# *Sustainable Industrial Jobs in the Hunter:*

## *Aluminium Manufacturing and Australia's Energy Advantage*

**By Jim Stanford and Alia Armistead**
**Centre for Future Work at the Australia Institute**

**February 2022**

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This report was prepared for the Hunter Jobs Alliance and the Australian Manufacturing Workers Union.

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The authors thank, without implication, Dan Cass, Warwick Jordan, Mark Ogge, and Cory Wright for helpful input.

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# Summary

Aluminium is an essential material in modern industrial society. Indeed, its favourable properties (including light weight, malleability, conductability, and recyclability) are driving steady worldwide expansion in its use. Environmental motivations (including the growing use of lightweight aluminium components to improve energy efficiency in motor vehicles and other applications) are reinforcing this positive trend.

Australia has been a major global producer and exporter of aluminium for the past half-century. This industrial success stemmed partly from rich domestic deposits of bauxite ore, the primary ingredient in aluminium. But it also reflected decades of pro-active policy efforts by previous state and Commonwealth governments, determined that Australia would play a significant role in this growing, global, high-technology industry.

In short, Australia's natural resource base and active industrial policies led to its emergence as one of the leading aluminium producers in the world. More recently, Australia's unmatched endowment of renewable energy sources, including solar, wind, and geothermal energy, has reinforced this natural advantage – since aluminium production is one of the most energy-intensive industries in the economy. Given these underlying positive fundamentals, one might assume that this important industry has a bright future in Australia.

Unfortunately, the continuing domestic presence of this industry cannot be taken for granted. In recent years, government economic policy has largely overlooked the importance of nurturing domestic manufacturing capacity, jobs, and exports. Government assumed that enough jobs were available in other industries (such as minerals extraction, property development, and banking) to assure adequate employment opportunities for Australian workers, and an adequate foundation for national growth and export success. That assumption was wrong. A steep decline in manufacturing jobs, output, and employment in Australia over the past 15 years has undermined economic security in many regions of Australia – including the Hunter. Domestic manufacturing production was replaced by imports, and international trade engagements became very unbalanced: with Australia more dependent on exports of primary products than any time in postwar history, and incurring an enormous and growing trade deficit in value-added manufactures. Aluminium production, once an industrial success story for Australia, experienced that decline along with other manufacturing sectors.

After recent closures, Australia now has just four operating aluminium smelters left. The largest is located in Tomago, NSW. The COVID-19 pandemic, which caused huge disruptions in global supply chains, has reawakened Australians' concern with maintaining a basic level of industrial self-sufficiency. And growth in global demand for aluminium, together with rapid changes in the technology and economics of renewable energy, suggest that Australia could engineer an historic renewal of this vital sector. A key element of that effort must be to retain and modernise the industrial assets Australia still possesses in the aluminium sector – including the Tomago facility.

Australian production of bauxite (the raw input to aluminium manufacturing) has grown rapidly in recent years. But closures of one alumina refinery and two aluminium smelters have dealt a serious blow to Australia's national capacity to add value to those abundant bauxite reserves. The secondary fabrication and manufacture of aluminium products has also diminished, in line with the broader crisis in Australian manufacturing. Australia's position in the global aluminium value chain, therefore, has become precariously concentrated in raw resource extraction.

The unit price of aluminium is 60 times greater than the unit price of bauxite. Why is Australia growing its presence at the lower-value end of this industry – while perversely shrinking its presence in an industry whose output sells for 60 times as much? By abandoning downstream capabilities in aluminium manufacturing (including smelting and secondary fabrication), Australia is shipping billions of dollars in value-added, and many thousands of jobs, to offshore jurisdictions.

This problem could get even worse, as important decisions are made regarding the future operation of some of Australia's remaining value-added aluminium manufacturing facilities – including the Tomago smelter. Its importance to employment, income, and fiscal well-being in the Hunter region is indisputable. But the facility plays an important role in Australia's national economy, too: including making a significant contribution to national exports, and supporting (through its supply chain purchases) output and employment in dozens of industries in all parts of the country.

Environmental factors are a major priority for the future evolution of the global aluminium industry. Aluminium smelting is highly energy intensive; the sector is the biggest single customer of electricity in Australia, accounting for 10 percent or more of electricity use in the states where smelting takes place. Given Australia's historic reliance on fossil fuels (and coal in particular) for generating most of its electricity, this imparts the aluminium industry with an unacceptable ecological footprint – particularly regarding large emissions of carbon dioxide and other greenhouse gases in

the course of generating the electricity supplies used in smelting. This is changing, however, with the rapid expansion of renewable energy sources; it could change faster with pro-active measures to pair aluminium reinvestments with renewable energy expansion. Indeed, by leveraging the enormous electricity purchases of aluminium smelters to underpin major expansion in renewable energy supply (through new power contracts with renewable providers), aluminium manufacturing could add irresistible momentum to the accelerating energy transition. An additional benefit for renewable energy development could also be facilitated through the growing importance of demand response measures (whereby major users, like smelters, reduce their demand for short periods of time in order to stabilise overall supply-demand conditions). For all these reasons, aluminium smelting can and should be seen as a partner in the development of a sustainable energy system in Australia.

Policy-makers and the public at large need to be aware of the great economic, social, and fiscal importance of the Tomago smelter – for its own sake, and as a case study in the broader problem of deindustrialisation which has so badly undermined Australian economic performance over the last decade. This facility plays a vital role in the regional and national economies. Paired with state-of-the-art renewable energy technologies, Tomago can be a leader in positioning Australia as a world-leading sustainable manufacturing superpower.[1]

This report reviews the recent negative trends in Australian aluminium manufacturing, in the context of global, macroeconomic, and environmental challenges. It describes the importance of the Tomago facility to the regional economy and labour market, and documents the extensive linkages between the Tomago operation and a wide range of other economic activities: including "upstream" linkages to the myriad of firms which sell parts, inputs, and services to the smelter, and "downstream" linkages through which the incomes and spending power of those employed in aluminium manufacturing (and its supply chain) support activity and jobs across the full range of consumer goods and services industries.

This study also reports results of macroeconomic simulations of the overall impacts of the Tomago facility on the national economy (including employment, incomes, GDP, and government revenue). These effects, because of the economic linkages between the smelter, its supply chain, and the consumer goods and services industries which depend on its continued existence, are very large. Our "base case" simulation suggests that the Tomago facility ultimately supports:

[1] Garnault (2019) and Nahum (2020) have discussed the potential of renewable energy resources to power a resurgence in Australian manufacturing.

- Over $1.2 billion in national GDP per year, with production benefits experienced in all states (70% in NSW).
- Household disposable incomes of almost $500 million.
- Direct and indirect employment of over 6000 jobs: in the smelter, in its various suppliers, and in downstream consumer industries.
- Incremental government revenues worth $465 million per year: two-thirds of which is captured by the Commonwealth, and $120 million by the NSW state government.

The local government areas around the Tomago facility[2] receive the biggest benefits from the smelter's operations, including 1850 jobs and over $100 million in additional household disposable income per year. Wages and labour market conditions are somewhat weaker in the Hunter region than national averages, so these well-paid jobs are especially vital in eliciting labour force participation, preventing outmigration by young people, and financing local services and infrastructure. But the benefits from the continued operation of the Tomago smelter are experienced across Australia.

We also report simulations that include potential spillover impacts of Tomago operations on the viability of bauxite and alumina facilities which feed into the plant. In a worst-case scenario, if the Tomago smelter were to hypothetically stop operations, mining operations in Weipa, Queensland, and the QAL alumina refinery in Gladstone, Queensland, would experience a significant loss of business and could potentially also close.[3] In this "high-case" scenario, the loss of the Tomago smelter would produce losses in national GDP, employment, and government revenue approximately twice as large as implied in the "base-case" scenario summarised above.

In the wake of the global economic disruptions caused by the COVID-19 pandemic and resulting recession, Australians have realized that national prosperity cannot be sustained solely on the basis of extracting and exporting unprocessed natural resources. This leaves the country too vulnerable to economic, supply chain, and environmental disruptions. Even the present Commonwealth government has acknowledged that Australia must pivot toward a more diversified economy, and find ways to add value to resource wealth through the production of a broader range of goods and services.

Australia cannot meet that challenge if the country loses more critical "anchor" manufacturing facilities like the Tomago smelter, and allows its exports and economic

[2] We consider impacts in five LGAs near the Tomago facility: Cessnock, Lake Macquarie, Maitland, Newcastle, and Port Stephens.

[3] Alternatively, those facilities could potentially continue operations oriented around export markets.

growth to become even more dependent on non-renewable resource extraction. Governments in other countries have taken powerful actions to support their domestic aluminium sectors – including with favourable energy supply arrangements, other financial subsidies and capital injections, export subsidies, requirements for domestic refining and manufacturing, and limits on aluminium imports. Australia and NSW must be prepared to do their part to support this vital facility.

# POLICY RECOMMENDATIONS

To that end, the paper concludes with a catalogue of several policy levers open to the state and Commonwealth governments to preserve and grow value-added aluminium manufacturing – at Tomago, and across Australia. These recommendations include:

1) **A clear and sustained commitment to rapid roll-out of renewable energy sources**: For reasons of both customer acceptance and climate policy, it is now essential for aluminium smelting to be founded on sustainable sources of energy. Fortunately, Australia's endowment of renewable energy is unmatched, and rapid technological advances allow renewable sources (including wind, solar, hydro and geothermal) to be applied in heavy industrial uses. The owners of Tomago have already committed to transitioning to full renewable power utilisation. Government can assist and accelerate this transition with clear, powerful measures to support expanded renewable energy developments, appropriate capacities (including batteries and pumped hydro) for backing up variable renewable power supplies, and fiscal measures that acknowledge the contribution Tomago could make (through the scale of its renewable energy purchases, as well as its potential role in demand-response measures that stabilise the regional electricity grid) to support NSW's transition to renewable energy.

2) **Full-cycle financial support and public equity**: Our simulations confirm a large fiscal payback to state and Commonwealth governments arising from the operation of the Tomago smelter, its supply chain, and the downstream consumer industries which depend on its continued operation. This gives both levels of government a major fiscal stake in Tomago's continuing operation. For that reason, in addition to supporting the roll-out of renewable energy, both governments should negotiate other forms of fiscal support for future capital improvements (including those tied to developments of renewable energy supply for the smelter). These could include tax incentives (such as an investment tax credit) and public equity participation in the smelter and/or associated infrastructure investments. These kinds of financial support were

important in the historical development of aluminium manufacturing in Australia, and similar supports have been proffered to other smelting operations in the country. Given the flow-through effects of the Tomago operation on national employment, GDP, exports, and government revenue, these forms of public fiscal participation can truly be considered investments – not 'handouts'.

3) **Leveraging public infrastructure and procurement**: Considerable demand for aluminium products will be forthcoming in future years as a result of the unprecedented investments being made by governments at all levels in new physical infrastructure: ranging from transportation to utilities to public buildings. The business case for continued aluminium manufacturing in Australia can be incrementally strengthened with pro-active efforts on the part of government to ensure that these investments (which are ultimately paid for by Australian taxpayers) embody maximum Australian-made content in all building materials and inputs, including aluminium.

4) **A value-added trade policy**: Australia has pursued a largely *laissez faire* approach to international trade arrangements in recent decades, underpinned by numerous bilateral, regional, and multilateral free trade agreements. This approach has naively assumed that merely eliminating barriers to international business activity would somehow ensure Australia a robust and promising role in world trade. Instead, Australia's trade profile has become concentrated to an unprecedented degree in the extraction and export of unprocessed or barely processed non-renewable resources; this has been coincident with a severe decline in domestic manufacturing and value-added activity, and a precarious dependence on imports to meet most domestic manufacturing needs. As will be shown in this paper, Australia's aluminium sector constitutes a textbook example of deindustrialisation: exports of raw or semi-processed resources (especially bauxite) have boomed, while production of value-added aluminium (including smelting and secondary manufacturing) has contracted. Australia thus fails to obtain maximum economic benefit from its resource base: exporting raw resources, and then importing more expensive, technology-intensive products made by other countries using Australian resources. A rethinking of Australian trade policy could help to reverse this damaging trend. This must include active interventions to limit the inflow (often at prices below cost of production) of aluminium products from other countries which are not making reciprocal purchases of value-added merchandise from us. The data provided below shows that the recent surge of imported aluminium products from China has been a major factor in the deterioration of Australia's

aluminium trade balance – which has eroded by more than half in the last decade. At the other end of the supply chain, trade policy should actively discourage exports of unprocessed bauxite, and instead require at least preliminary processing (and better yet, smelting) of Australian bauxite in Australian facilities. As discussed below, other major bauxite producers have implemented similar measures, and their application in Australia would provide a major boost to value-added activity here.

These actions, and others, would make a significant difference to the outlook for this industry and its vital, value-adding footprint. An essential first step, however, is for government to understand the importance of aluminium manufacturing to Australia's future industrial trajectory, and recognise that pro-active policy supports will be required to ensure that Australia can fulfil its potential as a leading, sustainable global aluminium supplier.

# I. Introduction

The aluminium industry has been an important pillar of Australian manufacturing for decades. Aluminium manufacturing and associated activities constitute a major source of employment in several regions. The industry makes important contributions to national output, incomes, and exports. It is a high-productivity, technology-intensive sector, that generates above-average incomes for its direct employees, supports many thousands of indirect jobs among suppliers and related firms, and generates billions of dollars in tax revenues for all levels of government.

However, Australia's aluminium industry has experienced significant pressure in recent years, arising from a number of factors. These include:

- dramatic swings in world aluminium prices;
- huge imbalances in global production and trade;
- environmental concerns, in particular climate change – which is necessitating a rapid transition to renewable energy on the part of the energy-intensive aluminium industry;
- this has been made worse by the failure of Australia's largely privatised electricity sector to deliver competitively-priced, reliable power, and the failure of governments to establish a consistent, effective policy framework to facilitate the transition to renewable energy;
- financial uncertainty for the large global companies which control most aspects of the industry's activity.

In the last decade, several important value-added aluminium facilities in Australia have closed (including two aluminium smelters, one alumina refinery, and several secondary aluminium fabrication facilities). This has badly damaged the national economy: with the loss of direct and indirect jobs, falling household incomes, a decline in exports, and lost government revenues.

