The Economic, Fiscal, and Social Importance of Aluminium Manufacturing in Portland, Victoria

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September 2016
BRIEFING PAPER

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This report was prepared for the Australian Workers' Union, Victorian Branch.

The author thanks, without implication, David Richardson and Tom Swann for invaluable assistance with data gathering and analysis.

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Summary

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. Aluminium is an essential material in modern industrial society; indeed, its favourable properties (including its light weight, malleability, conductability, and recyclability) are driving steady expansion in its use, including for environmental reasons (such as the growing use of lightweight aluminium components to improve fuel efficiency in motor vehicles).

Australia has used its natural resource advantages and smart economic policies to become a global aluminium superpower. And one might assume that a combination of abundant natural resources, national industrial experience, and growing global demand would ensure a bright future for this important industry in Australia. Unfortunately, this is not presently the case.

Squandering Value-Added Opportunities in Aluminium

While our extraction of raw bauxite continues to expand, and Australia is consistently the world's largest bauxite miner, value-added manufacturing activity related to aluminium has declined in Australia over the last five years. Closures of one alumina refinery and two aluminium smelters have already dealt a serious blow to Australia's national capacity to add value to our abundant bauxite reserves. Australia still ranks (for now) as the second-largest world alumina producer, but we have fallen to sixth place in aluminium production – our lowest standing in decades. Meanwhile, the secondary fabrication and manufacture of aluminium products has also contracted, in line with the broader crisis in Australian manufacturing.

Australia's position in the global value chain associated with the production and use of aluminium, therefore, has become more precariously concentrated on raw resource extraction. We are forgoing the jobs, incomes, exports, and productivity that would be generated by adding more value to our bauxite resources.

The unit price of aluminium is more than 50 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 50 times as much? By reducing our downstream capabilities in aluminium manufacturing (including alumina refining, smelting, and secondary fabrication and manufacturing), Australia is shipping billions of dollars in value-added, and many thousands of jobs, to offshore jurisdictions.

The Future of the Portland Smelter

This problem could get even worse, as important decisions are made regarding the future operation of Australia's remaining value-added aluminium manufacturing facilities. One such facility is the aluminium smelter owned by Alcoa and several partner firms in Portland, Victoria. This facility has been an important anchor for economic activity in the remote southwest of Victoria for three decades. Its importance to regional employment, income, and fiscal well-being 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 input purchases) output and employment in dozens of industries in all parts of the country.

Policy-makers and the public at large need to be aware of the great economic, social, and fiscal importance of the Portland facility – for its own sake, and as a case study in the broader problem of deindustrialization which has so badly undermined Australian national economic performance over the last decade. Australia can ill afford to lose another crucial "anchor" in its already-fragile manufacturing base. The spill-over impacts of the closure of the Portland facility would be felt in all regions of Australia, including potentially catastrophic impacts in Western Australia if the closure of Portland resulted in the parallel closure of alumina refining capacity in that state.

This report reviews the recent negative trends in Australian aluminium manufacturing, placing them in the context of global, macroeconomic, and environmental challenges facing the industry. It describes the importance of the Portland facility to the regional economy and labour market of southwest Victoria. It documents the extensive linkages between the Portland operation and a wide range of other economic activities: including both "upstream" linkages to a myriad of firms which sell parts, inputs, and services to the facility, and "downstream" linkages which depend on the incomes and spending power of those employed in the aluminium industry and its extensive supply chain.

Presently the Portland smelter supports:

- 1500 direct and indirect jobs in the region.
- Over $65 million in direct wages and salaries.
- One-fifth of all rate revenue for local government (and more than that indirectly).

Clearly, this facility is an economic and social anchor for the entire southwest region of Victoria.

The Importance of Aluminium Manufacturing

This report describes the broad economic importance of the aluminium industry. The recent loss of value-added manufacturing facilities in this sector is all the more devastating, in light of the overall decline in Australian manufacturing.

Total manufacturing output in Australia has declined by 15 percent since 2008, and the sector has lost over 200,000 jobs. Australia now has the lowest proportion of manufacturing jobs, as a share of total employment, of any industrialized country. In this context, it is vital for the country to maintain and nurture those manufacturing industries which remain here.

Aluminium smelting continues to make a disproportionate contribution to Australia's industrial fabric:

- Aluminium smelting generates over $6.5 billion in annual shipments, close to $2 billion per year in value added, and supports 5000 relatively high-productivity and well-paying jobs.
- The industry supports a complex and far-reaching supply chain, which generates thousands of additional jobs in virtually all sectors of the economy, and all regions of the country. In fact, there are more Australians employed in industries that supply aluminium smelting, than work in the industry itself.
- The Portland smelter alone purchases $625 million per year in goods and services from other industries.
- Output of aluminium smelting has declined by 15 percent since 2010, partly as the result of two previous smelter closures. Aluminium production declined more in Australia over the past five years, than in any other OECD country; Australia is thus bearing a disproportionate share of the total burden of adjusting to challenging world market conditions.
- Aluminium smelting contributes crucially to Australia's international trade. About 90 percent of our production of primary aluminium (and 100 percent of the output of the Portland smelter) is sold into export markets. At a time when Australia's balance of payments has deteriorated into record deficit, sustaining our ability to export such a high-value product is essential. Australia's trade surplus in aluminium was $2.8 billion in 2015; that's down by 45 percent since 2006 (due both to falling prices and reduced production), but still an important net export.

World Aluminium Markets and the China Factor

The rapid growth in Chinese production has significantly disrupted markets and prices in the aluminium sector. Chinese production of aluminium quadrupled in the last decade: from roughly 7.5 million tonnes in 2005 to over 31 million tonnes, now accounting for over half of global production.

Chinese smelting capacity has grown even faster. Chinese capacity now exceeds domestic demand by as much as 10 million tonnes, and the recent industrial slowdown in China is reducing the growth of demand there. Unfortunately, the combination of oversupply and weakening demand is leading to a surge in artificially inexpensive aluminium exports from China. This is repeating the devastating experience of the global steel industry, which has been thrown into crisis in recent years by low-priced exports from China.

Chinese aluminium exports have doubled since 2013, and are up 600 per cent since 2009. In large part because of slowing Chinese demand and surging Chinese exports, global aluminium prices have fallen by over 40 per cent since 2011. Current prices (in the range of $1500 U.S. per tonne) are historically low, equivalent to the temporary price trough experienced for only a short time during the global financial crisis.

In this challenging global environment, policy-makers in aluminium-producing countries around the world are taking active measures to support their domestic producers, and hence retain their share of a high-value industry which will surely continue to grow in the future. These actions include the commencement of countervail and anti-dumping trade measures in the U.S. and elsewhere, against the dumping of artificially low-priced Chinese aluminium products into their markets.

It is essential, in this context, that Australian governments are equally prepared to support the domestic industry through turbulent, but temporary, global market conditions.

Economic Impacts of a Portland Closure

The study authors contracted with the National Institute for Economic and Industry Research to perform a macroeconomic simulation of the effects of the hypothetical closure of the Portland facility. 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. The simulation suggests that the closure of the Portland smelter would result in:[1]

- The loss of $800 million in national GDP, with losses experienced in all states (including especially Victoria and Western Australia).
- A decline in household disposable incomes of $251 million.
- The loss of $840 million in national exports – at a time when Australia is already experiencing an all-time record deficit on its international payments.
- The loss of over 3600 jobs in total, in the facility, in suppliers, and in downstream consumer industries.
- A decline in government revenues of over $50 million per year in Victoria, and $192 million per year for the Commonwealth.

The local government area around Portland experiences the most dramatic impacts, including the loss of over 1500 jobs (more than one in four jobs in the community) and over $70 million in household disposable income. Wages and labour market conditions are already weaker in southwest Victoria than national averages, so the loss of these well-paid jobs would exacerbate existing problems of declining labour force participation, outmigration (especially by young people), falling real estate values, and difficulties financing local infrastructure.

These impacts represent estimates of the initial adjustment of Australia's economy to the shock resulting from the smelter's closure, under conditions of widespread unemployment, imperfectly flexible prices, and imperfectly mobile capital and labour. Eventually some of the displaced people and resources will find other occupations, but ongoing losses will remain substantial even in the long-term.

Domino Effects in Western Australia

The report also considers the possibility that the closure of the Portland smelter could cause the domino-effect closure of the alumina refinery which supplies all of its feedstock: the Kwinana operation in Western Australia. That facility is the oldest and smallest alumina refinery in Australia, at a time of global over-supply and financial restructuring by its parent firm (Alcoa). It is certainly possible that the loss of sales to Portland, rather than sparking merely a proportionate decline in output (about one-third of its total sales are destined for Portland on regular ship transfers), the facility's owners might close it entirely. In that case, the ultimate impact of the Portland and Kwinana closures could be far worse, if the huge loss of business resulting from the closure of the Portland smelter resulted in the closure of the alumina refinery which supplies it (from Western Australia). Estimated impacts of this worse-case scenario would be far worse, including:

- Close to 9000 jobs lost in total.

- $1.75 billion in lost GDP.
- $800 million in lost household disposable income.
- Dramatic losses in revenues to the Victoria, Western Australia, and Commonwealth governments.

A Turning Point

Australia's economy is at an important turning point, in the wake of the collapse of global commodity prices and the end of the mining boom. Australians have realized that their national prosperity cannot be based solely on the extraction and export of unprocessed natural resources. This strategy is too precarious, facing both economic and environmental constraints. Even the present Commonwealth government has acknowledged that the economy must pivot toward a more diversified economy, finding ways to add value to our resource wealth through the production of a broader range of goods and services.

We cannot meet that challenge by permitting the closure of more "anchor" manufacturing facilities (like Portland and Kwinana), the further contraction of value-added output and exports, and the further relegation of our national economy to the resource extraction end of the global value chain. Governments in other countries have taken powerful actions in the last two years to support domestic aluminium producers through the current global turbulence – including measures such as financial subsidies, capital injections, export subsidies, requirements for domestic refining and manufacturing, and limits on aluminium imports. Australia must be prepared to do its part to support the sector, or else the disproportionate loss of aluminium manufacturing capability which we have already suffered, is certain to get much worse.

This paper therefore concludes with a brief catalogue of several of the policy levers which are open to governments to preserve and grow value-added aluminium manufacturing – in Portland, and across Australia. Several policy options are introduced, any of which would make a significant difference to the outlook for this industry and its vital, value-adding footprint here in Australia. An essential first step is for policy-makers to understand the importance of this sector to Australia's future industrial trajectory.

