly unusual nature of western Australian bauxite.

Second, the global traded bauxite market is dominated by one country, Guinea, which would inevitably be the major source of any high volume 'replacement' bauxite. Importing Guinean bauxite would spell the end for Western Australian refiners on account of

- Prohibitively higher delivered cost – CM estimates bauxite sourced from the global third-party traded market would be of the order of 700% higher than current delivered costs, rendering refineries immediately uneconomic.
- Limited supply – new mines would need to be developed in Guinea to satisfy the additional volumes required, which would likely push delivered costs higher.
- Higher carbon emissions – freight distances push carbon emissions higher per tonne of alumina
- Additional infrastructure – Western Australia does not have the infrastructure in place to accommodate bauxite imports. Substantial investment in new infrastructure would be required to allow bauxite imports.

- Higher inventories – importing bauxite from Guinea, or anywhere for that matter, would necessitate the need for refiners to hold significant inventories to provide sufficient buffer against delays or interruptions to supply. Chinese refiners processing Guinean bauxite typically hold around 4-6 months' inventory. This compares with around two weeks 'supply currently held by Western Australia refiners processing local bauxite.

Sourcing bauxite from the third party traded market for processing through existing alumina refineries in Western Australia would increase landed bauxite costs by an estimated US$65/dmt (A$95/dmt), resulting in an increase in alumina refining costs of at least US$150/t (A$225/t). This estimate considers only the additional costs associated with sourcing bauxite from the third party traded market.

On bauxite costs alone, operating Western Australia's existing alumina refineries under the merchant refining model would be prohibitively expensive.

6.2 Queensland

Bauxite deposits in Far North Queensland (FNQ) are typified by high alumina content and high silica content. FNQ bauxite grades are considered reasonable in commercial terms, although their higher silica content increases refining costs relative to bauxites containing lower levels of silica.

FNQ bauxite is commercially processed into alumina via two dedicated refineries located in Gladstone (QLD), as well as exported to China in large volumes.

Over the past five years, the competitive position of Queensland's refineries has also been eroded by higher caustic soda prices, given the higher silica content of the bauxite, and the additional costs associated with changes to Queensland's royalty system.

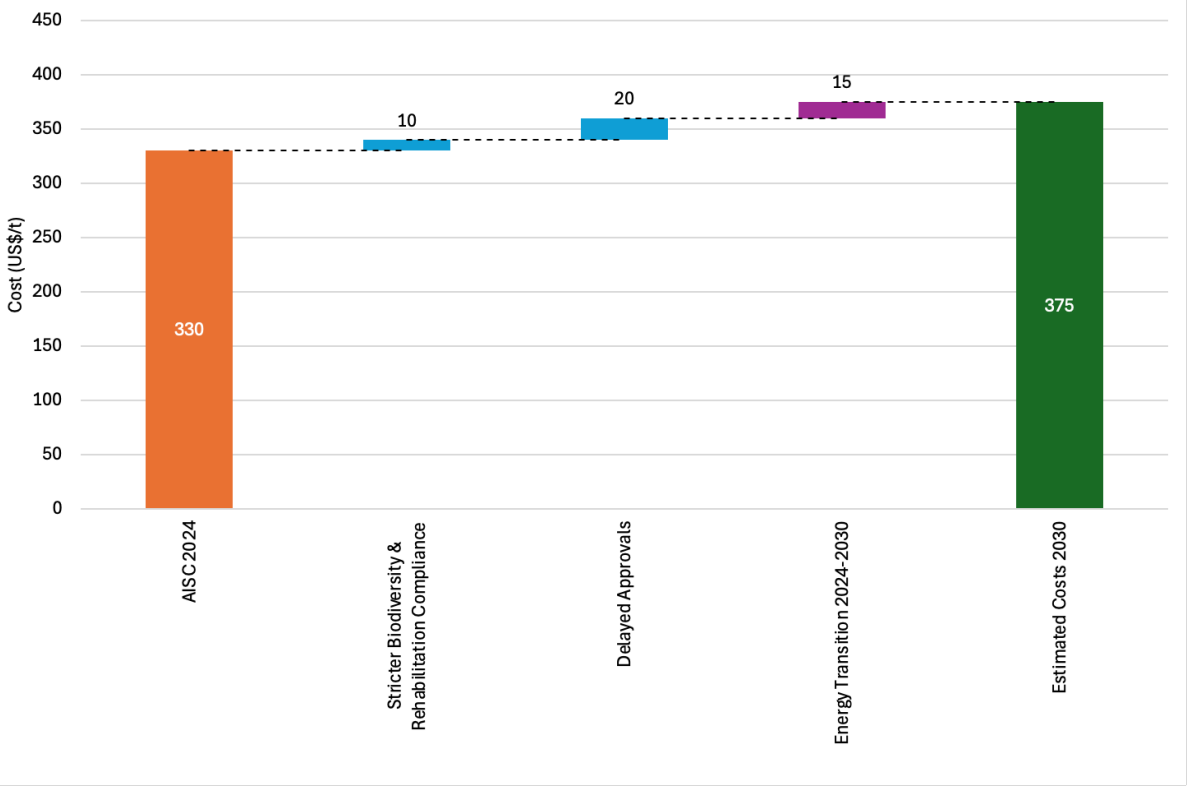
Delays to mining approvals in Queensland have the potential to be far more consequential for operators, not only because of their more precarious position on the global cost curve, but also as a result of the reduced life expectancy for RTA's Gove and Andoom mines, which currently feed them.