One especially worrisome dimension of these recent closures is an increasingly precarious structural imbalance in the industrial footprint that remains. Aluminium-related activity in Australia has become increasingly concentrated at the primary resource extraction phase. Even as value-added aluminium manufacturing has been significantly downsized, the extraction of raw bauxite (at the mining phase of the industry's value chain) has increased. Aluminium, if anything, will become increasingly important in the future global economy due to its favourable features (including light weight and recyclability). Yet Australia's role in the industry is becoming increasingly

confined to pure extraction – forgoing the economic opportunities associated with adding value to natural resource through refining, smelting, and secondary manufacturing. This trend, if it continues, will reinforce Australia's structural reliance on resource extraction, at a time when the limits of an extraction-based economy are becoming increasingly clear. Instead of leading a transition away from overreliance on extraction toward a greater diversity of value-added activity, recent aluminium closures have left Australia more reliant (not less) on the extraction and export of unprocessed non-renewable resources.

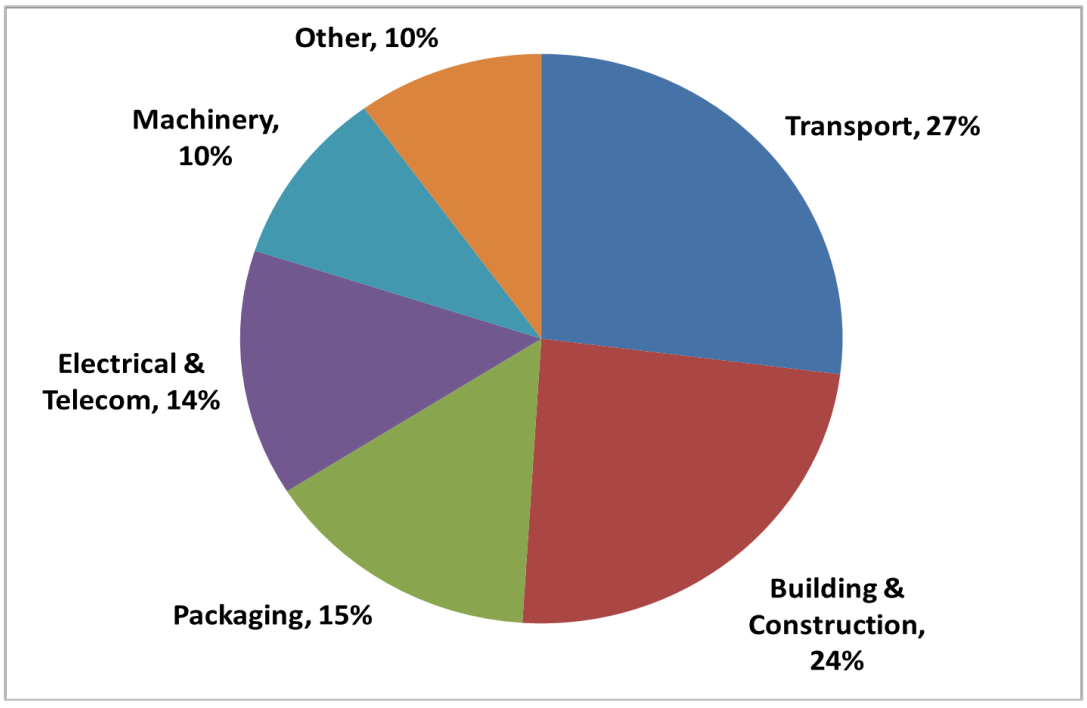
In this context, the fate of Australia's remaining aluminium manufacturing facilities takes on added importance. The aluminium smelter in Tomago, NSW, clearly plays an "anchor" role in the regional economy and labour market: it is one of the largest single employers in the region, and supports thousands more jobs in related supply work and consumer industries. Yet its importance is also clear at the state and national level: the facility is one of Australia's largest single sources of export revenue, and contributes significantly to the fiscal capacity of both the state and Commonwealth governments.

As Australia's economy continues to adjust to various economic and environmental pressures (including the transformation of the energy system toward renewable sources), policy-makers must recognise the long-run economic, fiscal, and social importance of the Tomago smelter – and other aluminium facilities like it. Australia's participation in the global aluminium industry has already been significantly downsized, and skewed disproportionately toward extraction. As all stakeholders negotiate the challenges that lie ahead, appreciation of the strategic importance of "anchor" manufacturing facilities like Tomago must inform their deliberations and decisions.

# II. The Aluminium Industry in Australia: Current Footprint & Structural Importance

Aluminium is a mainstay of modern industrial society. Next to steel, it is the most commonly used metal, and an essential input in a wide range of applications. The use of aluminium is well-balanced across a wide range of final uses, as illustrated in Figure 1: including transportation equipment and infrastructure, building and construction materials, machinery, packaging, and electrical and communications equipment. Aluminium has numerous properties that make it a preferred material for a wide range of functions: it is lightweight, highly malleable, durable, resistant to corrosion, highly conductive of both heat and electricity, and easily recyclable. Some of these features are driving increasing penetration of aluminium in new applications, in preference to competing metals (such as steel). For example, lightweight aluminium components are being adopted more widely in automobile manufacturing, because their lighter weight contributes to efforts to improve fuel efficiency and hence reduce vehicle emissions.

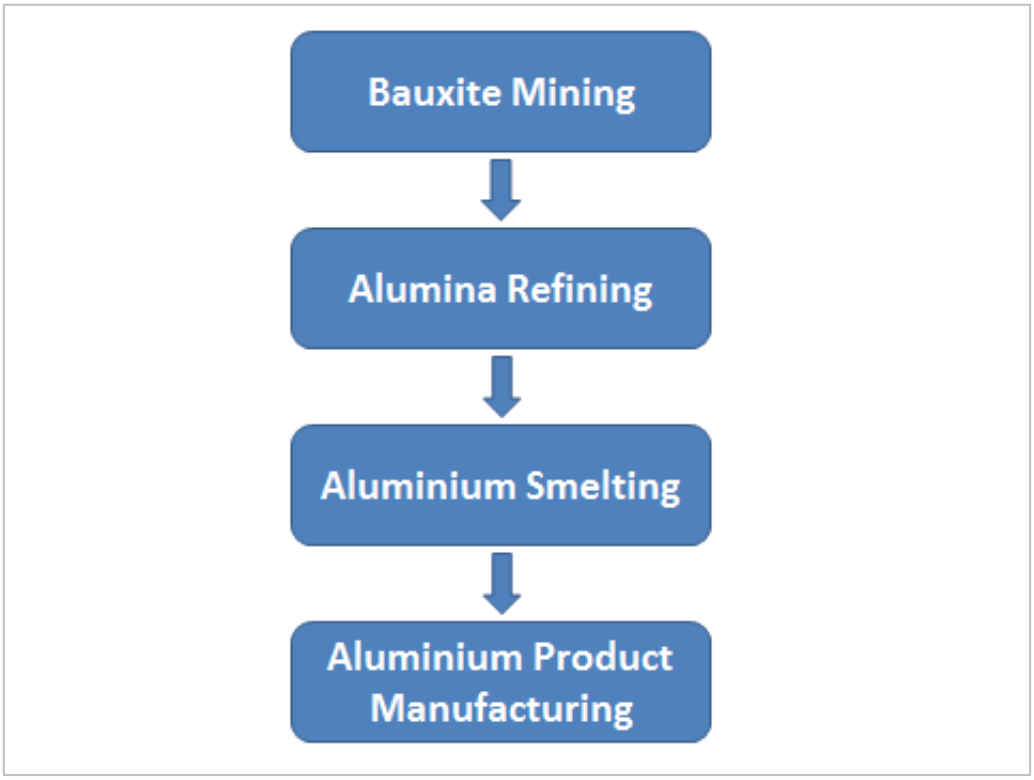
**Figure 1. Aluminium Use by Sector**




Source: Phillips et al (2015). Total 2020 global consumption: 65 million tonnes.

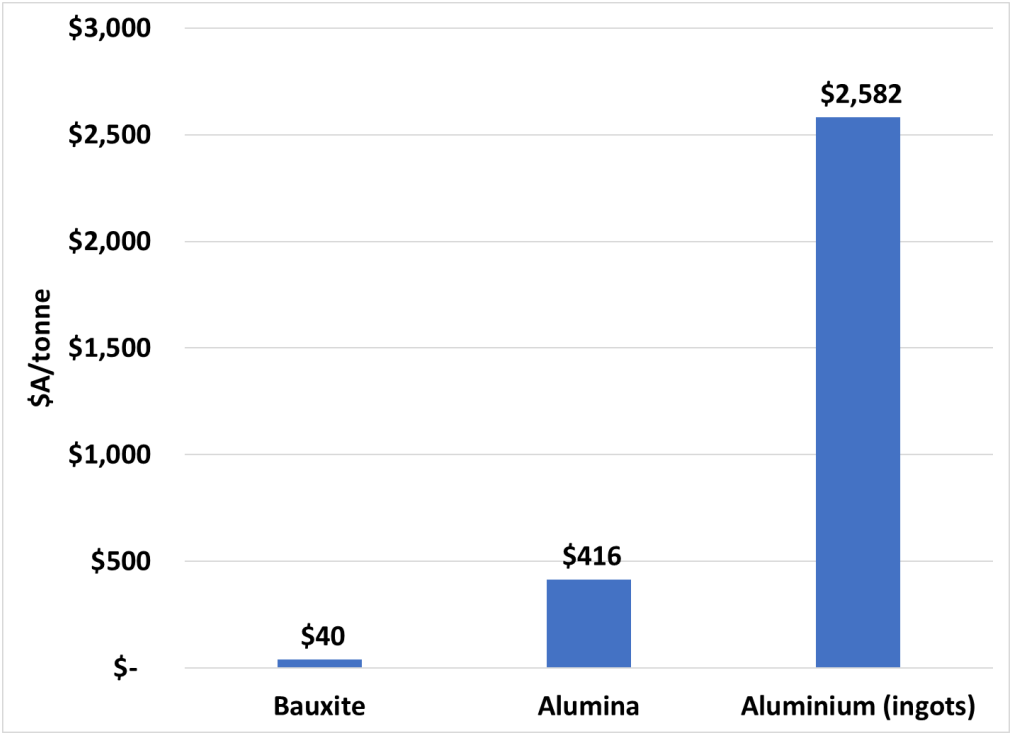
Australia has been a leading producer of aluminium and related products throughout the last half-century. This success stems in part from Australia's abundant reserves of the primary ore used in aluminium production: bauxite. Aluminium is the third most common element (and most common metallic element) in the crust of the earth (Geoscience Australia, 2020), but it is never found naturally in its pure form. Instead, bauxite is the most common and economically exploitable form of aluminium ore. Bauxite is abundant around most of the world, but Australia's deposits are very large and notably higher in quality compared to other producers. Large-scale bauxite mining began in Queensland, Western Australia, and the Northern Territory in the 1960s, and Australia soon became the world's largest bauxite producer. At present Australia accounts for about 30 percent of world bauxite production (U.S. Geological Survey, 2020), almost twice as much as second-place China.

**Figure 2. The Aluminium Value Chain**




However, from the earliest days of the domestic industry, Australian policy-makers recognized the risks of limiting Australia's position in aluminium production to simple ore extraction. So they began to apply active policy measures to promote the development of a more well-rounded aluminium industry, one that encompasses all stages of production. As illustrated in Figure 2, aluminium production involves several "links" in a chain of value-added activity. After initial extraction, bauxite must be refined, through a chemical process, to produce alumina: a concentrated white powder. Alumina in turn is the primary input to a smelting process, where it is

**Figure 3. Realised Export Unit Prices, Aluminium Exports, 2019-20**




Source: Dept. of Industry, Science, Energy & Resources (2021).

combined with electricity[4] and carbon to extract pure liquid aluminium – typically then formed into basic solid ingots. Finally, that primary aluminium is further processed and manufactured into the wide range of fabricated aluminium products used in everyday life. At every stage of production, value is added to the product through the application of labour, capital, and technology. This value-adding process is illustrated dramatically in Figure 3, which reports the average realized price attained per tonne in 2019-20 for Australian exports of bauxite, alumina, and aluminium. The unit price of alumina is 10 times greater than the unit price of raw bauxite (thanks to the refining and concentrating process associated with alumina production), while the unit price of aluminium ingots is more than 6 times the unit price of alumina. Realized prices for primary aluminium are therefore more than 60 times greater than prices for bauxite. The value gap between bauxite and finished aluminium has widened in recent years, in part because the rapid expansion of bauxite supply (including from Australia) has depressed its price. Clearly, in order to maximize the value-added, productivity, and incomes associated with aluminium production, it is essential to preserve a strong footprint in the higher-value-added stages of production.

[4] Aluminium smelting is a very electricity-intensive process, with energy costs typically accounting for about one-third of the total cost of production.

Postwar governments recognized and accepted the importance of developing a national capability at all stages of this industry, which was destined to play a strategic economic and technological role in so many aspects of modern industrial life. State and Commonwealth governments therefore applied active policy levers to ensure that Australia played a proportionate role in all stages of the aluminium value chain: extraction, refining, primary aluminium, and secondary fabrication. In fact, Australia's first aluminium smelter (at Bell Bay, Tasmania, conveniently located near to hydroelectric power supplies) began operations even before the advent of large-scale bauxite mining in Australia; initially, the Tasmanian smelter relied on imported alumina. That smelter was built in 1955 through a joint venture investment by the Commonwealth and Tasmanian governments, and was sold five years later (after successfully proving its capabilities) to Rio Tinto. Other active policy measures through subsequent decades helped to expand Australia's presence in alumina refining, aluminium smelting, and secondary aluminium manufacturing. So it is wrong to conclude that Australia's status as a major player in global aluminium production is solely or even mostly the legacy of its abundant deposits of bauxite. To the contrary, the presence of a well-rounded aluminium industry reflects a broad and active commitment to industrial development on the part of policy-makers at all levels of government.

**Table 1**
**Australian Aluminium Sectors, 2019-20**

| Industry | Shipments ($m) | Value-Added ($m) | Employment | Wages & Salaries ($m) |
|---|---|---|---|---|
| **Bauxite mining** | 4,300 | 2,100[1] | 2,500[2] | 225[2] |
| **Alumina refining** | 8,011 | 2,650[1] | 6,440 | 1,003 |
| **Primary aluminium smelting** | 4,841 | 605 | 2,979 | 205[1] |
| **Rolling and extruding** | 952 | 214 | 2,067 | 158 |
| **Architectural products** | 4,476 | 1,561 | 16,724 | 1045 |
| **TOTAL** | **$22.6 billion** | **$7.1 billion** | **30,700** | **$2.6 billion** |

Source: Australia Dept. of Industry, Science, Energy & Resources (2021), and ABS Australian Industry.
1. Estimate based on past ratios of wages to value-added.
2. Estimate based on company reports.