I. Introduction and Overview

This report reviews the recent negative trends in Australian aluminium manufacturing, placing them in the context of global, macroeconomic, and environmental challenges facing the industry. It describes the importance of the Portland facility to the regional economy and labour market of southwest Victoria. It documents the extensive linkages between the Portland operation and a wide range of other economic activities: including both “upstream” linkages to the myriad of firms which sell parts, inputs, and services to the facility, and “downstream” linkages which depend on the incomes and spending power of those employed in the aluminium industry and its extensive supply chain

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 regional economies across Australia. 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 in suppliers and related firms, and generates hundreds of millions 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: including dramatic swings in world aluminium prices, huge imbalances in global production and trade, and financial uncertainty for the large global companies which control most aspects of the industry’s activity. In the last five years, several important value-added aluminium-related facilities in Australia have closed (including two aluminium smelters, one alumina refinery, and several secondary aluminium fabrication facilities). This has imposed a number of negative consequences on the national and regional economies: including 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 the 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 a mining-based economy are being increasingly recognized. Instead of leading a transition away from overreliance on extraction toward a greater diversity of value-added activity, recent aluminium manufacturing closures are leaving us 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. One such facility is the aluminium smelter in Portland, located in the relatively remote southwest of Victoria. This facility clearly plays an "anchor" role in the regional economy and labour market: it is the largest employer in the region, and supports thousands more jobs in related supply work and "downstream" 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 to the fiscal capacity of both the state and Commonwealth governments.

The future of this important facility is uncertain for a variety of reasons – including the upcoming renegotiation of energy supply contracts with a now-privately-owned electricity utility, a continuing global reorganization of Alcoa (which owns the majority share of the Portland facility, and serves as its operating manager), and ongoing volatility in global aluminium prices and market conditions. In the face of these uncertainties, policy-makers must be sensitive to the long-run economic, fiscal, and social importance of the Portland smelter – and other aluminium facilities like it. Australia's participation in the global aluminium industry has already been both significantly downsized, and skewed disproportionately toward the extraction end of the industry's value chain. As the company, the community, and the state and national governments all negotiate the uncertainty that lies ahead, we must be aware of the larger role that "anchor" manufacturing facilities like this one play. And policy-makers must design their responses to emerging industry conditions and decisions accordingly.

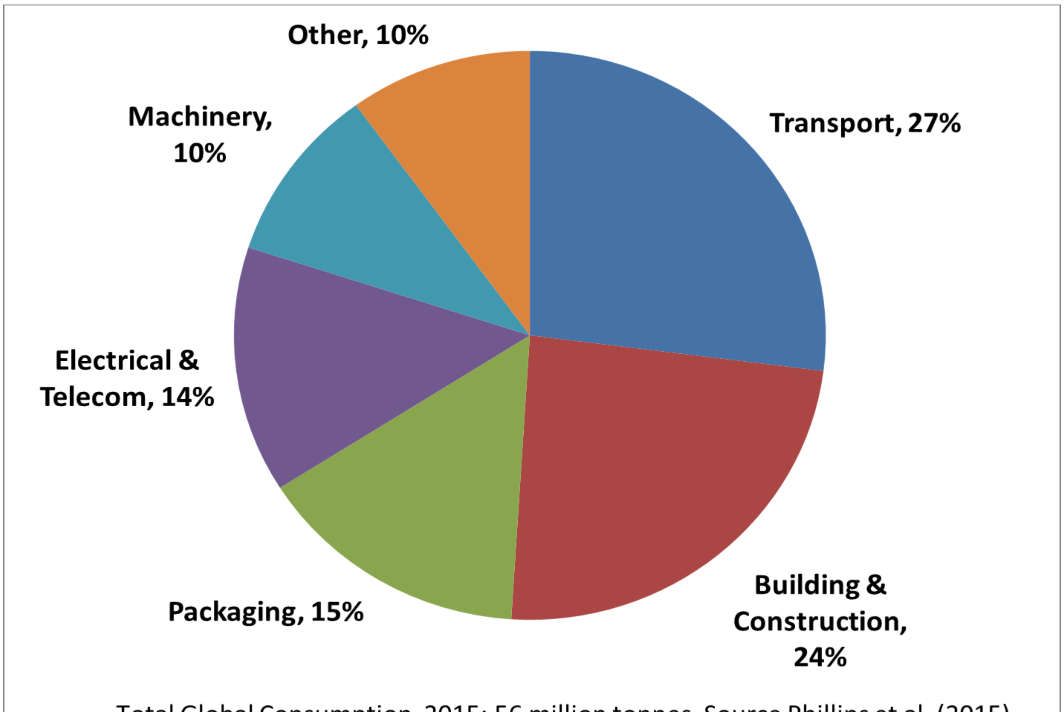
To enhance that understanding of the broader structural role played by key manufacturing facilities like the Portland smelter, this report conducts a detailed analysis of its economic, fiscal, and social importance. Section II of the report describes in more detail the current economic and industrial footprint of aluminium manufacturing in Australia, and its structural importance. Section III introduces the global and national context for the factors influencing the future of the Portland facility. In particular, it considers the dramatic changes in global aluminium markets in recent years (shaped most strongly by developments in China), and the broader challenges facing the overall manufacturing sector in Australia. Section IV describes the nature and operations of the Portland smelter in more detail, and explains its importance to the regional economy and labour market. Section V uses statistical data on industry input-output linkages to begin to map the importance of aluminium smelting to a wide range of supply industries – including mining, other manufacturers, and service providers. Section VI reviews existing economic research that attempts to quantify the total impact of aluminium smelting on aggregate economic and labour market performance, considering its direct, indirect (ie. supply chain), and induced (ie. macroeconomic or expenditure-driven) effects. This section also summarizes the results of original economic modeling which attempts to estimate the ultimate economic impact of the Portland facility. Finally Section VII of the report summarizes the previous findings, and considers a range of potential policy interventions which could be investigated by governments concerned with preserving Australia's footprint in this industry.

It is beyond the mandate of this report to provide specific policy recommendations to government; our goal, rather, is simply to describe why governments should be concerned with the future survival of this facility (and others like it). Nevertheless, our analysis of the challenges facing aluminium manufacturing in Australia naturally suggests a catalogue of some potential responses to those challenges. We list them in order to start a broader discussion on future policy options to preserve and enhance this important sector of Australia's economy.

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 to 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 (the largest single application), building and construction materials, machinery and equipment, 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.

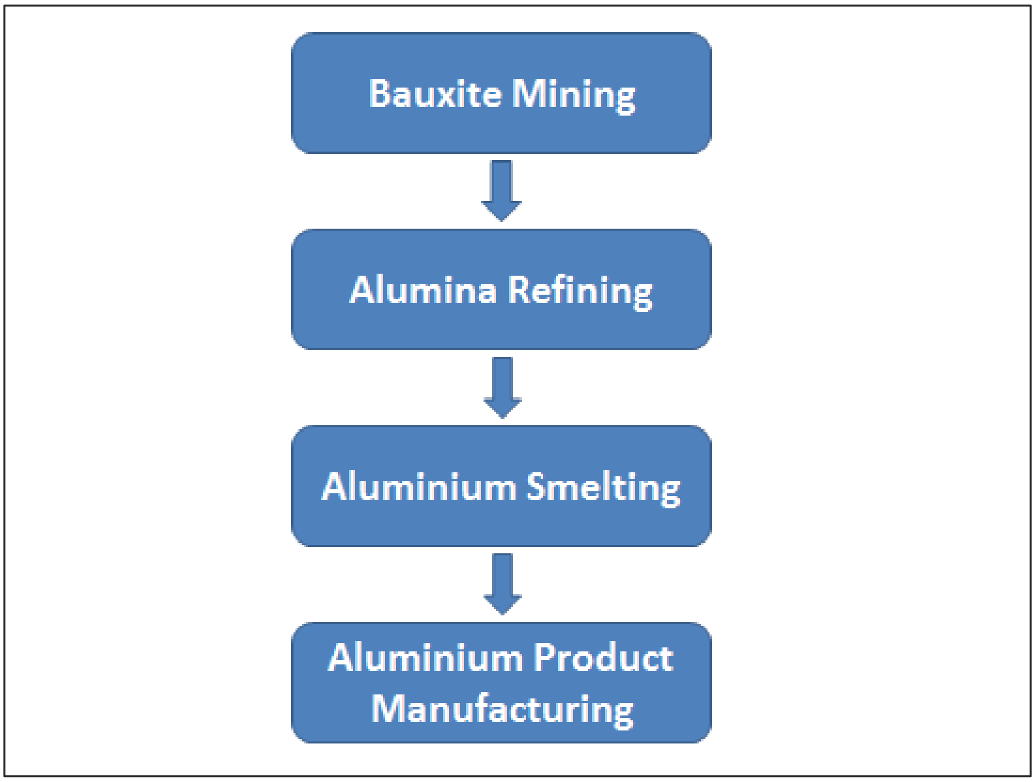
Figure 1 Aluminium Use by Sector, 2015



Total Global Consumption, 2015: 56 million tonnes. Source Phillips et al. (2015).