As these mines approach the end of their working lives, operators must be granted timely approval to develop replacement deposits. Any significant delays in mine development have the potential not only to significantly reduce export volumes, but also force the early closure of refineries.

Assuming Queensland refiners are forced into a similar situation as those in Western Australia, whereby they process lower grades of bauxite sourced from previously mined leases, we estimate Queensland refiners would incur additional costs of at least US$20 per tonne, again, excluding any longer-term costs associated with the impact of larger volumes of red mud waste on red mud dam storage capacity. This would again be the single largest source of refinery cost increase over the next five years.

Similarly, we estimate the costs associated with biodiversity and rehabilitation compliance to be approximately US$10/t alumina. As Australia transitions to its clean energy future, energy prices increase across the country, in real terms, directly impacting the operating costs of alumina refineries. Based on our estimated 10 GJ/t base load for a typical alumina refinery and a notional increase in energy prices of A$3/GJ, we forecast refining costs to increase by approximately US$15/t alumina.

Figure 6-3 Increases to Qld Refining Production Costs 2024-2030



Source CM Group

As is the case with Western Australia, should Queensland's alumina refineries be faced with the prospect of a complete ban on local bauxite supply, sourcing from the third-party traded market would impose an unacceptably large increase in costs that the refineries would be rendered immediately uneconomic, although the situation in Queensland would be slightly different.

A significant departure from a typical FNQ bauxite grade would be an unavoidable consequence of sourcing bauxite from the third-party market, although because the refineries in Queensland operate as HT refineries, they would be more accommodating of bauxite with different grades and qualities. That said, the impact on operational performance would still be substantial and likely render the refineries uneconomic.

Further, traded bauxite would most likely be sourced from Guinea, meaning the Queensland refineries would face the same issues as those facing the Western Australian refineries, namely, high cost, limited supply, higher carbon emissions and higher inventories.

In summary, operating Queensland's existing alumina refineries under the merchant refining model would be prohibitively expensive.