Today aluminium production remains an important mainstay of Australian industry. And despite economic pressures arising both at home and internationally, Australia retains a strong technical and economic capability at all stages of the aluminium value

chain. Recent data and estimates regarding production, value-added, employment, and wages and salaries for each of the stages of aluminium production are summarized in Table 1. Regarding secondary manufacture of aluminium products, Table 1 includes two important components of that activity which are separately reported in ABS data: aluminium rolling, drawing, and extruding (ANZIC industry code 2142), and architectural aluminium product manufacturing (ANZIC 2223).[5] Alumina refining and aluminium smelting account for the largest value of shipments of any of the sectors identified. Manufacture of aluminium building products (a relatively labour-intensive activity) accounts for the largest single source of employment – although labour incomes in that sector are lower than those paid in other aluminium manufacturing activities. The five industries listed in Table 1 account for total annual shipments of about $22.6 billion, and total employment of over 30,000. They generate combined annual value-added (GDP) exceeding $7 billion, and labour incomes of $2.6 billion.

**Table 2**
**Deindustrialising the Aluminium Value Chain**

| Product | Australia Global Rank: 2010 | Change in Production 2010-19 | Australia Global Rank: 2019 |
|---|---|---|---|
| **Bauxite** | 1 | +56% | 1 |
| **Alumina** | 2 | +5% | 2 |
| **Aluminium** | 4 | -19% | 6 |

Sources: Australia Dept. of Industry, Science, Energy & Resources (2021); USGS (2010 and 2020).

While Australia benefits from a strong footprint in aluminium production at all stages in the value chain, there is no doubt that within this industry – as for Australia's economy as a whole – there has been a definite trend toward deindustrialisation, the erosion of manufacturing capacity, and a growing focus on primary resource extraction. This worrisome trend is summarized in Table 2. In the last decade, Australian bauxite output has surged by 56%, spurred in part by growing global demand for the raw input to aluminium production. China is the biggest customer for this bauxite: over the last two decades it has become the world's largest producer of aluminium, but its bauxite mining capacity has not kept up. However, in contrast to surging output of bauxite, Australian alumina production has been relatively stagnant:

[5] Of course, there are dozens of other manufacturing sub-industries which also manufacture aluminium products; these two are the only aluminium-focused sub-sectors separately reported by the ABS.

growing just 5% over the same period. This indicates that most additional bauxite production is being exported in its raw form. Primary aluminium smelting, meanwhile, has declined over the last decade – dragged down by the closure of two major smelters. Australia's structural regression within the global aluminium supply chain is further evidenced by its national ranking within each of those stages of production. Australia remains the world's largest producer of bauxite, and the second largest refiner of alumina – but has fallen back to just the sixth largest producer of primary aluminium. While world consumption of aluminium continues to expand, therefore, Australia's participation in the industry is increasingly concentrated in raw resource extraction. To put the problem starkly, Australia is growing its presence in an industry whose output is worth $40 per tonne – and shrinking its participation in an industry whose output sells for 60 times that much.

**Table 3**
**Australia's Aluminium Smelters**

| Location | Capacity (kt/yr) | Opened | Employment[1] | Electricity Use (GWH/year) |
|---|---|---|---|---|
| Tomago, NSW | 580 | 1983 | 1140 | 8300 |
| Boyne Island, QLD | 570 | 1982 | 950 | 4800 |
| Portland, VIC | 350 | 1985 | 650 | 5200 |
| Bell Bay, TAS | 180 | 1955 | 550 | 3000 |

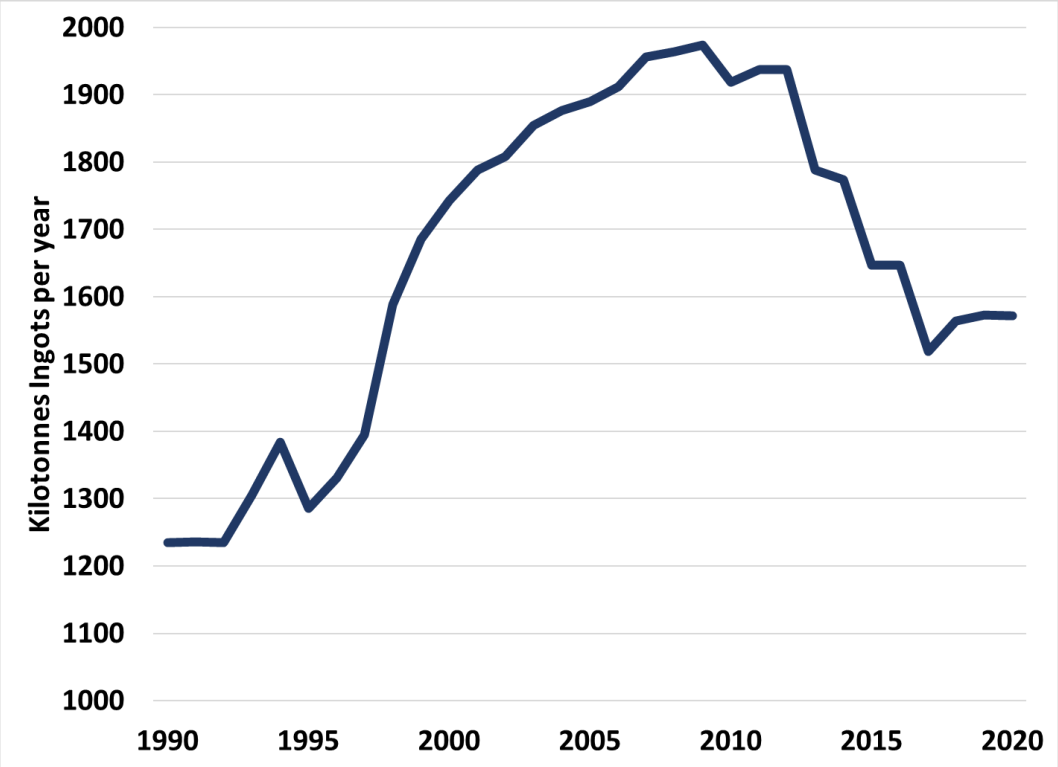
Source: Australian Aluminium Council, company reports, Butler (2020).
1. Approximate, including contractors.

Table 3 catalogues Australia's aluminium smelters. Until 2012 the country had six smelters, located across four states: New South Wales, Victoria, Queensland, and Tasmania. Two smelters were then closed. A smelter operated by Norsk Hydro at Kurri Kurri, NSW, closed in 2012, and an Alcan facility at Point Henry, Victoria, closed in 2014. Those closures reduced capacity in the industry by close to 400,000 tonnes per year, and eliminated some 1500 direct jobs. The four remaining smelters directly employ over 3000 workers (employees and contractors), with hundreds more working in head office and infrastructure functions for the various aluminium manufacturing firms. Of the four remaining smelters, the Tomago facility is the largest measured by both capacity and employment.

In addition to the closure of two aluminium smelters since 2012, Australian aluminium manufacturing has experienced other closures of value-adding facilities which have reinforced the worrisome dependence on raw resource extraction. A Rio Tinto alumina

refinery at Gove in the Northern Territory was closed in 2014 (with the loss of over 1000 jobs). The same year Alcoa closed two aluminium rolling facilities (at Point Henry, Victoria, and Yennora, NSW), with the loss of 430 positions. And numerous secondary aluminium fabrication and manufacturing facilities have closed since 2008, commensurate with the overall contraction of manufacturing activity in Australia. Bauxite mining has continued to expand. But new employment in that activity will not be sufficient to offset idled resources resulting from the decline of broader manufacturing activity. And the low and volatile economic returns from raw resource extraction cannot form the foundation for sustained national prosperity.

**Figure 4. Australian Primary Aluminium Production, 1990-2020**

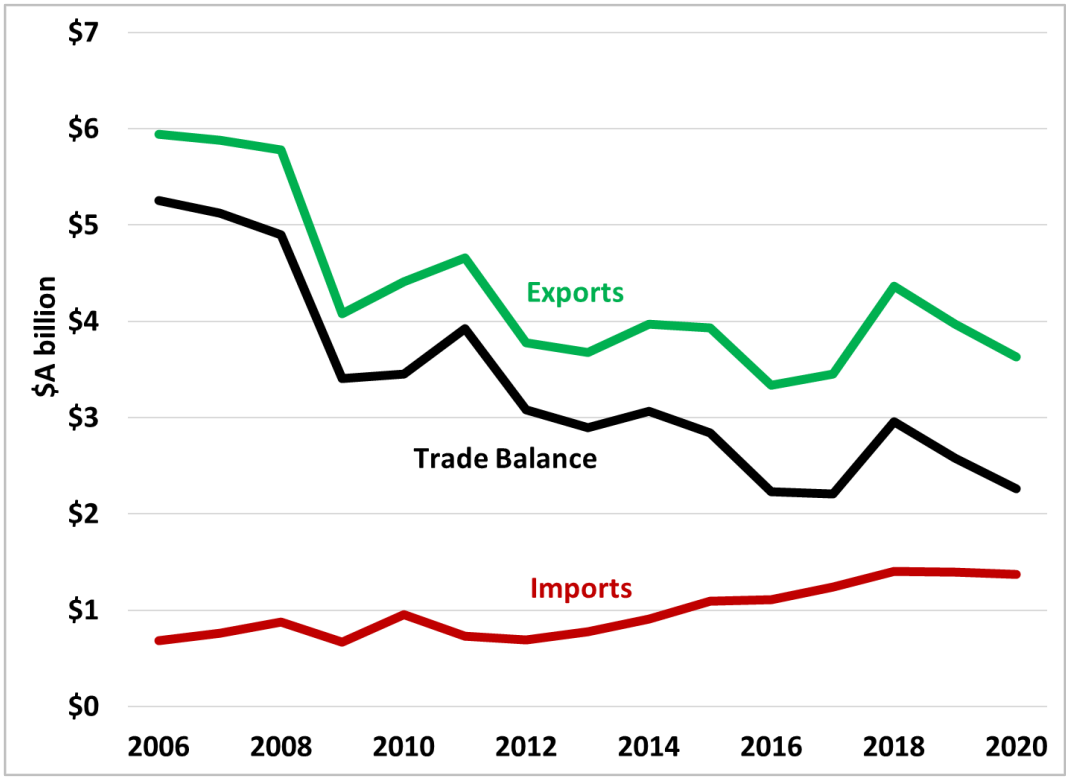



Source: Dept. of Industry, Science, Energy & Resources (2021).

The trend in Australian primary aluminium production over the past quarter-century is illustrated in Figure 4. After decades of growth, smelter output peaked in 2008 at just under 2 million tonnes. During the worldwide recession that followed the global financial crisis in 2008-09, production stagnated for several years; it then declined sharply after the two smelter closures. Production in 2020 was 20 percent below the 2008 peak. The value of output has been even more uncertain, because of huge fluctuations in world aluminium prices over the same period (discussed further below). The value of Australia's aluminium shipments in 2020 (measured in domestic currency terms) was almost 40% below peak revenues received in 2006 (when aluminium prices reached their pre-GFC peak). Global aluminium prices have surged in 2021 (as a result

of global supply and demand factors), and that will provide valuable revenues for Australian producers in the near-term. But the future of the industry cannot be trusted to the fleeting fortunes of global commodity price cycles. If Australia is to retain a strong and value-adding presence in this growing industry, it must commit to a fully developed aluminium supply chain – instead of the recent focus on raw extraction.

**Figure 5. Aluminium Trade Balance, 2006-20**




Source: DFAT Pivot Tables.

An important feature of aluminium production is its strong export orientation. About 90 percent of Australia's primary aluminium output is exported to other countries. In contrast to most other manufactured products (for which Australia incurs large chronic trade deficits), Australia remains a net exporter of primary aluminium, but its advantage in this industry has weakened in the wake of smelter closures and declining production. Figure 5 illustrates the evolution of Australia's net trade balance in aluminium.[6] Aluminium exports primarily flow to Asia; other major customers for Australian aluminium include the U.S. and Europe. Those aluminium exports generated $3.6 billion in 2020 – almost 40% less than peak 2006 export revenues. Nevertheless, these aluminium exports are crucial at a time when Australia's overall export

[6] The data in Figure 5, attained from the Department of Foreign Affairs and Trade, include some semi-processed aluminium products, in addition to primary aluminium ingots.

performance is challenged by the COVID-19 pandemic and resulting disruption in global trade.

At the same time, Australia is importing more aluminium: primarily semi-processed aluminium, much of it from China. Australia's aluminium imports have averaged $1.4 billion per year since 2018, further eating into Australia's traditional trade surplus in aluminium. These aluminium imports now offset close to 40% of exports. The resulting net surplus of $2.3 billion recorded in 2020 is less than half the trade surplus generated in 2006 ($5.3 billion). Nevertheless, despite the erosion of Australia's net exports of aluminium, this high-value manufacturing industry continues to serve as a valuable counterweight to the large trade deficits incurred in other manufacturing sectors. Australia's overall trade deficit in manufactured products reached $180 billion in 2019, equivalent to over 9% of national GDP.[7]

Despite the higher unit revenues generated by smelted aluminium, Australia's industry continues to concentrate on less lucrative segments of production: in particular, bauxite mining. This reflects a combination of corporate greed and policy failures by Australian governments. Left entirely to their own devices, global corporations will naturally locate refining, smelting and manufacturing operations in lowest-cost jurisdictions: taking advantage of ultra-low labour costs (often suppressed through violations of basic labour and human rights), foreign government subsidies, and lax regulations. Meanwhile, Australian governments have largely abandoned the tools of active industrial policy, allowing private corporate decisions to shape the future of the industry with little constraint or guidance from policy. For this country to be more than a supplier of raw resources, Australian governments must once again be willing to actively shape and direct private business decisions, with the goal of maximising the domestic benefits attained from domestic resources.

By allowing its value-added capabilities in aluminium manufacturing to atrophy (including alumina refining, aluminium smelting, and secondary fabrication and manufacturing), Australia is effectively shipping billions of dollars in value-added, and many thousands of well-paying jobs, to offshore jurisdictions. Indeed, if all of Australia's bauxite exports were refined into alumina at home (rather than in other countries), that would generate an additional $5 billion in annual revenues and support an additional 4000 jobs. Meanwhile, if all of Australia's current alumina exports were used in aluminium smelting here (instead of overseas), domestic smelting output would expand several times over – generating up to $20 billion in additional annual revenues, and 20,000 new jobs. Such a dramatic transformation of

[7] See Stanford (2020) for more description of the causes and consequences of Australia's manufacturing trade deficit.