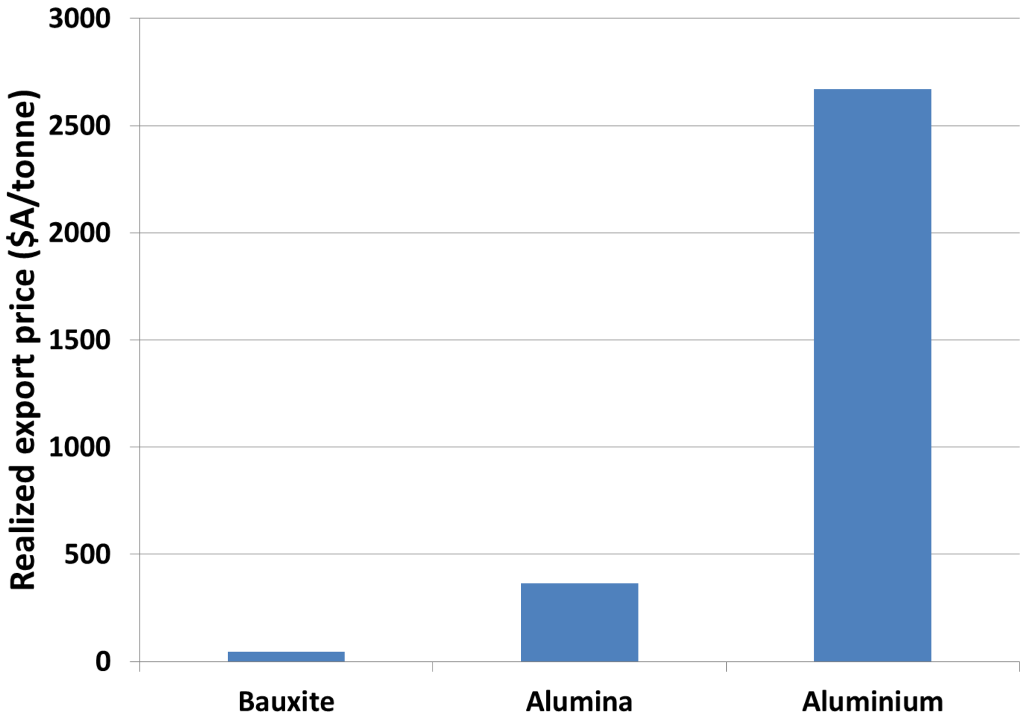
Australia has been a leading producer of aluminium and related products throughout the last half-century. This presence stems, in part, from Australia's abundant reserves of the primary ore used in aluminium production: bauxite. Aluminium is the third most common element (and most common metallic element) in the crust of the earth (Geoscience Australia, 2015), 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 nearly one-third of world bauxite production (U.S. Geological Survey, 2015), about 60 percent more than second-place China.

Figure 2 The Aluminium Value Chain



However, from the outset of the domestic industry, Australian policy-makers recognized the risks with 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 Attained Unit Values, Aluminium Exports, 2015



Source: Author's calculations from Australia Dept. of Industry, Innovation and Science (2016) data.

combined with electricity[2] and carbon to extract pure liquid aluminium – typically formed into basic solid ingots. Finally, that primary aluminium is then further processed and manufactured into the whole range of fabricated aluminium products used in everyday life. At every stage of production, value is added to the product through the application of more labour, capital, and technology. This value-adding process is illustrated dramatically in Figure 3, which reports the average realized price attained per tonne in 2014-15 for Australian exports of bauxite, alumina, and aluminium. The unit price of alumina is almost 8 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 7 times greater that the unit price of alumina.[3] 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.

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 fabriaction. 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 (using imported alumina). That smelter was created 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 throughout 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 resulted solely or even mostly from our abundant deposits of the primary resource to that industry. To the contrary, the presence of a more well-rounded 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

Industry	Shipments ($m)	Value-Added ($m)	Employment	Wages & Salaries ($m)
Bauxite mining	3,700	na	2,500	na
Alumina refining[1]	6,753	1,812	8,498	1,205
Primary aluminium smelting[1]	6,440	519	4,996	639
Rolling and extruding[2]	1,329	153	1,745	226
Architectural products[2]	4,235	1,520	15,866	911
TOTAL	**$22.5 billion**		**33,500**	

Source: Bauxite: Estimates from Australian Aluminium Council, Australia Dept. of Industry, Innovation and Science data, various years. Manufacturing sectors: ABS catalogue, 8155.0, "Australian Industry."
1. 2013-14, more recent data suppressed by ABS for confidentiality. 2. 2014-15.

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 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 reported separately in national income statistics: aluminium rolling, drawing, extruding (ANZIC industry code 2142), and architectural aluminium product manufacturing (ANZIC 2223).[4] Table 1 reports value-added and labour compensation data for the specified manufacturing activities only; unfortunately the ABS does not report equivalent detail for sub-sections of mining activity, and hence for bauxite mining the table only reports total shipments (estimated on the basis of annual production and average prices) and employment (based on Australian Aluminium Council reports). 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 employment levels – although labour incomes in that sector are less than half of those paid in other aluminium manufacturing activities. The fact that reported value-added in two sectors (smelting, and rolling and extruding) is smaller than the value of wages and salaries paid out, attests to the economic challenges facing aluminium manufacturing in Australia in the reported years: this implies a negative return to capital employed in those sectors during the year covered by the data. The five industries listed in Table 1 account for total annual shipments of about $22.5 billion, and total employment of 33,500. The four aluminium manufacturing sectors listed (excluding bauxite mining, for which data was unavailable) generate combined annual value-added (GDP) of $4 billion, and labour incomes of $3 billion.[5]

While Australia benefits from a strong presence of aluminium production at all stages in the value chain, there is no doubt that within the sector – as for Australia's economy as a whole – there has been a definite trend toward deindustrialization, the erosion of manufacturing capacity, and growing focus on primary resource extraction. This trend is summarized in Table 2. In the last five years, bauxite mining has continued to grow, spurred in part by growing Chinese demand for the raw input to aluminium production. (China has quickly become the world's largest producer of aluminium, but its bauxite mining capacity has not kept up; so even though China is the second largest bauxite producer, it has also become a large net importer of bauxite.) Alumina production has declined slightly, however, indicating that all of that incremental bauxite production is effectively being exported in its raw form. Primary aluminium smelting, on the other hand, has declined sharply during this period – largely as the result of the closure of two of Australia's smelters. Australia's structural regression within the global aluminium supply chain is further attested to by our national ranking within each of those stages of production: Australia remains the world's largest producer of bauxite, the second largest refiner of alumina, but has fallen to only the sixth largest producer of primary aluminium. While world consumption of aluminium continues to expand, therefore, Australia's participation in that industry is increasingly concentrated in the raw resource extraction phase of production. To put the problem starkly, Australia is growing its presence in an industry whose output is worth less than $50 per tonne – and shrinking its participation in an industry whose output sells for over 50 times as much.

Table 2 Deindustrialising The Aluminium Value Chain			
Product	**Australia Global Rank: 2010**	**Change in Production 2010-15**	**Australia Global Rank: 2015**
Bauxite	1	+18%	1
Alumina	2	-1%	2
Aluminium	4	-15%	6

Source: Author's calculations from Australia Dept. of Industry and U.S. Geological Survey Minerals Information data.

Table 3 catalogues Australia's aluminium smelters. Until recently the country had six smelters, located across four states: New South Wales, Victoria, Queensland, and Tasmania. Two smelters were closed earlier in this decade (an Alcan facility at Point Henry, Victoria, and a smelter operated by Norsk Hydro at Kurri Kurri, NSW), reducing capacity in the industry by close to 400,000 tonnes per year, and eliminating some 1500 jobs. The four remaining smelters directly employ close to 3500 workers (employees and contractors), with some hundreds more working in head office and infrastructure functions for the various aluminium manufacturing firms.[6] Of the four remaining smelters, the Portland facility is the youngest (beginning operation in 1985[7]), but the second smallest (bigger than the older plant in Tasmania, but smaller than the Tomago and Boyne Island operations). In recent years the Portland smelter has operated at approximately 80-85 percent of its listed capacity (with annual output

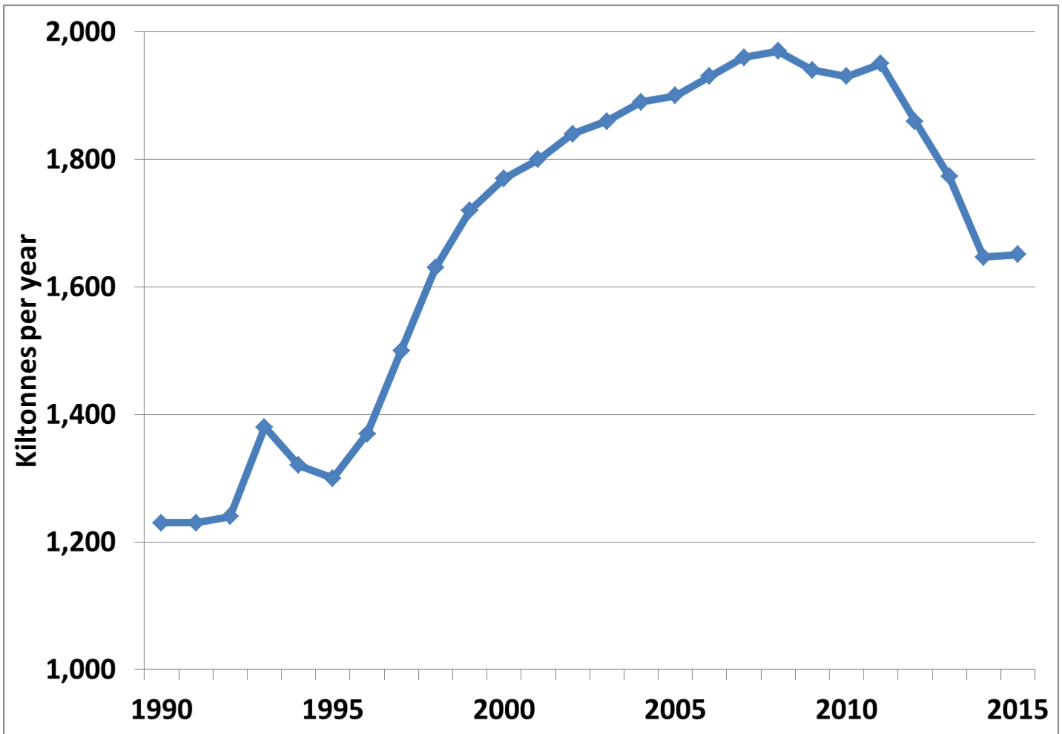
Table 3 Australia's Aluminium Smelters			
Location	**Capacity (kt/yr)**	**Opened**	**Employment[1]**
Tomago, NSW	585	1983	1140
Boyne Island, QLD	550	1982	1100
Portland, VIC	358	1985	650
Bell Bay, TAS	180	1955	495
Point Henry, VIC	190 (Closed 2014)	1962	1000
Kurri Kurri, NSW	180 (Closed 2012)	1969	500

Source: Australian Aluminium Council, company reports.
1. Approximate, including contractors.

around 300,000 tonnes per year). When contemplating the possibility of capacity reductions in an industry, it is common to worry most intensely about the fate of smaller, underutilized, and/or older facilities – in which case the Portland smelter would seem to face an elevated risk.

In addition to the closure of two aluminium smelters since 2012, Australian aluminium manufacturing has experienced other closures to 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 a total of 430 positions. And numerous secondary aluminium fabrication and manufacturing facilities have closed since 2008, commensurate with the overall downsizing of manufacturing activity in Australia. Bauxite mining has continued to expand. But employment in this activity cannot hope to absorb the idle resources resulting from the decline of manufacturing activity – and the low and volatile returns from mining cannot form the foundation for sustained national prosperity.