7 Indonesia's Alumina Refining Sector

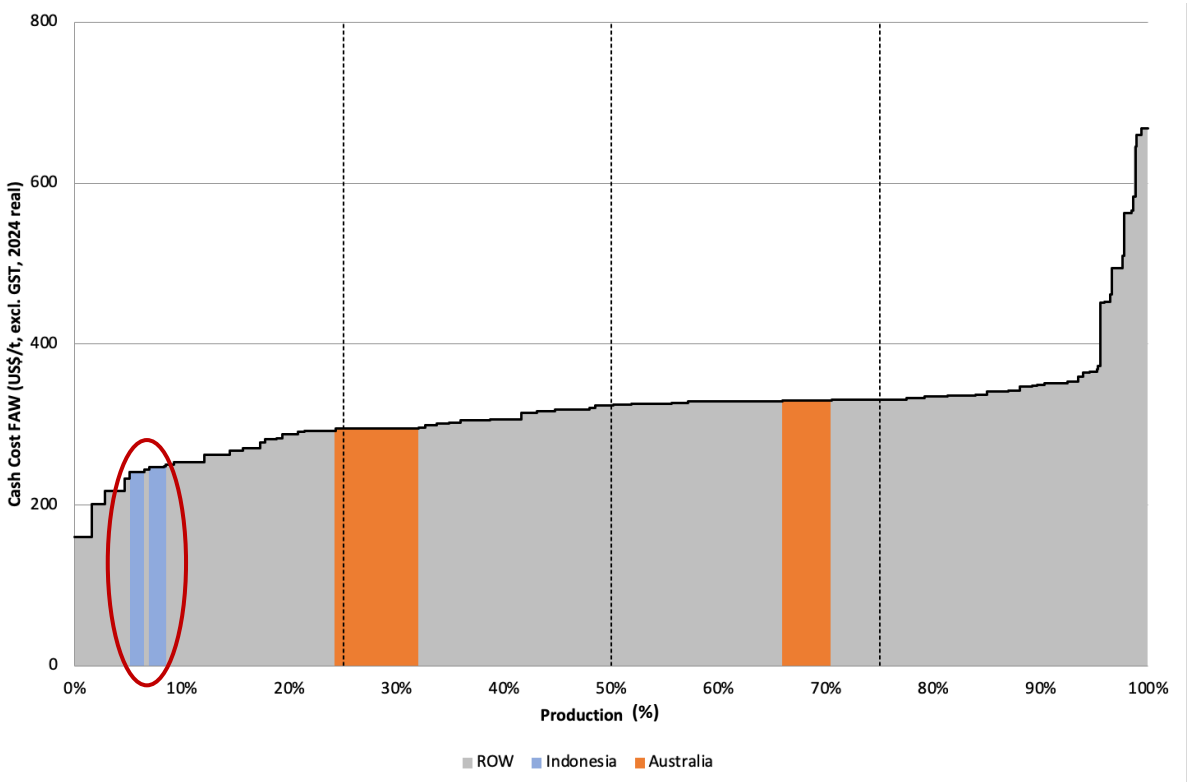
In 2014, Indonesia introduced a minerals export ban which, as the name implies, stopped all exports of raw minerals, including bauxite. Amendments were introduced to the ban in 2017 specifically aimed at allowing limited bauxite exports, controlled by a quota system, over a five-year period, to support the construction of new domestic alumina refineries.

Indonesia reintroduced its minerals export ban in full on 10 June 2023, although declining quotas saw export tonnages diminish significantly from the start of 2023 and cease by end Q1 2023.

While the ban removed around 20MTPY of bauxite exports from the market, the additional supply already under construction in Guinea was more than enough to compensate for the loss.

Indonesia now has two of the world's youngest and lowest cost alumina refineries, which have been built in response to the implementation of its minerals export ban. Two further refineries are under construction and a third and fourth are currently moving through the planning phase. It is expected that, by 2030, there could be an additional five alumina refineries with cumulative capacity of up to 10 MTPY operating in Indonesia, with the most likely source of energy, at least in their early years of operation, being coal.

Figure 7-1 World Alumina Production Cost Curve 2024



Source CM Group

Although the timeline for planning, approval and construction of alumina refineries in different countries can vary significantly, it is widely accepted that Indonesia's pro investment and pro value add policies generate project timelines significantly shorter than in other countries with similar mining and processing industries. Industry sources report that PT BAI, the Indonesian company responsible for construction and operation of the country's most recent alumina refinery project on Bintan Island, achieved all necessary approvals, including environmental impact approval, land management approval and local community approval, in approximately 24 months, with construction reportedly taking a further 30 months. Total project timeline therefore was approximately 4.5 years, from announcement of the project to production of the first tonne of alumina.

It is this combination of suitable bauxite reserves, geographical location relative to the South East Asian market, low cost of capital, low cost of labour and the favourable regulatory environment that could result in up to 10 MTPY of additional alumina refining capacity being constructed in Indonesia over the next five to seven years.