Australia's current aluminium footprint would take some years, and powerful policy interventions, to achieve. At a bare minimum, however, government must ensure the existing over-emphasis on raw extraction does not become even worse – which would occur if yet more smelters were closed.

# III. Global, National, and Environmental Context

The erosion of value-added aluminium manufacturing in Australia has occurred in the context of dramatic changes in the global aluminium industry, as well as the general deindustrialisation which has substantially weakened Australia's overall manufacturing capacities. This section reviews the national and global trends which have shaped recent developments in domestic aluminium manufacturing.

## GLOBAL MARKET TRENDS

As with so many other industrial commodities, world aluminium markets have experienced unprecedented upheaval in the past two decades because of the spectacular expansion in both production and consumption of aluminium products in China. China's rapid industrialisation has required massive inputs of all primary metals, including aluminium. And an over-arching emphasis on self-sufficiency has led state planners to ensure that domestic productive capacity has expanded in tandem. As a result, production of primary aluminium in China quintupled over the last fifteen years: from around 7.5 million tonnes in 2005, to 37 million tonnes by 2020.[8] China now accounts for over half of global aluminium production. Chinese demand for the metal has marched mostly in step with production, and hence China similarly accounts for around half of global aluminium demand. With its demand and supply rising roughly in tandem, the impacts of China's growth on aluminium markets in the rest of the world have been somewhat buffered. However, even modest changes in the net supply-demand balance within China have dramatic impacts on prices and trade patterns around the world, as a result of its dominant industrial footprint.

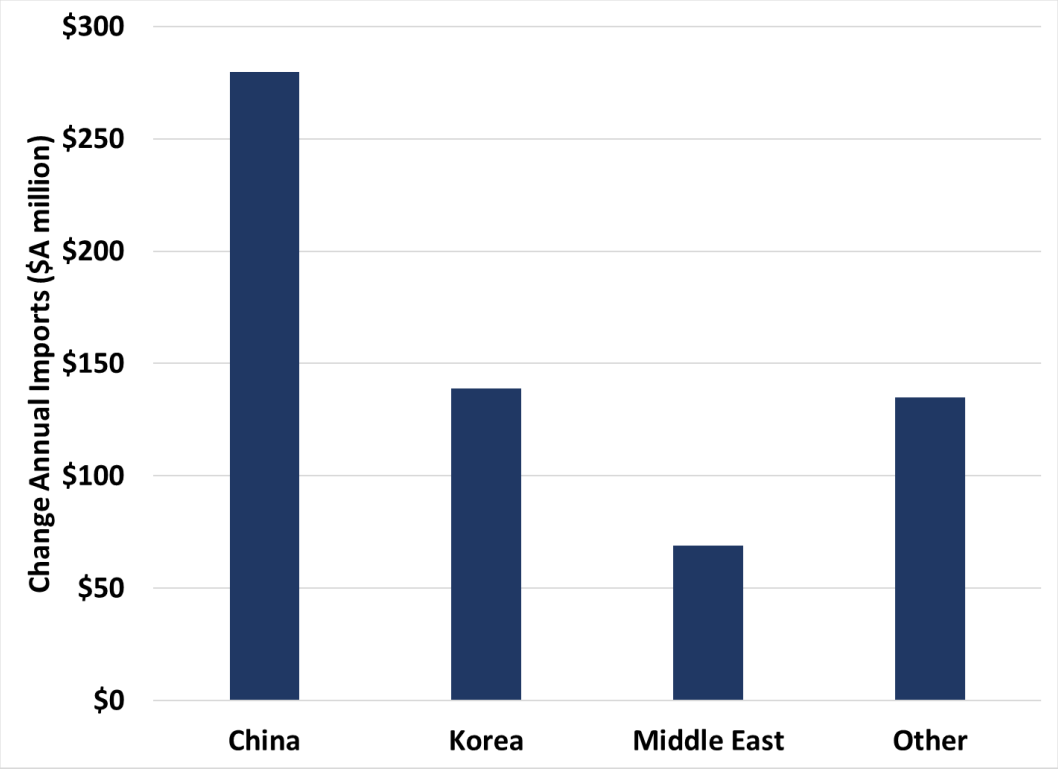
Excess smelting capacity has emerged within China in recent years, as continued investments in new smelter and manufacturing facilities outstripped growth in domestic demand. By 2020, that *excess* Chinese capacity was estimated to total 6,000 kilotonnes – equal to almost 10% of world output, and an amount that dwarves the *total* production capacity of any other country. How Chinese policy-makers manage this excess capacity has enormous implications for aluminium prices and conditions elsewhere in the world. One option would be to undertake a thorough restructuring of the Chinese industry, closing older, less efficient capacity and reattaining a better

[8] US Geological Survey (2020).

balance between domestic demand and supply. Another option would be to maintain production levels, and export excess output (in the form of both primary aluminium and semi-fabricated aluminium products). This has negative and potentially severe consequences for aluminium producers in other countries.

Chinese aluminium exports have indeed increased significantly in the decade since the GFC. The Chinese government has implemented active supports for aluminium exports – including state subsidies to domestic smelters (via direct subsidies, subsidized electricity, and low-interest loans) and changes in trade policy. In 2007 China began to tax exports of primary or barely-fabricated aluminium at rates of up to 15 percent, in order to enhance access to supply for domestic industrial users. But those taxes were eliminated in 2015 as part of a broad strategy to assist Chinese manufacturing. As summarized by the Australian Department of Industry, Innovation, and Science, "The Chinese government aim[s] to turn its aluminium industry to an export powerhouse by providing subsidies on power and logistics to China's aluminium exporters."[9]

**Figure 6. Growth in Australian Aluminium Imports by Source, 2012-2020**



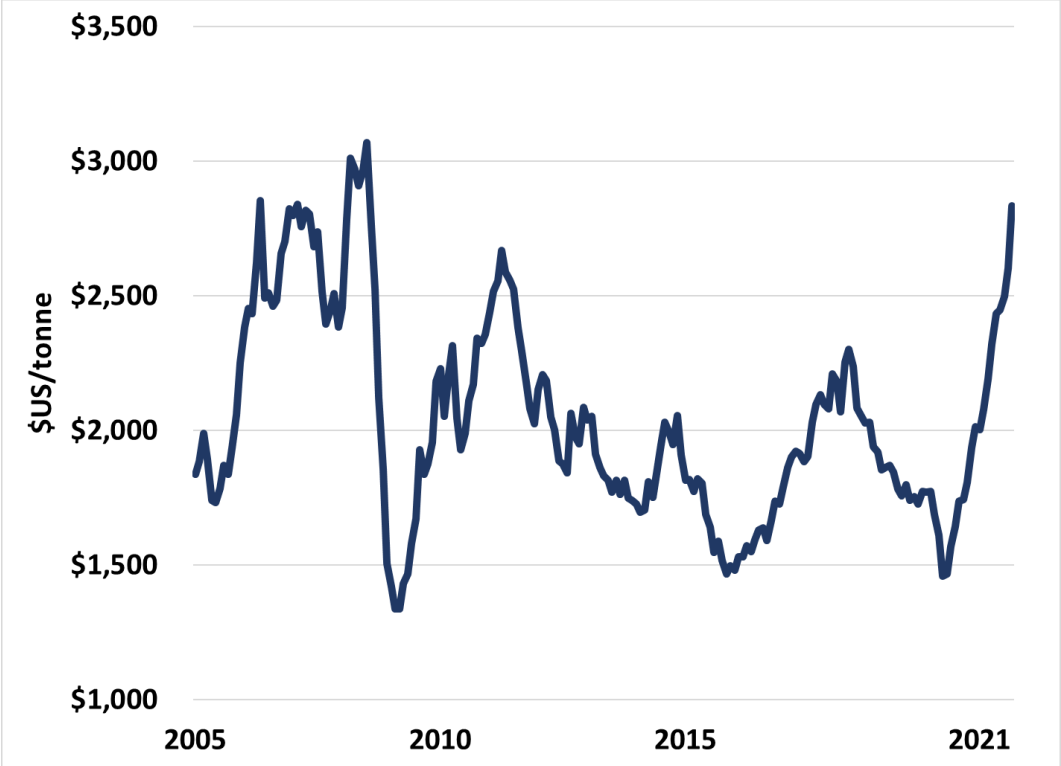

Source: DFAT Pivot Table.

Growing Chinese exports have had major impacts on aluminium prices, trade flows, and profits for producers outside of China. The U.S. government has moved to limit

[9] Australia Department of Industry, Innovation and Science and Westpac Bank (2016), p. 38.

imports from China and some other aluminium exporters – imposing a 10% tariff on aluminium imports from 18 countries (but not Australia) in early 2020. Australia has also become a significant destination for Chinese aluminium exports (including semi-fabricated products). Australia purchased $580 million worth of Chinese aluminium in 2020. Chinese imports have almost doubled since 2012: growing $280 million in that time, more than any other source of aluminium imports (see Figure 6). Imports from China have thus contributed substantially to the erosion of Australia's traditional trade surplus in aluminium, discussed above.

**Figure 7. World Primary Aluminium Price, 2005-2020**



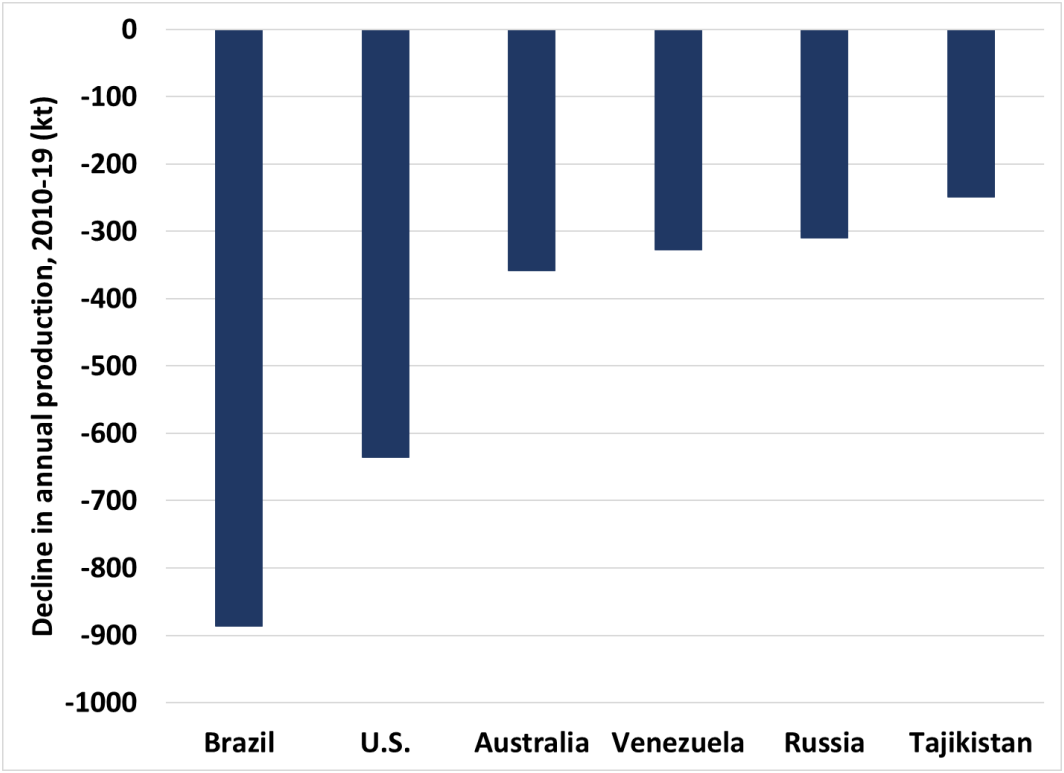

Source: Federal Reserve Bank of St. Louis.

In the face of China's slowdown and growing Chinese exports onto world markets, world aluminium prices declined by about half from peak pre-GFC levels (of $US 3000 per tonne) to below $US 1500 during the early months of the COVID-19 crisis (see Figure 7). This decline was interrupted by short-lived peaks in prices, reflecting unexpected and fleeting changes in global inventories, production disruptions, and other transitory factors. In recent months, another price surge has sent global prices soaring again. By September 2020, global prices reached $US 2800 per tonne – almost matching peak levels of 2006. How long prices remain elevated depends on numerous unpredictable factors, including the continuing course of the COVID pandemic, disruptions in global supply chains, and policy responses by the Chinese government. For as long as it lasts, this surge in prices will deliver valuable revenues and profits to

Australian aluminium producers – helping offset past losses incurred when prices were much lower. The bigger challenge, however, is to convert that short-term prosperity into longer-term security and stability in Australia's aluminium footprint.

Global aluminium turbulence has produced repeated episodes of financial distress and corporate restructuring among major global aluminium companies, including the leading players in the Australian aluminium industry. Rio Tinto, owner or part-owner of three smelters in Australia (including Tomago), has undertaken various cost-saving and restructuring measures in its global aluminium and other minerals businesses. Its major competitor Alcoa has closed smelters in the U.S., and in 2016 split itself into two separate publicly-traded companies: an "upstream" operation (encompassing mining, refining, and primary smelting), and a "value-add" company (Arconic) focused on higher-stage fabrication and manufacturing. In 2020 Arconic itself then split into two: with a new spin-off (Howlett Aerospace) focusing on aerospace-related manufacturing.