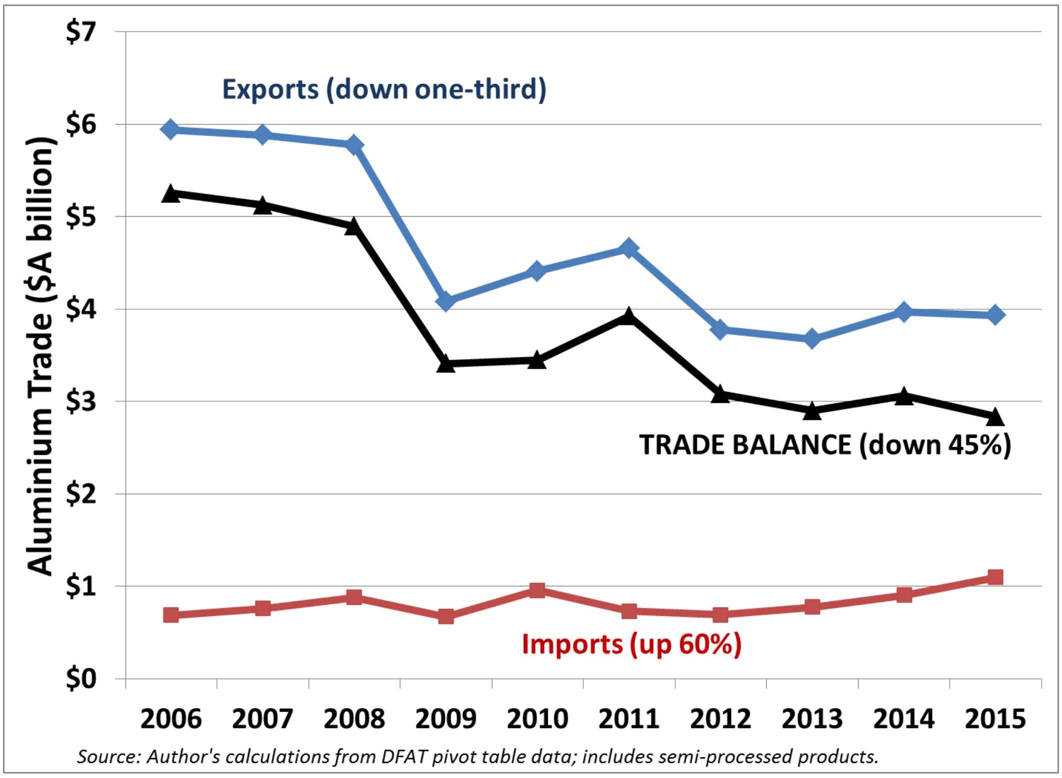
Figure 4 Australian Primary Aluminium Production, 1990-2015



Source: US Geological Survey Minerals Information.

Australian primary aluminium production over the past quarter-century is illustrated in Figure 4. After decades of steady production growth, smelter output peaked in 2008 at just under 2 million tonnes. Thanks to the uncertainty of the global recession that followed the global financial crisis, production then stagnated for several years – but then began to decline sharply with the two smelter closures (Kurri Kurri in 2012 and Port Henry in 2014). Physical production is now 15 percent below its 2008 peak. The value of output has declined more steeply, because of the sharp fall in world prices that was also experienced during the same period. The value of production has declined by over 40 percent since its peak in 2006 (when aluminium prices reached their pre-crisis peak).

Figure 5 Aluminium Trade Balance, 2006-15



One important macroeconomic impact of aluminium production is its strong export orientation. About 90 percent of Australia's primary aluminium output is exported to other countries (primarily in Asia, but other major customers for Australian aluminium include the U.S. and Europe). Those aluminium exports generated $3.8 billion in export revenues in 2014-15 – crucial at a time when Australia's overall export performance was flagging badly, and the country was racking up a $60 billion current account deficit.[8] In contrast to most other manufactured products, Australia remains a major net exporter of primary aluminium. Figure 5 illustrates the evolution of Australia's net trade balance in aluminium.[9] Exports have declined by about one-third since the global financial crisis occurred in 2008. This reflects a combination of weaker-than-expected world demand in the wake of that crisis, a sharp decline in global prices, and the closure of two Australian smelters. At the same time, Australia is importing more aluminium (primarily semi-processed aluminium, much of it from

China – a trend that will be discussed further below). Australia's aluminium imports reached a record $1.1 billion in 2015, and this further ate into Australia's traditional trade surplus in aluminium. The surplus of $2.8 billion recorded for the year is down by 45 percent from the level in 2006. Despite this incremental erosion of Australia's once very strong net exports of aluminium, the industry continues to generate an important trade surplus: a valuable counterweight to the ever-larger trade deficits we incur in most other manufacturing sectors.

III. Global, National, and Environmental Context

The erosion of value-added aluminium manufacturing in Australia in recent years has occurred in the context of dramatic changes in the global aluminium industry, as well as a generalized process of deindustrialization which has substantially weakened Australia's overall manufacturing activity. This section will consider the national and global trends which have shaped recent developments in domestic aluminium manufacturing. Environmental issues, and the need to reduce greenhouse gas emissions in particular, are another key factor influencing the future evolution of the industry, and these will also be introduced.

GLOBAL MARKET TRENDS

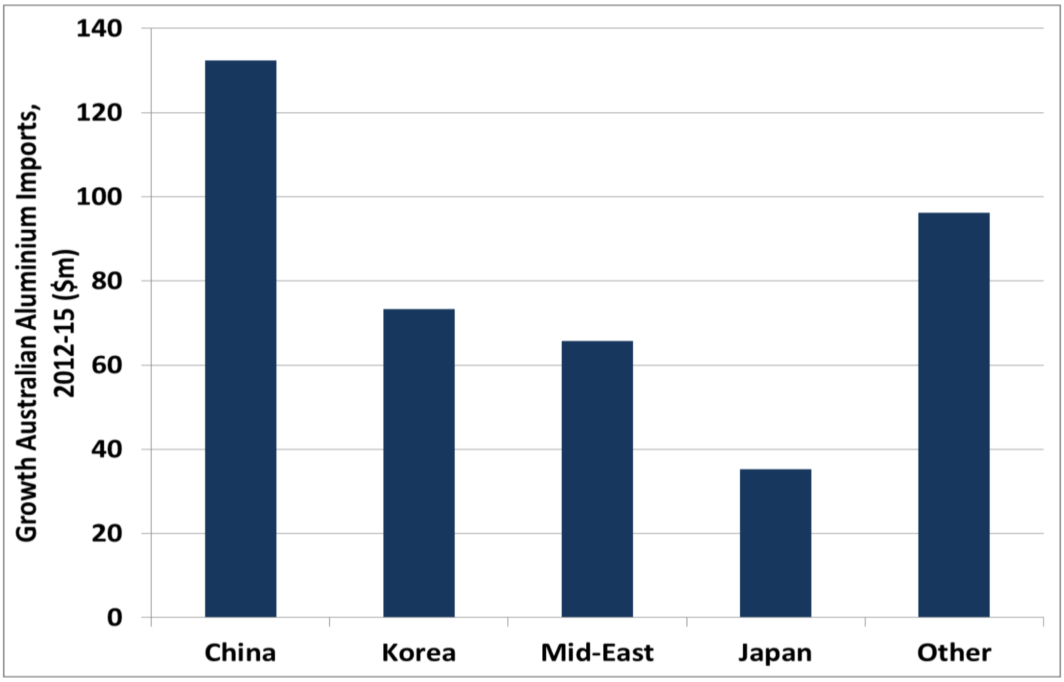
As with so many other industrial commodities, world aluminium markets have experienced unprecedented upheaval in the past decade because of the spectacular expansion in both production and consumption of aluminium products in China. China's rapid state-directed industrialization strategy has required 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 quadrupled in the last decade: from around 7.5 million tonnes in 2005, to some 31 million tonnes in 2015.[10] 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 half of global aluminium demand (slightly under 30 million tonnes in 2015). With demand and supply within China both rising so quickly, the impacts of China's stunning growth on aluminium markets in the rest of the world have been somewhat buffered. However, even residual changes in the net supply-demand balance within China, can have dramatic impacts on prices and trade patterns around the world as a result of its dominant role.

This is exactly what has occurred in recent years, with a slowdown in China's growth trajectory, and a resulting shift in economic policy emphasis there – now emphasizing more intensive, consumer-driven growth instead of extensive industrialization. Chinese aluminium consumption is still growing, but more slowly than expected previously. This has dual effects on global markets. First, producers outside of China face less robust market conditions for their own output. Second, a condition of significant excess capacity has arisen within China, as continued investments in new smelter and manufacturing facilities there have outstripped slower growth in domestic demand. Analysts now estimate that China's smelting capacity exceeds its domestic demand by as much as 10 million tonnes – an amount that dwarves the total production capacity of any other country.[11] How Chinese policy-makers choose to manage this excess capacity will have 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 match between domestic demand and supply. Another option, which seems to be the one preferred at present, is to maintain total production levels and export the excess output to world markets (in the form of both primary aluminium and semi-fabricated aluminium products). This will have negative and potentially severe consequences for aluminium producers in other countries – similar to the impact that Chinese exports of excess steel are now having on steel output and employment around the world.[12]

Chinese aluminium exports have begun to increase significantly. Chinese exports have doubled since 2013, and are up six-fold since the low point of 2009. Active policy efforts to support this growth in Chinese aluminium exports include state subsidies to domestic smelters (including direct subsidies, subsidized electricity contracts, active efforts to depreciate the Chinese currency, low-interest loans, and access to state-owned equity), as well as changes in trade policy. Since 2007 China taxed 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. 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."[13]