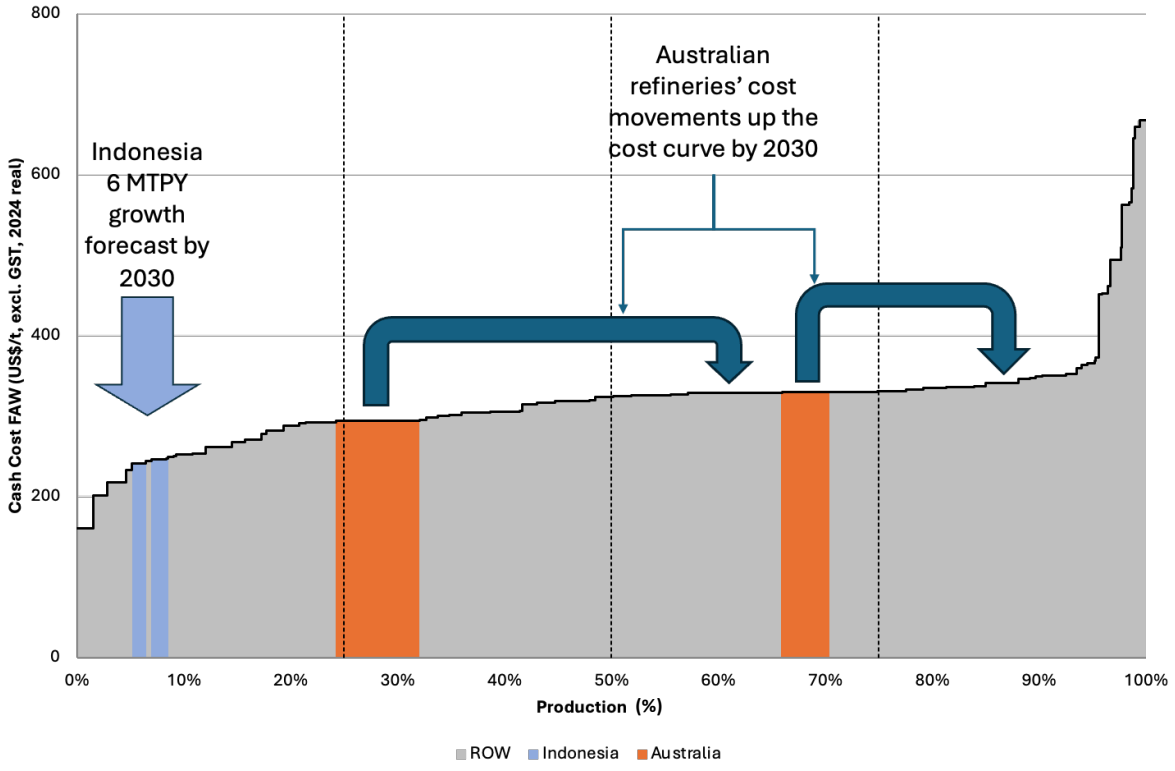
8 Potential Impact of Policy Uncertainty on Australia's Bauxite and Alumina Sectors

Based on the estimates for additional costs put forward in Chapter 6 and assuming global alumina refining costs remain stable on a relative basis, long delays to approvals have the potential to significantly increase costs, resulting in Australia's existing alumina refineries migrating into the third and fourth quartiles of the global alumina refining cost curve.

As they do, asset owners become less likely to commit the necessary maintenance and sustaining capital costs to ensure their long-term viability, as they consider other options across a range of competing assets and industries and different jurisdictions. Australia's position on the global refinery cost curve is likely to be further undermined as new, lower cost refining capacity enters the market. This is likely to be the case in Indonesia, where up to 10 MTPY of additional alumina refining capacity is either under construction or in the advanced stages of planning, with the potential to come onstream within the next five to seven years.

This new Indonesian capacity would be further incentivised to come onstream should Australia's existing refiners become less competitive. That said, it would also be reasonable to assume that a strong and competitive industry in Australia would delay the likelihood of new capacity coming onstream in Indonesia and elsewhere.

Figure 8-1 *World Alumina Production Cost Curve 2024 – Potential Changes for 2030*



Source CM Group

New alumina refineries, both greenfields and brownfields, would mostly come on-stream in

Q1 of the global cost curve, pushing the majority of global refiners, including Australia's five operational refineries, higher on the cost curve, exacerbating the cost pressures resulting from delays in approvals.

Further, the relative flatness of the mid-section of the global alumina cost curve means minor increases in costs can have a significant impact on global cost position and therefore greater exposure to price volatility and market downturns.

Australia's five operational alumina refineries are all highly sensitive to costs, as are their vertically integrated bauxite mines; as costs increase, competitiveness is eroded, and margins fall.

The absence of clear, unambiguous resources and environmental compliance policies is pushing bauxite mining and alumina refining costs higher and will continue to do so should the current policy trajectory be maintained.

That said, a constructive environmental approval and resources policy framework would have the opposite effect, whereby discrete components, agreed timeframes and clear integration into other major policy goals, would reduce costs and reduce industry carbon emissions.

A constructive framework also provides the regulatory assurances existing operators need to commit to the considerable capital investments necessary to achieve not only long-term competitiveness, but also to meet their decarbonisation targets.

The world's aluminium industry has a bright future, with the light metal set to play a pivotal role across some of the most important market sectors in the green energy transition, notably the transport and electrification sectors. Global aluminium demand growth is forecast to remain strong as a result, for at least the next two decades, and Australia's attractive bauxite reserves position the country well to take advantage of the opportunities this will present.

The future of the industry now sits firmly in the hands of policymakers, who can either set a course for prosperity and sustainable growth, or by absence of action create an uncertain environment that leads to the industry languishing and the country's competitive advantages to be eroded.

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