**Figure 8. Declining Aluminium Producers, 2010-2019**

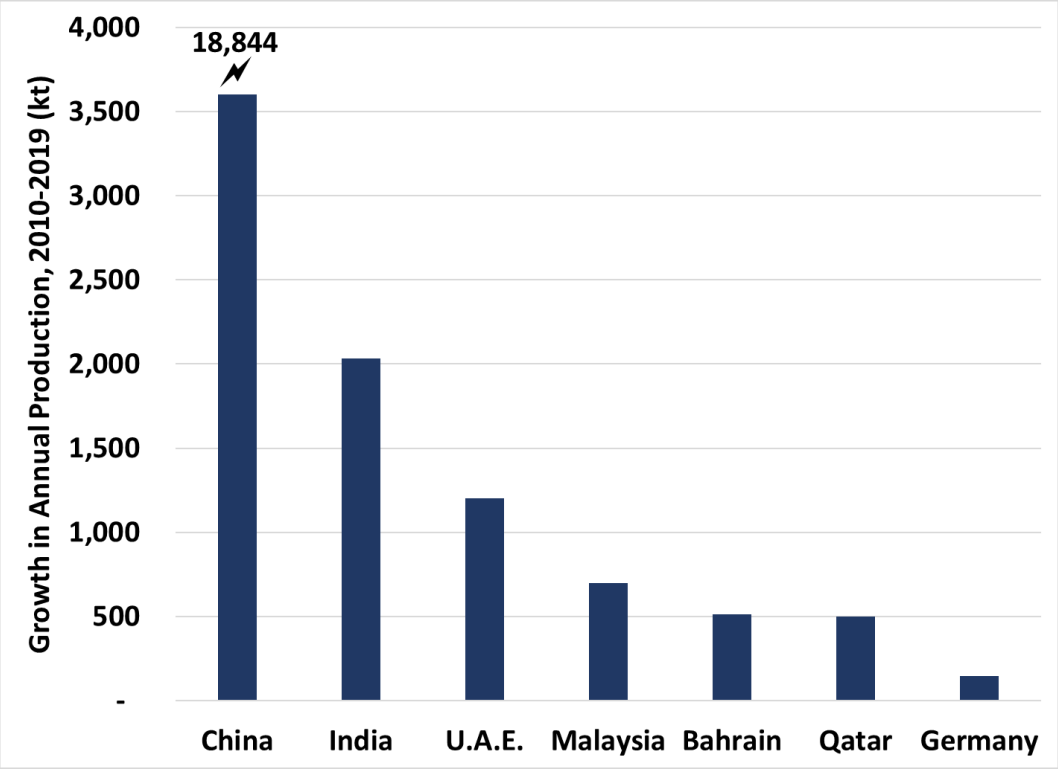



Source: US Geological Survey (2020).

The global aluminium industry continues to adapt to this uncertain market environment. As those adjustments occur, it is not just fundamental efficiency considerations that exercise the dominant influence over the industry's evolution. Policy pressures also critically influence which segments of the global industry will survive, and which will not. Capacity will decline outside of China, as some facilities are

closed in the face of global overcapacity and resulting financial pressures. Figure 8 illustrates that Australia has already borne a large and disproportionate share of capacity reduction (with two smelter closures). The decline in Australian capacity over the past decade was the third largest of any country (behind Brazil and the U.S.). In contrast, as indicated in Figure 9, several countries continue to increase their primary aluminium capacity. China's capacity additions, of course, have dwarfed all others. But three oil-producing countries in the Middle East (UAE, Bahrain, and Qatar), along with India, Malaysia, and Germany, also increased smelting capacity over the last decade. Governments in those countries actively support aluminium manufacturing for a range of policy reasons (including self-sufficiency and economic diversification). Even loss-making smelters in other countries are supported by government interventions, in the hopes of sustaining a domestic footprint through the current turbulence.

**Figure 9. Increasing Aluminium Producers, 2010-2019**




Source: US Geological Survey (2020).

Global demand for aluminium will continue to increase, on the strength of its various advantageous properties. The question facing policy-makers is whether Australia will retain a stake in that growth in the long-run – or whether even more domestic aluminium manufacturing will disappear in the face of global pressures which are neither permanent, nor reflective of economic fundamentals.

# AUSTRALIA'S DEINDUSTRIALISATION

The broader decline in Australian manufacturing is another important dimension of the economic context facing the domestic aluminium industry. The long contraction in Australian manufacturing over the last 15 years has had a negative impact on many aspects of macroeconomic performance: including employment, productivity, innovation, and exports. The COVID pandemic further highlighted the dangers of dependence on foreign-made manufactures of all kinds, including health equipment and pharmaceuticals. This makes it all the more important for Australia to rebuild its manufacturing footprint.

For many years conventional wisdom has held that as a high-wage, resource-rich economy, Australia was unable to competitively manufacture — nor was there a need to. Between digging up raw materials and shipping them to trading partners (who subsequently manufacture those resources into higher-value products which are sold back to Australians at premium prices) and success in some service exports (like higher education for foreign students), it was argued Australia no longer needed to produce the manufactured products it consumed. The COVID-19 pandemic has shattered that complacency. Even leaders of the current Commonwealth government, who long trumpeted the virtues of free trade and so-called "comparative advantage" specialisation, now concede that Australia's domestic manufacturing capability has declined too far.

It is commonly assumed that the contraction in manufacturing in Australia was the result of universal trends experienced across the developed world: the seemingly inevitable result of a transition toward a "services-based" economy. The migration of manufacturing activity to lower-wage countries is also invoked to explain the long decline in Australian manufacturing. In reality, however, there is no evidence that deindustrialisation of the sort experienced in Australia is either universal or inevitable, even for a developed, higher-income economy. Globally, manufacturing is growing, not shrinking. The idea that Australia is inevitably moving to a "post-industrial" economy, in which manufacturing no longer matters, is false. In fact, Australians consume more manufactured goods every year. Australia's purchases of manufactured goods now total some $565 billion per year. The problem is that Australia produces much less, in aggregate, than it uses. In fact, in aggregate, Australia now produces only about two-thirds (68%) as much manufactured output as the country consumes.[10]

[10] Stanford (2020) shows that the imbalance between Australia's consumption of manufactured products, and the smaller amount of manufactured output which it produces, is greater than for any other OECD economy.

Manufacturing carries a unique strategic importance to the performance of the overall national economy. As summarized in Table 4, for several qualitative reasons (including innovation intensity, export intensity, productivity, and its role in anchoring long and diverse supply chains), a strong domestic presence in manufacturing underpins broader economic and social well-being. This provides government policy-makers with ample rationale for pro-active measures to ensure that the domestic economy retains a healthy, proportionate manufacturing footprint.

**Table 4**
**The Strategic Importance of Manufacturing**

| | |
|---|---|
| **Innovation** | Australia's manufacturing industry re-invests 5 percent of GDP in new research and development, more than any other sector in the national economy. Manufacturing is an essential proving ground for the application of new product and process innovations, and manufactured capital goods are essential for the implementation of innovation in other sectors. A country cannot be an innovation leader without a strong domestic manufacturing capability. |
| **Productivity** | Productivity growth in Australian manufacturing has exceeded national average rates by one-fifth over the past quarter-century. Productivity is especially strong in capital-intensive advanced manufacturing sectors (including primary aluminium manufacturing). High and growing productivity provides a strong foundation for strong incomes and tax revenues. |
| **International Trade** | Manufacturing is an inherently export-intensive form of economic activity: manufacturing accounts for 40 percent of all Australian exports, far in excess of its 6 percent share of total GDP. A country without a viable manufacturing sector is prone to chronic trade and payments deficits (as Australia is experiencing at present), because it is effectively shut out of two-thirds of world exports. |
| **Supply Chains** | Australian manufacturers purchase $250 billion per year in inputs, supplies, and services from other businesses in all sectors and regions of Australia's economy. By "anchoring" complex supply chains, major advanced manufacturing facilities sustain production, jobs, and incomes far beyond their factory gates. |

Source: From Stanford (2020).

It is thus reasonable and realistic to set a goal of rebuilding domestic manufacturing so that its aggregate output is broadly proportional to national use of manufactured products. If we define a "fair share" as being a level of total manufacturing output that broadly matches (in aggregate value) Australian consumption of manufactured

products, then domestic manufacturing output would need to expand by almost half to match domestic purchases. In this context, retaining high-value manufacturing facilities like the Tomago smelter takes on a strategic importance far beyond the direct jobs and output that it supports. Supporting the modernisation and continued operation of "anchor" assets like Tomago will be critical in any successful effort to reverse the overall trajectory of Australian manufacturing.

# ENVIRONMENTAL ASPECTS OF ALUMINIUM PRODUCTION

The need to quickly reduce greenhouse gas emissions from all parts of Australia's economy is indisputable, and must now be a key criterion in all economic decision-making. Australia's recent adoption of a net-zero carbon emissions target for 2050 (although not yet backed with a credible plan for meeting it) provides further confirmation of the accelerating energy transition. When it consumes electricity generated from burning fossil fuels, aluminium manufacturing is a major emitter of carbon dioxide and other greenhouse gases. Three of Australia's four remaining aluminium smelters presently purchase electricity from utilities which still largely rely on coal-fired generation, while one (in Bell Bay, Tasmania) utilizes hydroelectric power. As a result, Australia's smelting industry emits more greenhouse gases per tonne of output than the worldwide average.[11] In addition, electrolytic smelting directly releases carbon dioxide and other greenhouse gases (including perfluorocarbons) in smaller quantities.[12] Aluminium producers have made significant investments in pollution abatement in recent years, including measures (such as cogeneration power systems, and greater efficiency in electricity use) to reduce greenhouse gas emissions. Nevertheless, emissions associated with aluminium production (mostly tied to the use of fossil fuels for electricity and heat) are still significant.

Simply closing down aluminium smelting in Australia in hopes of reducing carbon emissions is neither a feasible nor effective response to this problem. There is no guarantee that smelter closures would reduce total coal-fired electricity generation in Australia: that would depend on decisions made in the broader electricity system regarding allocation of the resulting excess power supply. Instead, removing the large base levels of power demand arising from smelting operations could slow the introduction of new renewable power sources. From a global perspective, meanwhile,

[11] See Butler (2020), p.2, n.7.

[12] Carbon anodes used in smelting cause the release of some non-energy-related carbon dioxide; the use of new "inert anode" technologies, now being installed in some smelters around the world, significantly reduces that secondary source of greenhouse gas emissions from aluminium smelting.

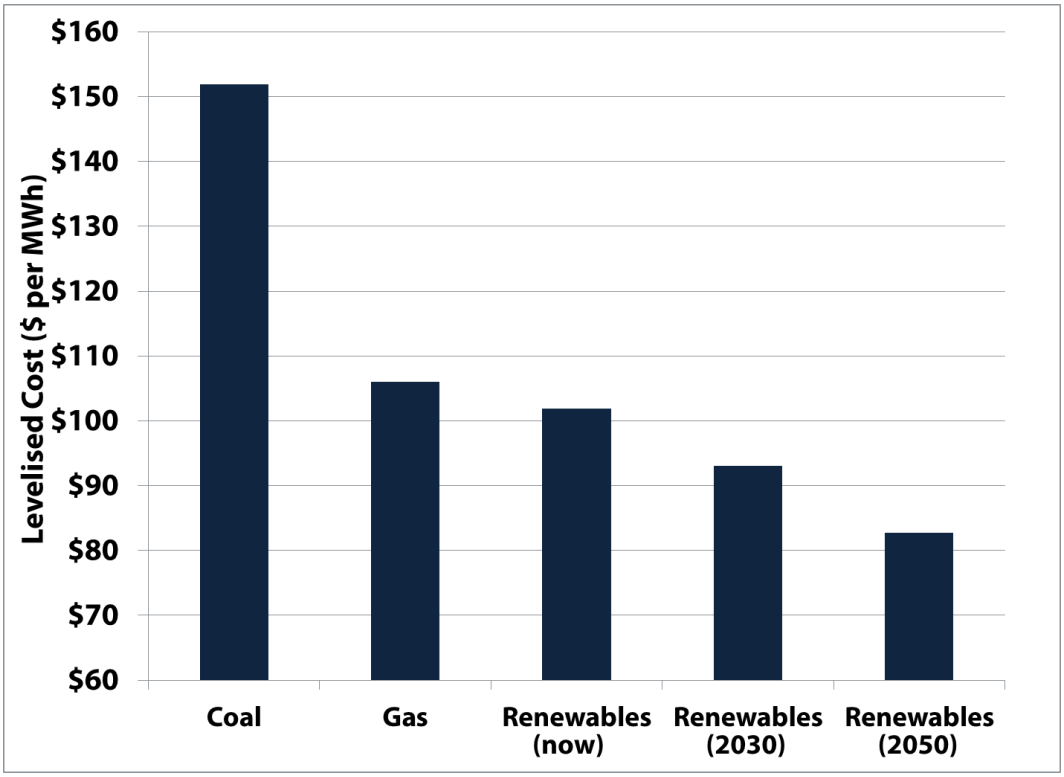
the impact of smelter closures in Australia on global emissions is also doubtful. Most countries which are adding new aluminium smelting capacity also rely on fossil fuels (coal or oil) to generate most or all of their electricity. Closing aluminium facilities in Australia, and shifting global production to China, India, or the Middle East, would have no positive impact on global emissions from the industry – and more likely a negative impact.

The Tomago smelter presently accounts for about 10% of all electricity consumption in the state of NSW, with demand during normal operations of 950 MW. It purchases its electricity through a firm long-term power contract with AGL, set to expire in 2028. That supply is normally underpinned by output from Australia's largest coal-fired power generation station, at Bayswater (100 kilometres northwest of the smelter). Reliance on coal-fired electricity for any use is no longer reliable, competitive, or sustainable. Indeed, the status quo is not an option for supplying Tomago with reliable, competitive power for many reasons, not just environmental concerns. The failures of electricity privatisation, supply disruptions from coal-fired plants, and uncertainty in Australia's energy and climate policy framework have together caused dramatic increases in industrial electricity prices, and repeated disruptions in reliability of supply – and no sector has paid a higher price for the failures of energy policy than the aluminium industry. The rapid transition to renewable energy is thus central to any plan to the long-term viability of the Tomago smelter.

Moreover, the aluminium industry is also being pushed by its customers to transition quickly to renewable energy sources. Leading purchasers now require suppliers to meet stringent emission-reduction targets (Lord, 2019); this includes key customers in the automotive (such as Toyota), electronics (Apple), and packaging (Tetra Pak) sectors. Aluminium suppliers which can comply with requirements for lower supply chain emissions command greater market access and premium prices. Those that cannot, will be squeezed out of global competition. In this light, a prompt and well-planned transition to renewable energy is a necessary prerequisite for the future viability of aluminium production.

Luckily, the parameters of Australia's electricity system are fundamentally and rapidly transforming, creating opportunities for the domestic aluminium industry to reposition itself as a clean and sustainable supplier. The cost of installing new renewable energy generation facilities is declining rapidly as a result of technological advances, production efficiencies, and economies of scale in manufacturing and installation. As illustrated in Figure 10, there is now widespread agreement that renewable energy offers the lowest-cost alternative for future generation (see also Graham et al. 2018, Garnaut 2019, and Ellsmoor 2019). And electricity prices in Australia are now declining because of the lower cost and growing penetration of renewables (Karp, 2020).

**Figure 10. Electricity Costs by Generation Mode**




Source: Authors' calculations from Graham *et al*. (2018). Includes levelised capital costs, costs of 6 hours storage for renewables, and 5% risk premium on fossil fuels. Figure presents averages of low and high cases for each fuel, and an average of solar and wind for renewables.