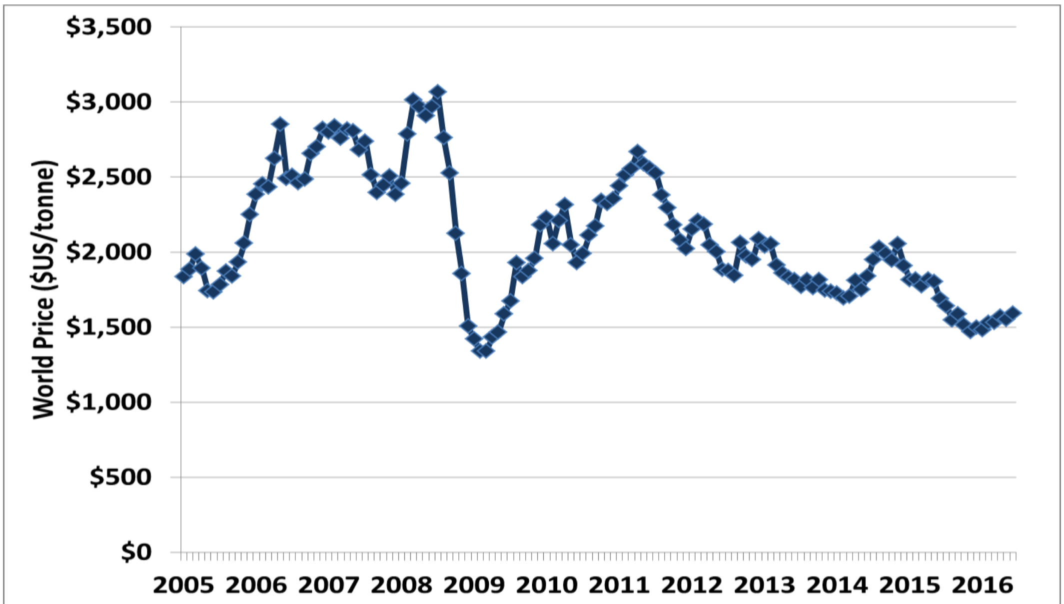
This incremental growth in supply to the rest of the world is having a major impact on aluminium prices, trade flows, and profits for producers outside of China. Aluminium producers in the U.S. have already commenced countervail trade actions against Chinese aluminium imports before the U.S. International Trade Commission. Even Australia has become a significant destination for Chinese aluminium (including semi-fabricated products): Australia purchased $433 million worth of Chinese aluminium in 2015. Imports from China have grown by 45 percent since 2012 (up by $132 million in that time, more than any other source of aluminium imports – see Figure 6). These imports from China have contributed to the substantial erosion of Australia's traditional trade surplus in aluminium discussed above.

Figure 6 Growth in Australian Aluminium Imports by Source, 2012-2015



In the face of China's slowdown and the surge of Chinese exports onto world markets, world aluminium prices have declined by over 40 percent over the past five years (see Figure 7). Current prices, in the range of $US 1500 per tonne, are almost as low as the unprecedented lows experienced temporarily during the global financial crisis in 2009. Analysts are near-unanimous, however, that prices will remain low for much longer in this down-cycle than was the case in 2009.

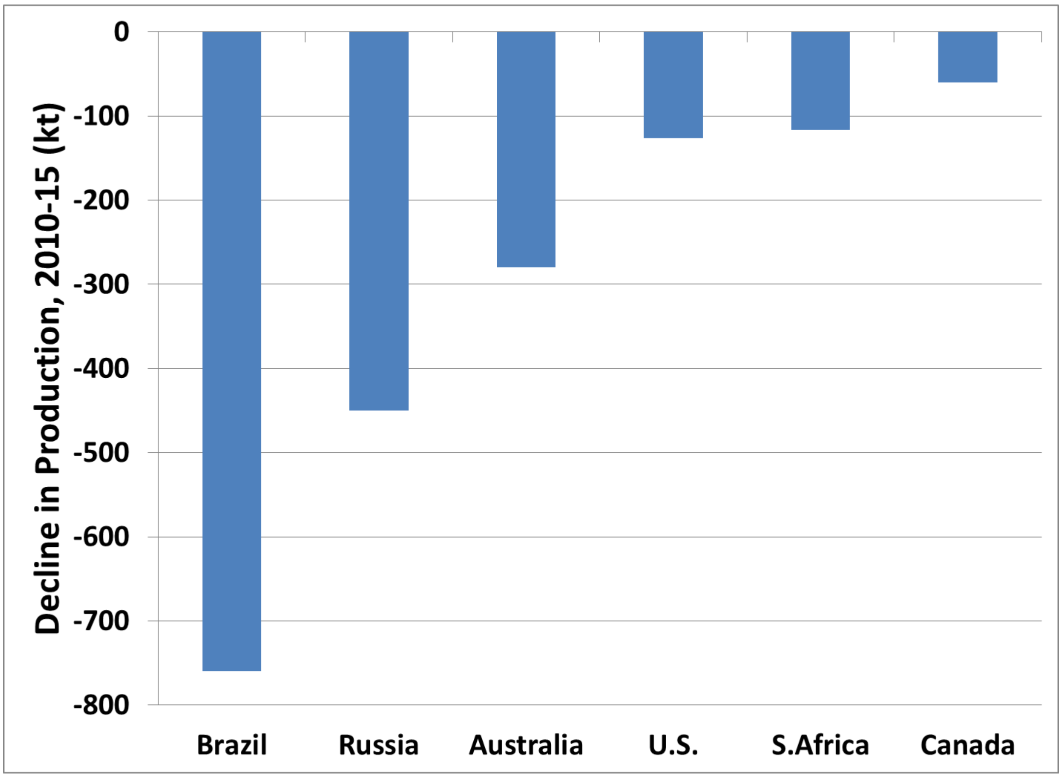
Figure 7 World Primary Aluminium Price, 2005-2016



Source: Federal Reserve Bank of St. Louis.

Global market turbulence has resulted in severe financial challenges facing major global minerals companies, including the leading players in the Australian aluminium industry. Rio Tinto, owner or part-owner of three smelters in Australia (all other than the Portland facility), has reported major losses for the 2015 financial year, and is undertaking various cost-saving measures to address the impact of lower commodity prices in its aluminium and other minerals businesses. Alcoa, the majority owner of the Portland smelter, is closing two aluminium smelters this year in the U.S., and proceeding with a corporate reorganization. Alcoa will be split into two separate publicly-traded companies by the end of 2016: an "upstream" operation (encompassing mining, refining, and primary smelting), and a "value-add" company (which has been the more profitable arm of the company in recent years) focused on higher-stage fabrication and manufacturing.

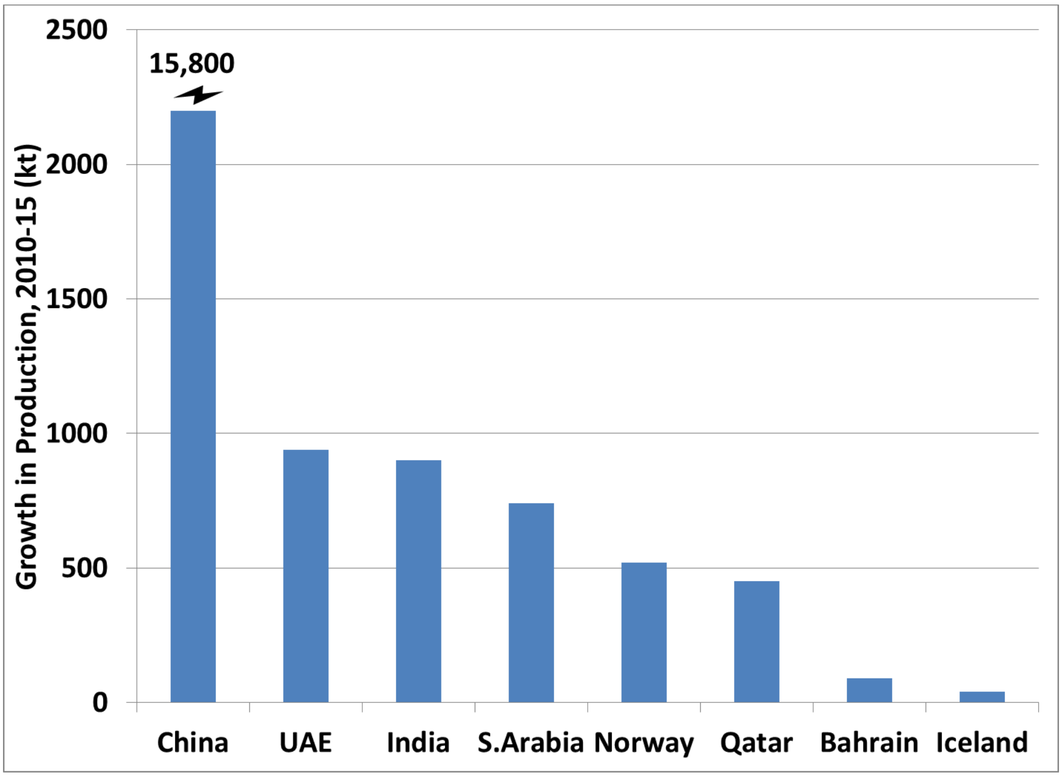
Figure 8 Declining Aluminium Producers, 2010-2015



The global aluminium industry will eventually adapt to this challenging market environment, but it would be a mistake to assume that fundamental efficiency considerations will exercise the dominant influence over the nature of that adjustment. Policy pressures will also influence which segments of the global industry survive this shake-out, and which do not. Capacity will decline in countries other than China, as some facilities are closed in the face of sustained price pressures. Figure 8 illustrates that Australia has already borne a large and disproportionate share of that capacity reduction (due to the two smelter closures that have already occurred here).

In fact, the decline in Australian capacity over the past five years has been larger than any other OECD country.[14] In contrast, as indicated in Figure 9, there are still several countries which are adding to primary aluminium capacity, despite the challenging economic and financial environment. China's capacity additions, of course, dwarf all others. But several oil-producing countries in the Middle East, along with India and Norway, have also increased their smelting capacity since 2010. Governments in those countries are actively supporting aluminium manufacturing for a range of policy reasons (including self-sufficiency, economic diversification, and others). Similarly, 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, 2010-2015



Even with China's slowdown, global demand for aluminium will continue to increase, on the strength of its various advantageous properties.[15] The question facing policy-makers in Australia is whether we intend to retain a stake in that growth in the long-run – or whether we will watch as even more this industry disappear in the face of global pressures which are neither permanent, nor reflective of economic fundamentals.

AUSTRALIA'S DEINDUSTRIALIZATION

The broader decline in Australian manufacturing is another important dimension of the economic context facing the aluminium industry going forward. The overall contraction in Australian manufacturing has had a negative impact on many macroeconomic indicators: including employment, productivity, innovation, and exports. It is widely recognized that the Australian economy must reduce its reliance on mining exports, in the wake of a sharp downturn in investment and employment in the sector, and global weakness in global commodities prices. At this juncture, therefore, it becomes all the more important for Australia to nurture and sustain its presence in manufacturing.