While the inconsistency and uncertainty of energy policy in Australia (especially at the Commonwealth level) have slowed down this transformation, creating frustrating and needless uncertainty among investors, the growing economic advantages of renewable energy sources are nevertheless overcoming this policy confusion. Hence the market share of renewables is growing rapidly despite policy confusion and backflips. From around one-quarter of total electricity generation at present, the share of renewables is projected to exceed 50% by 2030 (Clean Energy Council, 2021; Richard, 2019). New South Wales has an especially ambitious plan to accelerate the transition toward renewable energy (as part of a state plan to reduce greenhouse gas emissions by 50% below 2005 levels by 2030).[13] This includes the phase-out of coal-fired electricity generation by 2030, and projections that renewable energy will account for 65% of all electricity generation in the state by 2030 and nearly 90% by 2040.[14]

Even by simply buying power from the integrated statewide grid, therefore, more than half of Tomago's power needs would effectively come from renewables by 2030. And

[13] See Mazengarb (2021b).

[14] See NSW Dept. of Planning, Industry and Environment (2020).

the reliability and cost competitiveness of the overall electricity system is improving steadily, thanks in large part to the rapid expansion of renewable energy sources. In its latest supply forecasts, the Australian Energy Market Operator (AEMO) sees adequate supply forthcoming from existing and committed projects in NSW, with the result that a previously-expected "reliability gap" in state electricity supply in the coming 5 years is no longer foreseen.[15] And forthcoming new supply from renewable sources will be capable of ensuring reliable supply-demand balance in subsequent years, as well. NSW's strong state-level energy planning policy, described in the *NSW Electricity Infrastructure Roadmap*,[16] provides an additional level of confidence in future power supplies. Under this plan, after 2023 the state will purchase all energy in several identified Renewable Energy Zones (REZs) through long-term agreements reached with both generators and storage providers. This commitment provides a stable foundation for planning future additions to renewable generation capacity, as well as investments in complementary storage and firming systems. The latest cost forecasts developed by AEMO and CSIRO confirm that even after including costs for renewable power firming (through batteries and pumped hydro), renewable energy will generate significant cost savings for power consumers as the energy transition continues.

This overall energy market regime thus provides an improving and attractive context for Tomago to proceed with its transition to renewable energy sources. The smelter has already announced its goal to utilise effectively 100% renewable power for its operations by 2030.[17] But additional, pro-active efforts by the smelter, power companies and government regulators can accelerate that transition, and provide additional certainty regarding the adequacy and reliability of supplies of renewable power in the future. Achieving this goal, essential to the long-run viability of the smelter, will require active support from government – particularly to facilitate necessary investments in power storage and firming, and the capacity and reliability of the electricity grid. Those are the key operational challenges that must be overcome to ensure stable, reliable, renewable power for the smelter.

Recent technological and economic developments have disproven false stereotypes that large industrial plants cannot reliably operate on renewable power. Improved storage technologies and firming capacity, and stronger integration into an upgraded regional grid, allow large industrial users to reliably operate on renewable power. Other major metal manufacturing facilities have already transitioned to renewable power in Australia (such as the renewed Whyalla steelworks in SA, and the Sun Metals facility in Queensland). International experience further proves it is both

[15] See AEMO (2021).

[16] See NSW Dept. of Planning, Industry and Environment (2020).

[17] See Cox (2021) and Macdonald-Smith (2021).

technologically feasible and financially attractive to operate major industrial facilities on the basis of renewable energy. Australia's unmatched endowment of renewable energy should constitute a critical competitive advantage as this transition continues – but only if all stakeholders, including government, are pro-active in supporting and accelerating the roll-out of renewable energy capacity and corresponding improvements in grid infrastructure and firming systems.

Some critical preconditions must be met for the transition to renewable energy at Tomago (and other heavy industrial users) to be secure and successful. A critical one is the development of firming resources to stabilise renewable supply, given natural fluctuations in solar and wind conditions. Rapid improvements in the capacity and cost competitiveness of batteries are very helpful in meeting this challenge. So is the enhanced potential of pumped hydro systems as another technique for firming renewable power supplies. Investments in stronger grid infrastructure will further stabilise the flow of energy from dispersed renewable power sources. The transition of the Tomago smelter to renewable energy is thus technically feasible and economically essential. But the scale and technical challenges of this transition should not be underestimated. The state and Commonwealth governments will need to actively support investments in new renewable energy supplies, firming resources, and grid connectivity through a range of fiscal and regulatory interventions.

By accelerating Tomago's transition to renewable energy supply, governments would also provide an enormous boost to the expansion of renewable energy across the state's entire power system. Achieving long-term supply arrangements with a user of Tomago's importance would lift the renewable energy sector to a new critical mass. Economies of scale associated with supply commitments of this magnitude, and the spillover benefits to the whole grid arising from complementary investments in firming capacity and grid stability, would reinforce NSW's rapid transition toward renewable energy – which the state government has set as a central goal of NSW's future economic development.

An additional, symbiotic benefit the Tomago smelter can offer in this regard is its potential role in demand management practices. Strong and flexible demand response measures help to offset fluctuations in power supply or demand, and thus stabilise the electricity system in the face of variability from other consumers or power supply sources (including variable renewable sources). New technology allows heavy industrial users – like aluminium smelters, the biggest electricity consumers in the economy – to support demand response by temporarily reducing their own large

demands on the grid, but without damaging capital equipment.[18] The ability to reduce demand for several hours provides a valuable service in stabilising the supply-demand balance in the overall power grid. Ideally the smelter should be compensated for this service – thus creating an important new revenue source which would further enhance its financial viability.[19]

In sum, integrated planning between the smelter, energy suppliers, and state and national regulators could ensure that Tomago's continued operation becomes a leading and practical example of how Australia's manufacturing industry can take advantage of abundant renewable energy resources to rebuild its competitive position in global manufacturing.[20]

[18] Previously, even relatively short interruptions in power risked hundreds of millions of dollars in damage to aluminium smelting equipment due to the solidification of molten product in the absence of power. See Butler (2020), Ludlow (2019), and Parkinson (2020) for more detail on the potential of interruptible power use by smelters in stabilizing the electricity system.

[19] An arrangement paying the smelter for commitment to reducing power need when needed has recently been concluded involving Alcoa's Portland smelter in Portland, Victoria (see Mazengarb, 2021a).

[20] Nahum (2020) surveys various dimensions of the use of renewable energy as a source of competitive advantage for Australian manufacturing.

# IV. The Tomago Smelter and its Regional Importance

The Tomago aluminium smelter is an independently-managed joint venture company owned by Rio Tinto (the majority owner), Gove Aluminum Finance (itself a joint venture of CSR and AMP), and Norway's Norsk Hydro. The smelter employs about 1140 workers (including direct employees and contractors), who receive total wages, salaries, and benefits exceeding $100 million per year. Compensation in the facility is significantly higher than average earnings in other jobs, reflecting the high productivity and capital intensity of the work. The smelter is the largest of the four remaining smelters in Australia, with annual output of 590,000 metric tonnes per year. Most of the facility's output (about 90%) is exported by ship to offshore markets, primarily in Asia. Summary data on the Tomago smelter is provided in Table 5.

**Table 5**
**Tomago Aluminium Smelter, Key Parameters, 2021**

| | |
|---|---|
| Facility | Tomago Smelter |
| Location | NSW |
| Product | Aluminium ingots |
| Physical Output | 590,000 t/yr |
| Approx. Unit Price (2020-21, $A) | $2750/t |
| Value of Gross Output | $1.6 billion/yr |
| Proportion Exported | 90% |
| Employment[1] | 1140 |
| Wages, Salaries, and Benefits Paid ($A) | >$100 million/yr |
| Electricity Purchases | 8300 GWh/yr |
| Main Inputs | Electricity from AGL (Bayswater)<br>Alumina from QAL (Gladstone, QLD)<br>Bauxite from Weipa, QLD |

Source: Author's compilation from company reports, Dept. of Industry, Science, Energy & Resources (2021), Butler (2020).
1. Includes contractors.

The Tomago smelter makes a vital contribution to the economy and labour market of the whole Hunter region. Manufacturing is one of the most important sources of employment in the Hunter, accounting for 22,700 jobs as of August 2021. As indicated in Table 6, manufacturing employment has increased in the Hunter over the past five years. However, that expansion only partly offsets previous larger losses in manufacturing work in the region. Indeed, over the previous decade, the Hunter and Newcastle SA4 regions together lost more manufacturing jobs than any other region in Australia (Hunter Jobs Alliance, 2021). And the share of manufacturing employment in the Hunter region's total employment has also declined: from around 12% of all regional jobs a decade ago, to just 7% today (now roughly equivalent to the overall average for Australia).

**Table 6**
**Employment by Sector, Hunter Region**

| Sector | Employment (August 2021) | 5-Year Change (%) |
|---|---|---|
| Health care and social assistance | 54,000 | +14.3 |
| Retail trade | 42,000 | +47.5 |
| Education and training | 27,500 | +9.9 |
| Construction | 26,600 | -3.9 |
| Hospitality | 23,600 | -16.4 |
| Pro., scientific and technical services | 23,200 | +21.1 |
| Manufacturing | 22,700 | +20.6 |
| Public administration | 17,900 | +22.3 |
| Mining | 14,300 | -15.4 |
| Other services | 13,500 | +4.4 |
| Transport | 13,000 | +3.0 |
| Administrative and support services | 9,900 | -16.0 |
| Finance and insurance | 7,500 | -32.9 |
| Arts and recreation | 6,700 | +6.5 |
| Wholesale trade | 5,800 | -10.0 |
| Utilities | 5,200 | -5.0 |
| Agriculture and forestry | 4,400 | -41.7 |
| Rental and real estate | 3,900 | -21.3 |
| Information, media and telecom | 1,300 | -17.9 |
| **TOTAL** | **323,100** | **+5.2** |

Source: Labour Market Information Portal, Employment Region Profiles.
Includes Newcastle, Hunter Valley, and Lake Macquarie SA4 areas.

Securing existing manufacturing jobs (including at Tomago), and stimulating new industrial job-creation, are vital priorities for the region's economic and social development. Hundreds of smaller businesses in the Hunter region depend, directly or

indirectly, on the continued operation of the Tomago smelter: as a source of business, as a magnet for specialized skills and services, and to cover a significant portion of the fixed costs of local infrastructure and utilities.

In addition to manufacturing, other important employing sectors in the Hunter include health and social services; retail; education; construction; hospitality services; and professional and technical services. But many of these other sectors depend ultimately on the presence of local "anchor" industries (like aluminium smelting) in order to justify and support their continued operation in the region. Without the initial spur to employment, income, and spending power which arises from facilities like the Tomago smelter, there would not be an adequate economic base to support regional activity in restaurants, home building, or schools and hospitals. In short, the continued operation of these "downstream" employers clearly depends on the continued presence of anchor facilities like the smelter.

**Table 7**
**Socio-Economic Parameters, Hunter Region**

| Indicator | Hunter | Australia | Difference |
|---|---|---|---|
| Population Growth 2015-2020 (%) | +6.0% | +7.9% | -1.9 %pts |
| Working Age Population (15-64), 2019 (% total) | 63.0% | 65.4% | -2.4%pts |
| Net Inward Migration 2020 (% population) | +1.1%[1] | +0.8% | +0.3 %pts |
| Overseas-Born Population 2016 (% total pop.) | 10.3% | 25.4% | -15.1%pts |
| Labour Force Participation Rate August 2021 (%) | 63.2% | 65.2% | -2.0%pts |
| Unemployment Rate, August 2021 (%)<br>Total<br>Youth | <br>4.7%<br>13.4% | <br>4.5%<br>10.7% | <br>+0.2%pts<br>+2.7%pts |
| Average Employment Income 2018 | $60,293 | $62,063 | -2.9% |
| Manufacturing Employment (% total), 2020 | 7.0% | 7.0% | - |
| Ratio of Business Entries to Exits, 2017-2020 | 1.22 | 1.22 | - |
| Median Residential Price 2019 ($)<br>House<br>Attached | <br>$548,000<br>$458,000 | <br>$545,000<br>$490,000 | <br>+0.6%<br>-6.5% |

Source: Authors' calculations from Labour Market Information Portal and ABS data.
1. Includes internal migration (70% of total) and international migration (30%).

In sum, a critical “anchor” employer like the Tomago smelter supports a much wider network of local jobs, incomes and spending throughout the Hunter region. Aluminium smelting boosts household incomes; generates hundreds of millions of dollars in revenue for local governments; generates massive purchasing power for local businesses; and provides attractive economic opportunities that help to deter the outmigration of young people that afflicts many regional communities in Australia. There is no doubt that decisions regarding the future of the aluminium operation will be a crucial factor in the future economic evolution of the whole Hunter region.

# V. Upstream and Downstream Linkages of Aluminium Manufacturing

A major capital-intensive manufacturing facility like an aluminium smelter plays a crucial role in "anchoring" a broad range of economic activity in its host region, and in the country as a whole. These facilities secure many jobs in related sectors – in addition to the high-quality jobs directly created within the anchor facility itself.

**Figure 11. "Anchor" Industries and their Linkages**

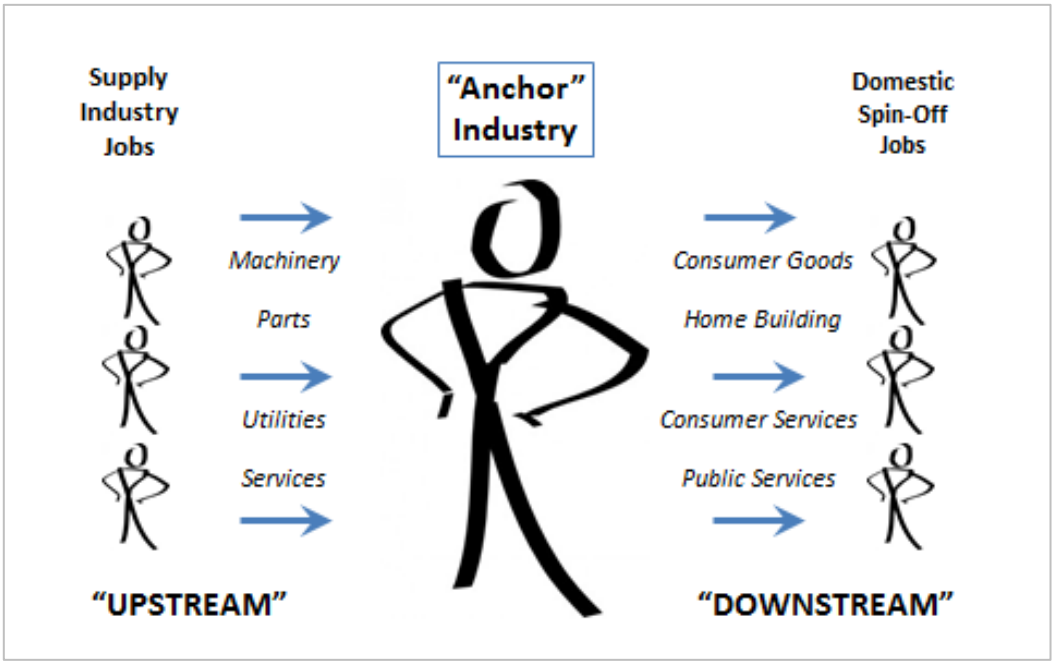



Figure 11 illustrates the linkages between an anchor facility and the various indirect jobs which depend on that facility for their own survival. One category of indirect jobs includes those located "upstream" from the anchor industry: in the numerous supply and service sectors which sell inputs (including raw materials, parts, machinery, utilities, and services) to the anchor facility. Another set of indirect jobs is found "downstream": in the various consumer goods and services industries which require an initial population of employed workers nearby to serve as their own market. When those workers subsequently spend their earnings – on everything from homes to consumer goods to private services (like restaurants and dry cleaners), and even

supporting public services from their tax payments – they create the economic foundation for thousands of downstream jobs.