Measured by GDP produced, Australia's manufacturing sector peaked in 2008. Output fell sharply during the global financial crisis, and then partly recovered. Since 2012, however, real output has commenced a steady decline, and is now 15 percent lower than its 2008 level.[16] Over 200,000 jobs have been lost from manufacturing in the same period. Investment spending on new plant and equipment in manufacturing has also declined, falling to $8.5 billion in 2015 compared to typical annual averages of $12-13 billion up to 2011. Demand from Australian consumers and businesses for manufactured products continues to expand, even as national output of manufactures contracts. This implies a large and growing trade deficit in manufactured products that contributes substantially to Australia's overall balance of payments difficulties. In 2015 this deficit in manufactures reached almost $150 billion, and it is the largest single factor behind Australia's record balance of payments deficit. As noted above, the deterioration in Australia's traditional trade surplus in manufactured primary aluminium has contributed incrementally to that deterioration in net trade performance.

It is commonly assumed that the contraction in manufacturing in Australia merely reflects similar trends experienced across the developed world: the seemingly inevitable result of a transition toward a "services-based" economy. An equally inevitable 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 deindustrialization of the sort experienced in Australia is either universal or inevitable, even for a developed, higher-income economy. Manufacturing's share of total employment in Australia is now lower than for any other member country of the OECD: falling below 7 percent by end-2015. In this regard, Australia's experience constitutes an outlier even among industrial countries – not a typical or somehow "normal" outcome. The decline in Australian manufacturing GDP since 2009 also ranks among the worst of any OECD country.

Even among countries which are relatively small and remote, Australia's manufacturing trajectory has been uniquely negative. Consider, for example, those OECD countries with a population lower than 50 million, and which do not share a land border with an integrated market containing at least 100 million inhabitants. By those criteria there are 7 "remote" countries in the OECD (including Australia, New Zealand, Korea, Ireland, Iceland, Israel, and Chile) which depend on ocean or air shipping to get their products to a large market.[17] The crisis in Australian manufacturing has been much worse than for any of those other countries, measured by declines in output and employment in the past five years. In fact, in most of these other "remote" countries, manufacturing output and employment grew during this period. So Australia's size and geography cannot be the explanation for the uniquely severe loss of manufacturing output and employment that has been experienced since 2009.

Far from being an inevitable or "natural" trend, the unique and severe decline of manufacturing in Australia reflects a lack of understanding and policy attention. Policy-makers have not adequately appreciated the structural importance of manufacturing to future economic progress. These structural benefits are summarized in Table 4, and include: the leading role of manufacturing in innovation; superior productivity trends; the greater export intensity of manufactured products; and the role of major manufacturers in anchoring supply chains and thus supporting dozens of other goods- and services-producing industries around the country. Past policy has failed to adequately support and insulate domestic manufacturing in the face of damaging macroeconomic developments (including the dramatic over-appreciation of the Australian currency between 2002 and 2014, and the implementation of new trade agreements which had a very one-sided impact on manufacturing trade). All this left Australia's economy very vulnerable to the inevitable downturn in primary resource extraction – which had become the dominant focus of national economic strategy during the upswing of the mining boom.

It is not too late to begin repairing the damage from this past neglect of manufacturing. The national exchange rate has returned to more normal levels, following years of extreme overvaluation – although the Australian dollar is still overvalued according to purchasing power parity benchmarks.[18] At this more typical exchange rate, labour costs (including fringe benefits and payroll taxes) in Australian manufacturing are once again on par with those in other industrial economies: equivalent to U.S. and European levels.[19] Australia retains a strong reputation for quality, productivity, and innovation in several key sub-sectors of manufacturing – including aluminium manufacturing. At this turning point in Australia's economic trajectory, with the need to diversify beyond natural resource extraction and export more apparent than ever, it is vital that we seize every opportunity to preserve and nurture our remaining footholds in value-added manufacturing.

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 (2016).	

ENVIRONMENTAL ISSUES

The need to transition toward a lower-carbon economy, and to reduce greenhouse gas emissions from all industries, is indisputable, and must now be a key goal considered in all economic decision-making. Aluminium manufacturing has important environmental side-effects, including local impacts on land-use and water quality, and emissions of carbon dioxide and other greenhouse gases. Most greenhouse gas emissions are associated with the generation of electricity for aluminium smelting;

three of Australia's four remaining aluminium smelters presently purchase their electricity from utilities primarily dependent on coal-fired generators, while one (in Bell Bay, Tasmania) utilizes hydroelectric power. In addition, electrolytic smelting directly releases carbon dioxide and other greenhouse gases (including carbon dioxide and perfluorocarbons) in smaller quantities. Aluminium producers have made significant investments in pollution abatement in recent years, including a range of measures (such as investments in cogeneration power systems, and greater efficiency in electricity use) to reduce greenhouse gas emissions, although emissions associated with aluminium production (mostly tied to the consumption of energy for electricity and heat) are still significant.

Consideration of future emissions from the aluminium sector now takes place within a regulatory context oriented around the imposition of a national cap on greenhouse gas emission: Australia's national commitment is to reduce emissions to 26-28 percent below 2005 levels by 2030. Future trends in greenhouse gas emissions from the aluminium industry, therefore, cannot be considered separately from changes in emissions from other sectors covered by the cap. Even closing the aluminium industry entirely would not necessarily alter overall emissions, given the existence of the national cap (and depending on how other economic actors respond). Regarding electricity, in the event of a smelter closure, the utility which supplied it with power would seek other customers for the resulting excess supply; again, there would be no predictable impact on either total electricity generation or on emissions.[20]

From a global perspective, the impact of smelter closures in Australia on global emissions is even more doubtful. The countries which have recorded the most rapid expansion in aluminium production capacity in recent years, rely on fossil fuels to generate most or all of their electricity supply. Most important in this regard, China's aluminium industry (which accounts for 85 percent of all new global production since 2000) almost exclusively utilizes coal-fired electricity generation; moreover, electricity utilities there do not meet the same efficiency standards or emissions regulations as Australian utilities. Similar concerns surround the expansion of capacity in other high-growth jurisdictions, including India and the Middle East. Closing aluminium facilities in Australia, and shifting global production to China or elsewhere, would have no positive impact on global emissions from the industry – and more likely a negative impact.

Efforts to reduce emissions from electricity generation and consumption must be targeted at the entire power generation system, not at particular users. This is the approach adopted by the national Renewable Energy Target, and by the more ambitious sub-national targets that have been established by some states (including Victoria[21]). Most greenhouse gas emissions currently associated with aluminium manufacturing result from the consumption of energy (for both heat and electricity). An overarching national effort to develop reliable and affordable sources of sustainable energy, therefore, will be essential for attaining parallel progress in reducing emissions from aluminium manufacturing.

There are other environmental dimensions to aluminium production and use that must also be considered in developing a policy framework for the future of the industry in Australia. As noted above, the use of aluminium has important environmental advantages – due to its light weight (in transportation applications), its reflectivity (in building applications), its recyclability, and other properties. In this context, the evolution toward a sustainable economy is likely to require the use of more aluminium, not less; indeed, this is one of the factors driving continued growth in aluminium consumption, even in mature developed economies. One interesting new environmental application has been the development of new procedures to use molten aluminium (present within smelters) as an efficient natural battery for electricity storage. German electric utilities, which are among the most dependent on renewable generation in the world, have developed viable systems for storing electricity in aluminium smelters to help offset the normal fluctuations in wind power generation (Noble, 2014). In this regard, the continued presence of aluminium smelting in Australia could serve as a useful complement to the coming expansion of renewable electricity generation (including wind). This suggests a potentially symbiotic relationship between aluminium smelting and renewable energy.

IV. The Portland Smelter and its Regional Importance

The Portland aluminium smelter is a joint venture between Alcoa Aluminum (a U.S.-based firm that is presently the fifth-largest producer of primary aluminium in the world) and minority investment partners; the facility is operated and managed by Alcoa (Alcoa Aluminum, 2016). The smelter employs about 650 workers (including direct employees and contractors), who receive total wages, salaries, and benefits worth an estimated $65 million per year. The resulting average annual compensation level (of approximately $100,000 per employee per year) is significantly higher than average compensation in that region (and indeed than in Australia as a whole), reflecting the high productivity and capital intensity of the work. The smelter is the youngest of the four remaining smelters in Australia, but ranks third of the four in terms of annual production capacity (358,000 metric tonnes of ingots per year). The plant's annual output has averaged about 300,000 metric tonnes in recent years (representing an average capacity utilization of below 85 percent). All of the facility's output is exported by ship to offshore markets, primarily in Asia. Summary data on the Portland smelter are provided in Table 5.

Like Australia's overall value-added aluminium footprint, the Portland smelter was the result of a pro-active approach to industrial development policy – in this case, led by the Victoria state government. Concerned with generating decent job opportunities in Victoria's poorer regions, as well as with accelerating the development of strategically important industrial sectors, the state government entered a joint venture with Alcoa to co-invest in the construction of the smelter, and to tie its development to the construction of electricity generation and transmission facilities. Those electricity investments were motivated not only by the energy needs of the smelter, but also by a plan to connect western regions of the state to the state's main electricity grid. The resulting enhancements in electricity supply (measured both by security of supply and cost) would benefit residents and other businesses throughout the region. State support for the investments in both smelting and electricity capacity was delivered in various forms, including an initial 40 percent public equity share in the smelter, and the negotiation of a favourable long-term electricity supply contract through the then-publicly-owned power utility. These interventions allowed the project to proceed. Victoria sold its equity stake in the operation in 1998 (which by then had been diluted to 25 percent).[22]

Table 5 Portland Aluminium Smelter, Key Parameters, 2015	
Facility	Portland Smelter
Location	Victoria
Product	Aluminum ingots
Physical Output	300,000 t/yr
Unit Price (2014-15, $US)	$2000/t[1]
Value of Gross Output ($A, at current ex.rate)	$800 million
Proportion Exported	100%
Employment[2]	650
Wages, Salaries, and Benefits Paid ($A)	$65 million
Electricity Purchases	$150 million
Total Raw Materials Purchases	$325 million
Other Input Purchases in Australia	$150 million
Main Input	600,000 t/yr alumina from Kwinana Refinery (WA)

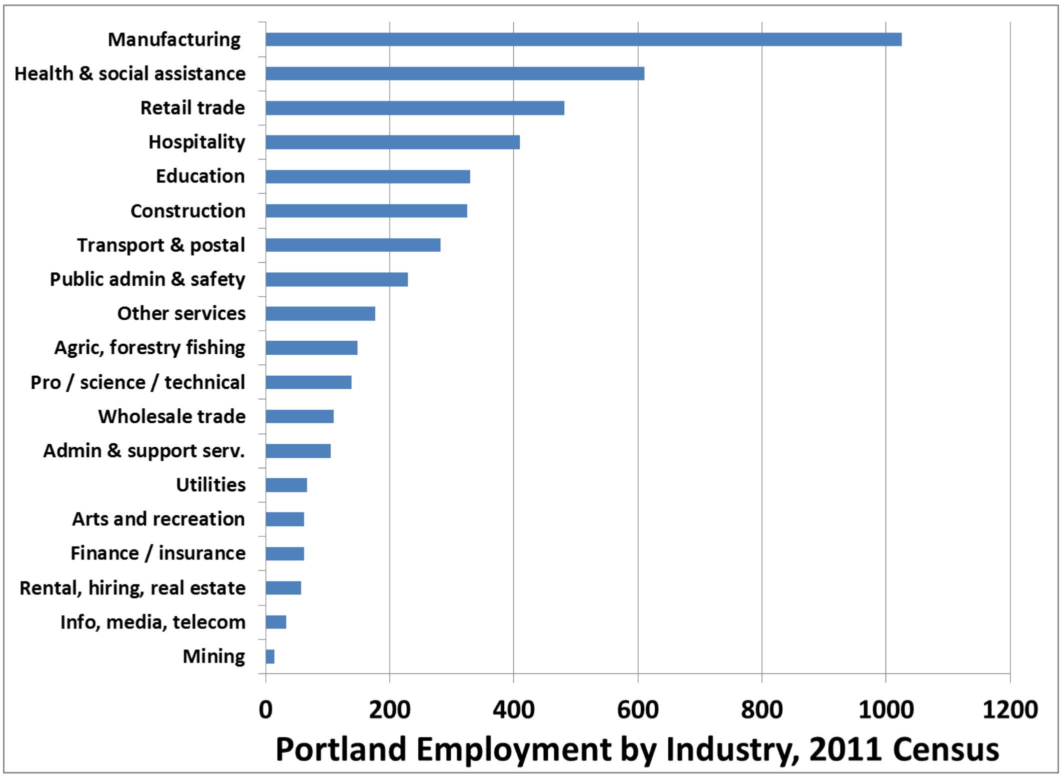
Source: Author's compilation from company reports.

1. Includes premium for Japanese market of approx.. $100/t (US).
2. Includes contractors.

Portland's economy and labour market is highly dependent on the smelter, and on manufacturing more generally. Manufacturing is by far the largest single source of employment in Portland, accounting for over one in five jobs in the community at the time of the last census in 2011. Within manufacturing, the Portland smelter accounts for about two-thirds of all local manufacturing jobs But the facility also serves as the industrial anchor for a surprisingly diverse range of manufacturing activity in the region, generating over 400 more jobs. Portland's reliance on manufacturing employment is more than twice as high as the equivalent ratio for the same time for Australia as a whole (which was 9 percent at the time of the 2011 census, and below 7 percent today). The second-largest manufacturing employer in Portland is Keppel Prince Engineering, which supplies specialized engineering services and other inputs to the Portland smelter – and which also manufactures towers for wind turbines. Other smaller manufacturing firms in the region also depend, directly or indirectly, on the Portland 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.

Next to manufacturing, other important employment sectors in Portland in 2011 included health and social services; retail; hospitality services; education; and construction. (A full sectoral breakdown of employment in Portland at the time of the 2011 census is provided in Figure 10.) It is clear that most of these other sectors depend ultimately on the presence of an "anchor" industry like aluminium smelting, in order to justify and support their continued operation in the region. Without that initial economic anchor to support employment and incomes in the community, the continued operation of most of these other "downstream" employers would not be possible.

Figure 10 Employment by Sector, Portland, 2011



Even the provision of public services depends on the jobs and incomes stimulated by the smelter. It is the largest ratepayer to local government in the region (Glenelg Shire), accounting single-handedly for 19 percent of all rate revenue expected to be received in the current fiscal year (Glenelg Shire Council, 2016). If we also consider the levies paid by individuals employed at the smelter (and at other businesses which also ultimately depend on the smelter), then it is apparent that local government and services are crucially dependent on the continued operation of the facility.

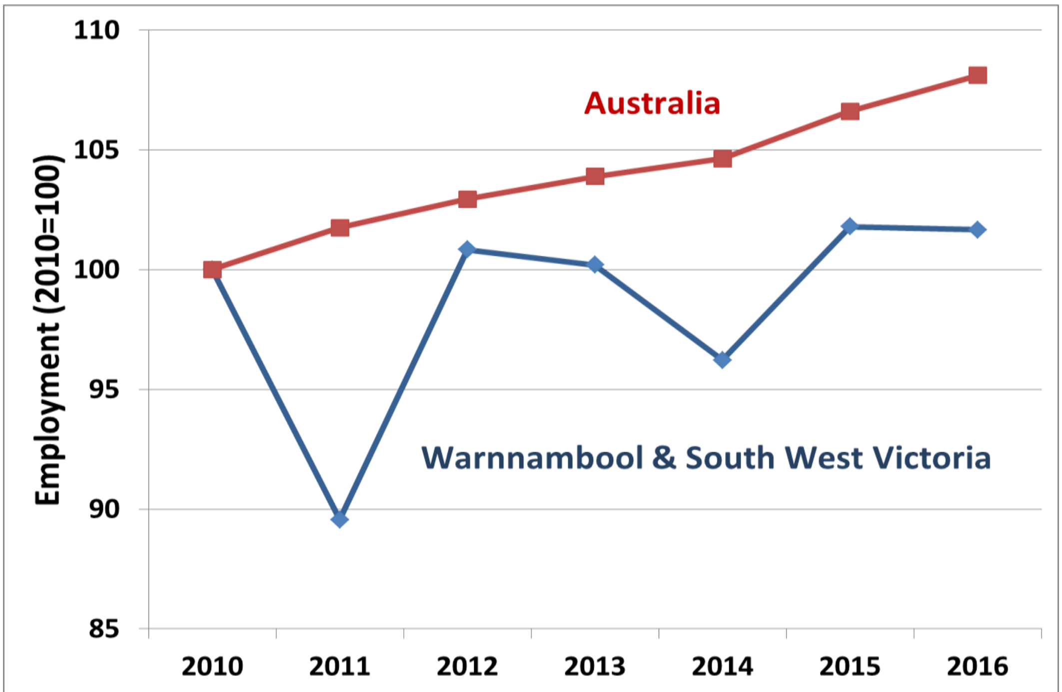
Table 6 Socio-Economic Parameters, Portland VIC			
Indicator	**Portland**	**Australia**	**Difference**
Population Growth 2010-14 (%)	-0.46%	+6.62%	-7.1 %pts
Net Migration 2012-14 (% starting population)	-2.62%	+2.88%	-5.5 %pts
Median Employment Income 2013	$44,218	$48,030	-7.9%
Median Total Income 2013[1]	$41,334	$44,940	-8.0%
Employment Income as Share Total 2013 (%)	87.3%	81.9%	+5.4 %pts
Average Home Price 2013	$238,445	$425,477	-44.0 %

Source: Author's calculations from ABS data.
1. Total income excludes government transfer payments.

Even with the presence of a significant and rather unique manufacturing base, the regional labour market in and around Portland has been characterized by stagnant employment levels, an older population than other parts of Australia, significant net out-migration (primarily young people seeking better opportunities elsewhere), and lower labour force participation than elsewhere in Victoria and Australia. A summary comparison of key socio-economic indicators between Portland and the rest of Australia is provided in Table 6. Portland's population has declined slightly in recent years, mostly due to a net outmigration that has accelerated more recently – reducing the community's population by close to 1 percent per year since 2012. Consequences of population stagnation and outmigration include relatively depressed property valuations. Average home prices are only 56 percent of average national levels. And recent commercial data indicates median sale prices are falling further (down over 20 percent from year-ago levels, according to Property Value, 2016). Uncertainty regarding the ongoing presence of the region's dominant employer, will obviously exacerbate outmigration and its consequences.

Personal incomes are lower in Portland than national averages. Median employment income, estimated at just over $44,000 in 2013, is about 8 percent lower than for the country as a whole. The presence of the relatively well-paying jobs in the smelter are thus crucial for lifting community incomes and reducing the gap with the rest of Australia. Median total incomes (including investment, business, and superannuation income) is lower still. The Portland regional economy is more dependent on employment incomes than is the case elsewhere in Australia: employment earnings account for over 87 percent of total personal incomes (excluding government transfers). This confirms that the loss of the largest employer would have an especially devastating impact on local incomes and spending. It is noteworthy that the Portland smelter single-handedly accounts for about one-quarter of all employment income in Portland, even before considering incomes of the indirect supplier and consumer industry jobs that also ultimately depend on the facility.

Figure 11 Employment Growth, 2010-2016

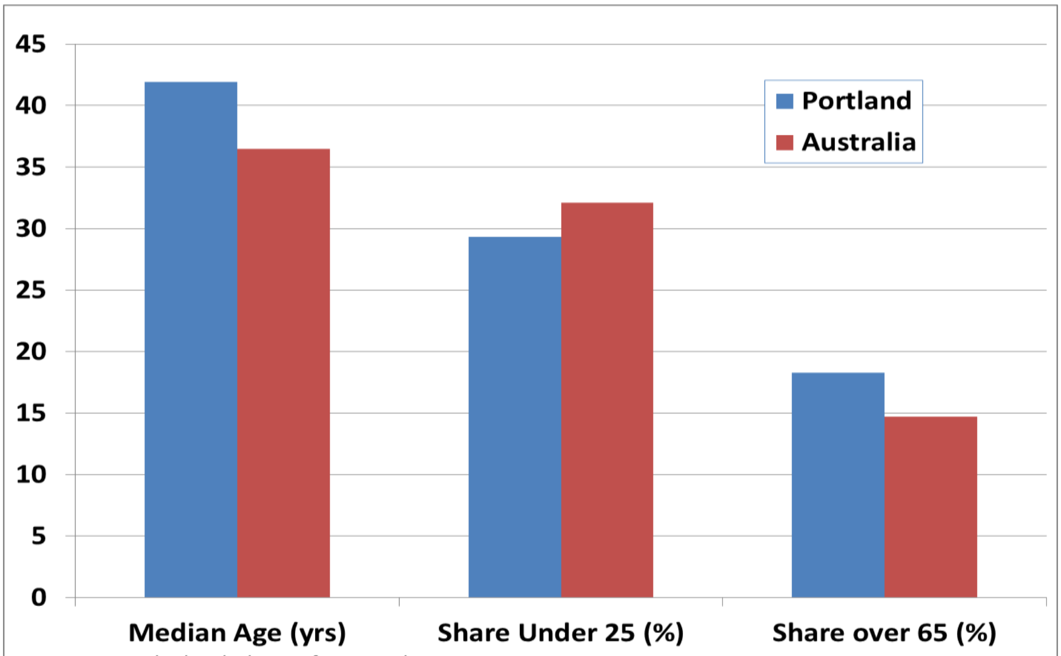


Source: Author's calculations from ABS data. 2016 data for first 6 months.