The economic impact of aluminium production thus extends far beyond the confines of the smelter. Because this industry purchases a rich and diverse portfolio of inputs from dozens of different supply industries, Australians in all broad segments of the economy, and all states in the federation, receive incremental business and income from the industry's presence and activity. Table 8 summarises the main upstream industries which supply non-ferrous primary metal production, including aluminium, nickel and zinc.[21] For each major supply industry, Table 8 reports the total business generated by sales to producers of aluminium and other non-ferrous metals, and the number of jobs supported by those sales in each sector.

**Table 8**
**Non-Ferrous Metal Manufacturing, Output and Key Inputs, 2016-17**

| Industry | Sales/Purchases ($m) | Supported Employment[1] |
|---|---|---|
| ***Non-Ferrous Metal Manufacturing*** | **39,888** | **13,277** |
| ***Major Input Purchases:*** | | |
| Mining & Refining | 23,430 | 17,075 |
| Other Manufacturing | 214 | 490 |
| Electricity Generation and Transmission | 1,676 | 904 |
| Other Energy | 1,791 | 680 |
| Transportation | 1,330 | 4,841 |
| Other Services & Suppliers | 823 | 2,891 |
| ***Total Domestic Supply Chain Purchases*** | 29,264 | 26,881 |
| ***Imported Supplies*** | 7,048 | |
| ***Domestic Value-Added*** | 3,459 | |

Source: Compilation from Australian Bureau of Statistics Catalogue 5209.0.55.001, 2016-17, and 8155.0.
1. Includes direct inputs only (excluding employment associated with indirect linkages to higher-order suppliers). Estimated based on average sales/employment ratios for each supply industry.

[21] Australia's input-output statistics group all non-ferrous primary metal industries into a single category, making it impossible to differentiate aluminium smelting from the other metal groups. See ABS Catalogue 5209.0.55.001. The input-output structure of the aluminium sector is not perfectly representative of broader non-ferrous metals production (it is somewhat more energy intensive, for example), but this approach constitutes a legitimate

Of course, the biggest single input to aluminium smelting is bauxite (initially refined into alumina). Electricity is another major purchase. But in total there are 68 different goods and services industries (as defined by the Australian Bureau of Statistics) that supplied at least $1 million in the 2016-17 financial year to non-ferrous metal manufacturing). Total supply chain purchases by non-ferrous primary metal firms in 2016-17 equaled almost $30 billion. And in turn, an estimated 27,000 jobs depend on those input purchases – twice as many as the 13,000 direct jobs present in basic non-ferrous metal production itself.

Moreover, this still does not paint the entire picture of the supply chain linkages of aluminium manufacturing. Keep in mind that every supply industry requires its own input and supply purchases – which in turn support output and employment in the various industries which they purchase from. Presumably a proportionate share of that higher-order supply activity is also therefore dependent, ultimately, on the initial presence and activity of the aluminium industry. We can differentiate the tiers of supply purchases by referring to the immediate input activity as "Tier 1" (suppliers which sell their product directly to the anchor facility), while using "Tier 2" or higher to refer to higher-order linkages (the suppliers to suppliers).

Meanwhile, the downstream spending of workers employed in aluminium production – as well as all the industries which supply aluminium production – also support further activity and employment across the consumer goods and services industries which depend on the purchasing power of average Australians. That includes private consumer goods and services businesses, as well as public services financed with tax revenues collected from those workers and industries.

An approximate indication of the scale of downstream economic activity that depends on aluminium manufacturing, and its supply chain, can be developed according to the following logic. Household final consumer spending in Australia accounted for 55 percent of Australian GDP in the last full calendar year before the COVID-19 pandemic (and resulting recession). Government final consumption (consisting of the direct services provided by government) accounted for another 19 percent.[22] A significant share of consumer spending, and a small share of government services, is directed toward imported products (and hence does not translate into new expenditure on Australian-made goods and services). Applying the same average import propensity (21 percent) as applies to Australian GDP in aggregate, this implies that 58 cents of each dollar in incremental aggregate output (GDP) will tend to show up in domestic consumption expenditure (both private and public) on Australian-made goods and

[22] All data in this section reflects authors' calculations from ABS National Income Accounts.

services.[23] So whatever level of direct and indirect activity is supported by an anchor industry and its supply chain, there will be an additional volume of output and employment (often termed "induced" economic activity) generated by the subsequent downstream expenditure of people employed in those industries. That downstream expenditure will immediately accentuate the initial boost to employment and income resulting from the anchor industry and its suppliers by a factor of almost 0.6. And once again, that is only the first-order effect of the downstream linkages: individuals employed in those downstream sectors, will in turn spend their own incremental incomes, further amplifying the ultimate spin-off effect of the initial activity.

Combined, these "upstream" and "downstream" linkages generate a multiplied overall impact from aluminium production equal to 4 or more jobs in total, for each direct job in an aluminium smelter. Of course, some argue that if aluminium smelters closed, displaced workers would eventually be reabsorbed into other jobs. But that will not happen smoothly or quickly, especially in a macroeconomic environment in which overall output and employment are still suppressed by the continuing effects of the COVID-19 pandemic.

# FISCAL LINKAGES

Public services are among the downstream industries that depend on the initial existence of an anchor industry, like an aluminium smelter. Those services are supported by incomes generated by the anchor industry and its suppliers, expressed through tax revenues collected from the resulting incomes, expenditures, and profits. In a region like the Hunter, the aluminium smelter (and other anchor businesses in the community) underpin both the demand for public infrastructure and services, and the community's financial capacity to pay for them.

Here we review the various channels through which an anchor industry like aluminium smelting, and its suppliers, contribute to the fiscal capacity of all levels of government in Australia – thus enhancing the capacity to provide public services and infrastructure. On average in Australia, about 37 cents of every dollar in GDP ultimately shows up in gross revenues of government: 13 cents is received by state and local governments, and over 24 cents by the Commonwealth government.[24] Of course, these ratios

[23] More precisely, in 2019 the sum of the average private consumption propensity (55 percent) and government consumption propensity (19 percent) times 1 minus the aggregate import propensity (21 percent) equals 58 percent.

[24] Includes non-tax revenues; this ratio of state and local revenues excludes transfers received from the Commonwealth. Authors' calculations from ABS data.

| Table 9<br>Aluminium Manufacturing and Government Revenue Streams | |
|---|---|
| **Revenue Stream** | **Rate** |
| ***Commonwealth Government*** | |
| Personal Income Tax (employees) | Up to 45 percent |
| Medicare Levy (employees) | 2 percent |
| Fringe Benefit Tax (employer) | 47 percent |
| Corporate Profit Tax (employer) | Up to 30 percent |
| Goods and Services Tax (employees on spending) | 10 percent |
| Regulatory Fees & Licenses (employer) | Various |
| Excise and Customs Duties (both) | Various |
| ***State Government*** | |
| NSW State Payroll Tax (employer) | 4.85 percent |
| icare Workers' Compensation Premium (employer) | 1.44 percent |
| Land Taxes & Stamp Duties (both) | Various |
| Insurance, Motor Vehicle, and Other Taxes (both) | Various |
| ***Local Government*** | |
| Rates Paid by Residents (employees) | Various |
| Rates Paid by Companies (employer) | Various |
| User fees for local services (both) | Various |
| ***Aggregate Revenue Ratio (2019-20)*** | |
| Commonwealth | 24.2 percent of GDP |
| State and Local[1] | 13.6 percent of GDP |

Source: Author's compilation from Australian Bureau of Statistics and various government sources.
1. Excludes transfers from Commonwealth.

represent the composite effects of a wide variety of different tax and revenue streams. Table 9 lists some of the more important government revenue flows affected by the presence or absence of aluminium manufacturing in Australia.

The provision of local government services in the Hunter depends especially directly on aluminium smelting, and the various taxes and fees paid to local and regional authorities by the smelter, its suppliers, and employees. But even the services provided by higher levels of government also depend on the incomes and revenues generated by the facility. We will apply the aggregate fiscal ratios reported in Table 9 to the estimates of total economic impact developed in the next section of this report, to describe the extent to which the public sector's fiscal position is strengthened by the continued operation of the Tomago smelter.

# VI. Estimating the Aggregate Economic Impacts of the Tomago Smelter

This section considers the total impact of aluminium smelting in Tomago on the overall economic and employment performance of the region, the state of NSW, and Australia as a whole. The analysis will incorporate and integrate the various categories of linkages introduced above: including direct, indirect (supply chain or "upstream"), and induced ("downstream") activity and employment.

Other published research has estimated the overall economic impact of aluminium manufacturing, on the basis of input-output parameters and upstream and downstream linkages. The results vary, depending on the scope of the defined industry (is the anchor industry defined as aluminium smelting only, or does it include other activities such as secondary fabrication?), the geographic scale of analysis (does the analysis consider just the immediate region around the anchor facility, or broader national spill-over effects?), and the types of upstream and downstream linkages incorporated into the analysis (does it include only Tier 1 suppliers, or higher-order supply chain linkages?).

One national-level study especially relevant to the present discussion was conducted for the Aluminum Association in the U.S. (Dunham, 2016). It defined the aluminium industry broadly, including smelting and a wide range of less capital-intensive secondary fabrication and service activities; it included only Tier I supply chain relationships, and relatively modest downstream expenditure effects.[25] It estimated that the ultimate impact on U.S. GDP of aluminium production totalled $186 billion (U.S.), or 2.5 times the direct GDP produced by aluminium producers. Total employment dependent on the sector was estimated at over 700,000 positions, or about 4.4 times the direct employment in the (broadly defined) aluminium manufacturing sector. Other studies have estimated the impact of aluminium manufacturing within smaller regions or states.[26] In general, the smaller is the geographical area considered in the analysis, the smaller will be the estimates of final

[25] In this study downstream spending stimulated by aluminium producers and their Tier 1 suppliers increased total output by a factor of 0.35, but increased total employment by a larger multiple (0.69) – reflecting the greater average labour-intensity of downstream consumer industries.

[26] See, for example, Conway (2006), Flynn (2005), Kunin (2003), and Von Nesson (2015).

economic impact, by virtue of the greater "leakage" of supply-chain and downstream expenditure effects out of the immediate regions to other parts of the national economy. In contrast, national-level studies capture more of these indirect and induced linkages, and hence tend to generate larger estimated impacts.

Research into the economic impacts of other capital-intensive manufacturing sectors, similarly incorporating a range of modelling methodologies, starting assumptions, and scopes, has produced similar findings. The general pattern of impact studies for manufacturing industries suggests that estimated upstream and downstream linkages tend to be stronger, when:

- The geographical scope of the analysis is larger (national rather than regional);
- The industry being considered is capital-intensive;
- The industry's supply chain is more extensive.

For example, the cross-sector survey of Australian manufacturing impact effects conducted by Dixon et al. (2012) finds especially strong impacts in capital-intensive industries (such as chemical, petroleum, pulp and paper, and basic metal manufacturing). Studies of the economic impact of automotive manufacturing also find very strong spillover effects, reflecting the complex supply chain of automotive assembly operations, and the very capital-intensive nature of its activity.[27] Given these previous findings, an impact study focused on aluminium smelting (the most capital-intensive segment of the entire aluminium value chain), conducted at a national level, would be expected to generate relatively strong spillover effects.

We now describe simulation results from a regionally-disaggregated macroeconomic model, constructed and operated by the National Institute for Economic and Industry Research (NIEIR). The model describes input-output flows on the basis of fixed coefficients; output and employment also respond to downstream aggregate demand conditions. The model can trace the impact of a key facility like the Tomago smelter on output and employment through all the supply chain industries which feed into that operation, as well as downstream impacts resulting from changes in consumer spending. Given widespread unemployment and underemployment in Australia, overall economic output is evidently constrained by weakness in aggregate purchasing power. In this demand-constrained context, the loss of direct and indirect jobs resulting from the closure of an anchor facility like the Tomago smelter would have a widespread and lasting impact on total employment: affecting not just the allocation

[27] Hill et al. (2015) and Barbaro and Spoehr (2014) report very strong upstream and downstream linkages for automotive manufacturing in the U.S. and Australia, respectively, with final supported employment (including direct, indirect, and induced effects) up to 8 times larger than original vehicle manufacturing employment.

of employment across different activities, but also its total quantity. The operation of the Tomago smelter thus makes a sustained contribution to overall employment and output. Its closure, by the same token, would have far-reaching and long-lasting consequences – and not just for a temporary period of adjustment, but rather for many years.

We contracted the NIEIR to simulate the direct, indirect, and induced economic effects resulting from the operation of the Tomago aluminium smelter. The NIEIR model features a high degree of regional disaggregation (down to the level of local government areas) and sectoral detail (providing information on output and employment in 86 different industries, broadly matching the same detail reported in the ABS input-output database).

The simulation results are produced by generating and comparing sequential solutions of the model. A "status quo" solution of the model is solved, to reflect the likely path of the economy given current conditions and knowledge. Then an impact estimate is generated by re-solving the model with a hypothetical change imposed within it: in this case, the model is adjusted to reflect a reduction in output of aluminium from the Hunter region corresponding to the hypothetical closure of the Tomago smelter. The incremental impact of the smelter is then estimated by the difference between the two solutions (one with the smelter operating, and one without it). The results are measured two years after a hypothetical closure, allowing for supply chain and demand responses (but not considering longer-run adjustments to the absence of this activity, such as changes in interest rates or exchange rates).

The main simulation case considered (labeled the "Base Case" in Table 10) desribes the incremental economic impact of the Tomago smelter alone. The simulation captures upstream and downstream linkage effects supported by the facility. National GDP is $1.2 billion per year higher as a result of the smelter's operation, and national employment is boosted by over 6000 positions. The total gain in national employment is five times larger than the number of people employed directly at the Tomago facility. ***This implies a consolidated employment multiplier effect of 5-to-1 associated with the smelter***; that is broadly consistent with the aluminium modelling results surveyed above. About 60% of the job impacts, not surprisingly, are experienced in NSW. However, because of the spillover impact on demand for bauxite and alumina produced in Queensland, that state also experiences significant gains from the operation of the Tomago plant (including over 800 direct, indirect, and induced jobs, and $117 million in GDP). The smelter lifts household disposable income by close to $500 million across Australia. Governments also enjoy significant revenues as a result of the plant's operation: direct state revenues in NSW (based on the average state revenue share in GDP) are boosted by $120 million per year, and the Commonwealth

government (which collects a much larger share of total GDP in various taxes) captures almost $300 million per year.

**Table 10**
**Base Case Scenario: Tomago Smelter Impacts**

| | NSW | Queensland | Other States | Australia |
|---|---|---|---|---|
| **GDP ($m)** | $882 | $117 | $230 | $1230 |
| **Employment** | 3641 | 833 | 1574 | 6048 |
| **Wages ($m)** | $377 | $85 | $147 | $609 |
| **Household Disposable Income ($m)** | $264 | $69 | $145 | $477 |
| **Consumer Spending ($m)** | $222 | $61 | $119 | $402 |
| **Direct Tax Revenue ($m)[1]** | $120 | $16 | $31 | $297 |

Source: Economic simulations as explained in text.
1. Estimated by application of aggregate tax ratios in Table 8 to GDP changes in first row. Australia column refers to Commonwealth level revenues only, not state revenues.

The Hunter region, of course, receives the largest and most direct benefits from the smelter. Our simulation results suggest that 1850 jobs, and over $100 million in household disposable income, are supported in the five local government areas[28] surrounding the Tomago facility.

These "Base-Case" simulation results confirm that the Tomago smelter holds national economic significance. This large, high-productivity, export-oriented, capital-intensive manufacturing facility supports visible gains in aggregate national economic indicators including employment, GDP, and government revenues. However, in practice it is possible that even more jobs and incomes depend on the smelter – and hence the ultimate impacts of its hypothetical closure could be even worse. Two major upstream facilities in Queensland depend on the operation of the Tomago facility for a significant share of their total sales: the Weipa bauxite mining operation in the far north of the state, and the QAL alumina refinery near Gladstone. It is possible that the closure of the Tomago smelter could have a domino effect on those facilities, which could

[28] Including Cessnock, Lake Macquarie, Maitland, Newcastle, and Port Stephens.

conceivably close entirely – not just lose a portion of their business (as was simulated in the base case above).[29]

In that event, described below as a "High Case" scenario (see Table 11), an even larger volume of total employment, output, and expenditure in Australia's economy (and especially in Queensland) are seen to depend on the continued operation of the Tomago smelter. The total increment to national GDP from the smelter, the refinery, and the mine is estimated at nearly $2.2 billion. Over 11,000 jobs are at stake in total. In the high case simulation, the impact on state GDP, disposable income, and employment is now almost as large in Queensland as in NSW. The Commonwealth government experiences a total revenue gain in excess of $500 million per year, and Queensland receives over $100 million in annual state revenue thanks to the smelter, the refinery, and the mine. The bottom-line economic impacts in NSW are also larger than in the base case simulation, since that state also captures indirect benefits from the upstream operations in Queensland – on top of the direct and indirect activity supported by the closure of Tomago.

**Table 11**
**High Case Scenario: Tomago / Weipa / QAL Impacts**

| | NSW | Queensland | Other States | Australia |
|---|---|---|---|---|
| **GDP ($m)** | $1044 | $765 | $369 | $2178 |
| **Employment** | 5066 | 3523 | 2511 | 11,100 |
| **Wages ($m)** | $587 | $370 | $237 | $1195 |
| **Household Disposable Income ($m)** | $408 | $244 | $221 | $873 |
| **Consumer Spending ($m)** | $344 | $224 | $181 | $749 |
| **Direct Tax Revenue ($m)[1]** | $142 | $104 | $50 | $527 |

Source: Economic simulations as explained in text.
1. Estimated by application of aggregate tax ratios in Table 8 to GDP changes in first row. Australia column refers to Commonwealth level revenues only, not state revenues.

In the event of a hypothetical closure of the Tomago facility then, the impact of knock-on downsizing or even closure at major supply facilities (including Weipa and QAL) would magnify the negative impact on the economy through Queensland and the

[29] An alternative response would be for those operations to shift their sales toward export markets, but that depends on the ability to confirm foreign customers and displace existing suppliers of bauxite and alumina from those markets.

broader national economy. Perhaps most worryingly, in the absence of another aluminium smelter (and potentially other facilities upstream), the ongoing retreat of Australia from value-added aluminium manufacturing would be accelerated. Australia's aluminium footprint would then become even more intensely focused on the extraction and export of raw, unprocessed resources – abandoning the value-added work of refining, processing, and manufacturing to other countries. With the critical mass of value-added aluminium manufacturing in Australia already in jeopardy, those knock-on effects could be catastrophic for the whole sector.

# VII. Conclusions and Policy Recommendations

Aluminium manufacturing in Australia, despite the challenges it has faced in recent years, remains an important, value-added industry that makes far-reaching contributions to national employment, incomes, exports, productivity, and fiscal capacity. The demand for aluminium products is growing over time, and will continue to do so – for many reasons, including the superior environmental properties of the metal. The environmental footprint of aluminium production can be reduced as part of a broader strategy to develop sustainable, secure energy supplies. This is an industry that will become more important in the future, not less. Other countries have responded to volatility in aluminium markets with active policy interventions to support domestic producers, until a more stable and economically rational balance in the global market can be achieved. These interventions include trade policy (such as anti-dumping actions against Chinese aluminium imports in the U.S., and China's export-stimulating changes in tax policy), direct and indirect assistance to aluminium producers, public equity injections, supportive energy supply actions, favourable domestic procurement rules, and more.

Australia can and should remain a significant player in global aluminium manufacturing. A strong natural resource base, an unmatched endowment of renewable energy, industrial experience and capability, strong innovation potential, and an important domestic market all justify such a role. The fundamental question is whether Australia's presence in this industry will be limited to the extraction and export of non-renewable ore, or whether the country can build a more diversified and value-adding economy.

After several years of instability and downsizing, Australian aluminium manufacturing (at all stages, from refining to smelting to fabrication) is fragile. The industry cannot afford the loss of another critical facility. As described here, the continued operation of the Tomago smelter supports direct and indirect economic activities that are both regionally and nationally significant. It underpins significant increments in national output, employment, and export performance. It supports Commonwealth, state, and local government revenues – all the more vital at a moment when government needs every dollar to finance needed public services in the wake of the COVID-19 pandemic and recession. And the Tomago smelter supports thousands of jobs upstream in the aluminium supply chain (including major mining and refining facilities in Queensland).

Governments at all levels should take note of the deindustrialisation of Australia's aluminium activity, and the growing risks facing this industry in the future. If they agree that aluminium manufacturing is an activity that should be nurtured and supported (rather than neglected and allowed to wither away), there are numerous policy avenues for supporting the industry which could be explored:

## Commitment to renewable energy

Prospects for a viable, prosperous aluminium industry are now fully entwined with the imperative to expand reliable, affordable sources of renewable energy. Coal-fired electricity is one of Australia's largest sources of greenhouse gas emissions; renewable energy is now more competitive and reliable (as well as less polluting), and this provides further impetus for the phaseout of coal power. The owners of the Tomago smelter acknowledge this accelerating transition, and have set a goal of fully transitioning to renewable power by 2030. The aluminium industry's customers also demand this change, driven by their determination to ensure their overall supply chains make appropriate contributions to greenhouse gas reduction.

With a clear, stable commitment to roll-out of renewable energy sources from all the industry's major players (including smelters, power companies, and governments), transitioning aluminium production to renewable power is entirely manageable. And once in place, renewable power offers the promise of competitive and stable long-term energy. Unlike fossil fuel energy, renewable energy experiences no ups and downs in the price of its 'fuel' – removing an important source of volatility in energy-intensive industries like smelting. However, the transition to renewable energy poses important operational and financial challenges to the Tomago facility. Chief among these is the need to identify and contract future supplies of renewable power (from Tomago's existing supplier, AGL, and/or from new ventures by other power producers), and the corresponding need to ensure appropriate firming of those power supplies through technologies and back-up systems that are consistent with the overarching goal of greenhouse gas reduction.

Major advances in the technology and economics of large-scale batteries and pumped hydro open ample opportunities to partner future renewable power supplies to Tomago with consistent and sustainable back-up firming. Tomago's underwriting of long-term, large renewable power developments will support a faster expansion of renewable power for NSW's overall electricity system. With such an important and stable customer locked in as a foundation for new renewable power developments, renewable suppliers can then leverage expanded market share by winning other customers. And the economic feasibility of major investments in firming and grid

capability will be enhanced accordingly. A secondary benefit arising from aluminium smelting is its potential to provide flexible demand response capacities. The Tomago smelter's ability to substantially reduce consumption for temporary periods (in response to supply fluctuations or surges in demand arising from other customers) provides a stabilising buffer for managing supply and demand in the overall grid – one that should be recognised and rewarded through appropriate fiscal arrangements.

The NSW and Commonwealth governments should provide generous fiscal support for the energy transition which is critical to the future viability of the Tomago facility. That support could be delivered through various channels: including fiscal incentives to support the smelter's own capital spending to transition to renewable power; fiscal support for complementary investments in renewable energy resources (including firming facilities like batteries or pumped hydro); support for improvements to the reliability and connectivity of the state grid infrastructure; and revenue flows which reflect the smelter's participation in demand response systems. A first step in this process would be government support for technical assessments and investment planning to develop a consistent and viable plan for Tomago's transition to renewable power. This process should be guided by scientific and economic principles, not by political or ideological criteria.[30] In sum, the transition to renewable energy – in which Australia has unmatched advantages – is fully complementary to the goal of once again making Australia a global leader in aluminium manufacturing.

## Leveraging public infrastructure and procurement

Considerable demand for aluminium products will be forthcoming in future years as a result of the unprecedented investments of governments at all levels in new physical infrastructure: from transportation to utilities to public buildings. The business case for continued aluminium manufacturing in Australia can be incrementally strengthened through pro-active efforts to ensure that these public investments, financed ultimately by Australian taxpayers, result in maximum demand for Australian-made aluminium (and other domestically produced building products).[31] Traditional arguments that governments should simply purchase the 'cheapest' inputs for infrastructure investments and other public procurement, ignore the full-cycle impacts of government procurement decisions on employment, incomes, and tax revenues. By

[30] The Commonwealth government's politicization of energy policy-making has been especially disruptive to consistent transition planning. A current example is the government's misguided and politically-motivated drive to subsidise expanded use of gas.

[31] Stanford (2018) catalogues the various ways that pro-active government procurement, and other strategies for leveraging government buying power, can support stronger domestic job-creation and improved labour and social conditions.

leveraging public procurement spending into new opportunities in high-value domestic value-added industries (like aluminium manufacturing), the pro-active use of procurement as an industrial development tool can reduce the net integrated cost of these purchases (once the flow-back effects of local production are experienced, including through enhanced government revenues).

## Full-cycle financial support and public equity

The simulations above confirm that aluminium manufacturing generates important fiscal benefits for Australian governments at all levels: local, state, and Commonwealth. In this context, governments should be prepared to play an active fiscal role in ensuring the continued viability of the industry here. We have already highlighted the importance of fiscal support for the energy transition that will be vital to Tomago's long-term viability. But there is a strong case for broader government participation in capital improvements in the smelter, as well. Indeed, public equity investments were essential to the initial establishment of many aluminium manufacturing facilities in Australia in the first place.

With a direct payback through the tax revenues generated by incremental economic activity, this fiscal participation can genuinely be considered an investment – not a "handout." Taxpayers and budget deficits will both be worse off if aluminium manufacturing continues to migrate out of Australia. Fiscal support could be structured in many different forms (in addition to support for the renewable energy transition, described above). Tax incentives should be focused on leveraging incremental Australian investment and production; investment tax credits are an effective tool in this regard. Public equity co-investments, to support the recapitalization and modernization of existing facilities, could also be helpful. From a full-cycle cost-benefit perspective, considering the tax revenues returned to government through the industry's continued presence here, these initiatives could generate a healthy positive financial return to government – in addition to helping to preserve high-value jobs and incomes that are so vital to the future economic prosperity of the whole Hunter region.

## Value-added trade policy

Australian aluminium manufacturing (both primary smelters and secondary fabrication) has been negatively affected by rising aluminium imports (especially from China). This experience echoes the similar negative pattern experienced in recent years in the global steel industry. The Australian government must activate existing trade remedies to address dumped aluminium imports from China. Implemented in

concert with complementary measures by other countries (such as in the U.S.), this would send a strong message that overcapacity in China cannot be allowed to result in the destruction of this important industry elsewhere.

Trade policy can also be used to discourage the further deindustrialisation of Australia's aluminium footprint. As described above, Australia's exports of raw bauxite have boomed, even as production of smelted aluminium fell by one-fifth since 2009. Other countries (most recently including Indonesia and Malaysia) have imposed quantitative limits or taxes on exports of bauxite – to stimulate more refining and smelting within their own borders. The continuing deindustrialisation of Australia's aluminium industry needs to be similarly addressed, through fiscal measures which reward integrated value-added refining and smelting here in Australia (and discourage the export of raw bauxite). Merely ensuring that all Australian bauxite was at least refined into alumina here before export, would boost the alumina sector's annual output by $5 billion, and create 4000 jobs. Ensuring that the alumina, in turn, was smelted in Australia, would have even larger expansionary effects.

* * *

These are just several of the broad policy options available to governments to help nurture Australia's presence in this strategically important manufacturing sector. They require further analysis and development; and other policy responses could be added to the list. Ensuring the continued presence and modernisation of the Tomago smelter, linked to its transition to renewable energy supplies, is the most immediate test of government's willingness to play an active role in supporting value-added aluminium manufacturing.

There is no doubt that active government policy would make a positive difference to this industry's future Australian presence. The question is whether our political leaders have the foresight and determination to halt, and reverse, the damaging erosion of Australia's presence in this strategic sector.

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