Reliable annual data on employment and labour force trends are not available at the level of smaller communities such as Portland. Regional data covering the broader Warnnambool and South West Victoria region, however, further attests to the generally weaker starting position of the regional labour market. In that broader region, employment levels have fluctuated around a very slowly growing trend.[23] As illustrated in Figure 11, regional employment levels as of the first half of 2016 are only 1.6 percent higher than in 2010 – and employment has endured volatile cycles during that period. Overall employment in Australia's economy, meanwhile, grew almost 5 times faster (by a cumulative total of over 8 percent in the same period).

The combination of weak employment growth, with ongoing outmigration (primarily driven by the loss of young people), has meant that the regional labour force is relatively older. As illustrated in Figure 12, Portland's population has a higher median age (more than 5 years older than the national median), a larger share of the population over 65, and a smaller share of the population under 25. These indicators attest to the challenge regional communities face in Australia of retaining young workers. Because of the older average age of Portland workers, the process of adjustment to the loss of well-paying jobs at the smelter would be especially lengthy and painful; many would never find permanent employment again.

Figure 12 Labour Force Profile, 2014

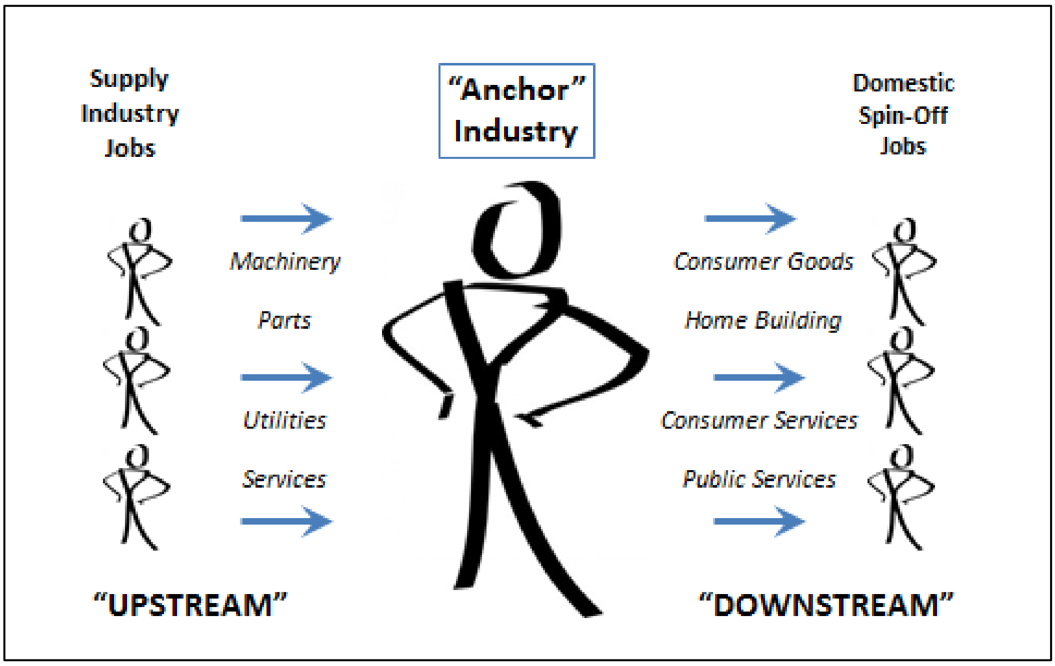


In the context of a relatively depressed regional economy, therefore, the continued operation of the smelter (and other manufacturing businesses) in Portland takes on added importance. The cessation of aluminium smelting would deal a harsh blow indeed to this community. It would cause a dramatic decline in incomes; a major loss of revenues for local government; an acceleration of outmigration and population decline; and a likely collapse in the value of property (and hence in the accumulated household wealth of all Portland residents). The loss of this facility would also throw into question the viability of many other local businesses – including those which supply the smelter itself with goods and services, those which depend on the smelter's presence to justify and fund core infrastructure (including energy and transportation services), and those which depend on the consumer spending power of smelter workers and suppliers. Local business and civic leaders are working hard to broaden the community's economic base, invest in infrastructure and amenities, and to project and promote Portland's many positive features to potential migrants and businesses (as exemplified, for example, in the work of The Committee for Portland, 2015). But there is no doubt that decisions regarding the future of the aluminium operation will be the dominant factor in Portland's future evolution.

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 much broader range of economic activity in its host region, and in the country as a whole. The facility secures many jobs in related sectors – in addition to the high-quality jobs directly created within the "anchor" facility itself. Figure 13 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 various supply and service sectors which sell inputs (like 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 the public services financed from their tax payments – they create the economic foundation for jobs in those downstream sectors.

Figure 13 "Anchor" Industries and their Linkages



Any particular region, and indeed the country as a whole, needs a stable economic foundation of "anchor" industries, hopefully producing a range of sophisticated goods and services for diverse markets (including exports). Without them, the indirect jobs located upstream and downstream would be in jeopardy. From a national perspective, it is best to have several "anchors," not just one; the resulting diversification helps stabilize the economy when one industry falls on hard times (as has recently occurred in the mining sector, for example). We have already noted the various structural and strategic factors which make manufacturing an especially desirable anchor – including its innovation intensity, its superior productivity, its natural engagement with international trade, and its intense supply chain linkages. All of these factors are even stronger in the case of aluminium smelting. By virtue of its capital intensity, the advanced technology used in production, the high productivity and hence high incomes associated with work in the industry, its export orientation, and its extensive and complex supply purchases, smelting demonstrates especially strong linkage effects both upstream and downstream. This section will describe some of the linkages associated with aluminium production in Australia.

SUPPLY CHAIN LINKAGES

Table 5, presented earlier, summarized the broad categories of input purchases associated with the operation of the Portland smelter. This data indicated total supply chain purchases worth about $625 million per year, divided into three broad categories: raw material (primarily alumina), electricity, and "other." Understandably, the proprietary nature of the company data prevents a more detailed reporting of the facility's particular supply purchases.

The Australian Bureau of Statistics provides a more detailed description of the overlapping supply chains which link various industries in Australia, through the input-output tables which are compiled as part of the ABS's national income accounts. The most recent edition of this database describes industry-to-industry flows for the 2013-14 year, and it provides data for 114 different categories of input purchases. Unfortunately, however, the ABS data does not describe aluminium smelting explicitly within its input-output matrix – in part because of the small number of facilities which constitute this industry (raising confidentiality issues related to the public disclosure of the data). Instead, aluminium smelting is amalgamated within a broader category titled "non-ferrous metal manufacturing" (NFMM). This broader combined sector includes alumina refining and aluminium smelting, along with other smaller operations in copper, lead, zinc, and silver refining and smelting. It also includes a range of secondary non-ferrous fabrication activities, including casting, rolling and extruding.[24] Aluminium smelting typically accounts for up to one-quarter of the broader NFMM sector's total employment, labour income, and value-added. It should be kept in mind that the parameters attained from the ABS input-output system therefore imperfectly represent the inputs purchased in aluminium smelting alone. In particular, smelting is a more capital-intensive and high-productivity activity (compared to some of the other sectors contained within the NFMM amalgam), and hence the input-output data will tend to understate the importance of supply chain purchases relative to the number of people employed in smelters.

Table 7
Non-Ferrous Metal Manufacturing, Key Input Purchases, 2013-14

Supply Industry	Purchases ($m)	Derived Employment (full time equivalent)[1]
Non Ferrous Metal Ore Mining	23,167	33,118
Basic Non-Ferrous Metal Manufacturing	2,713	na
Petroleum and Coal Product Manufacturing	1,137	797
Electricity Transmission and Related Services	988	982
Electricity Generation	878	1,258
Road Transport	651	2,705
Oil and Gas Extraction	576	403
Water, Pipeline and Other Transport	324	614
Rail Transport	286	900
Coal Mining	280	385
Gas Supply	242	672
Finance	195	336
Other Suppliers	1,055	2,588
Total Supply Chain Purchases	**32,492**	**44,758**

Source: Compilation from Australian Bureau of Statistics Catalogue 5209.0.55.001.
1. Includes direct inputs only (excluding employment associated with indirect, higher-order suppliers).

Nevertheless, a perspective on the breadth and importance of the smelting industry's supply chain is readily apparent from the ABS data. Table 7 reports the input purchases of the total NFMM sector in 2013-14. The industry purchased a total of

$32.5 billion worth of inputs from various industries in Australia.[25] Total domestic production of the industry for that year was worth $35.6 billion; the difference between the two figures represents the value added in that particular stage of production. The largest input purchase used by NFMM, not surprisingly, was raw material from the mining industry (including bauxite for aluminium). But a total of 77 of all of the 114 industries defined in the ABS input tables reported positive input sales to NFMM. Table 7 lists the 12 largest of those supply sectors (including the non-ferrous metal industry itself, which re-sells some of its own output to other producers within the same broad industry). The web of input purchases of NFMM, therefore, spreads through most of Australia's economy.

Those input purchases, in turn, support a share of the total output and employment undertaken by those various supply industries. Without their customers in NFMM, those suppliers would have to scale back their activity and reduce their payrolls. A first-order indication of the importance of those supply chain relationships to employment can be attained by simply estimating the share of employment in each of the supply industries which depends on their sales to NFMM.[26] This analysis is summarized in the right-hand column of Table 7. Derived employment (measured in full-time equivalents) is listed for each supply industry, based on the share of its total employment presumed to be associated with sales to NFMM. The input purchases of the industry are thus seen to directly support some 45,000 jobs across those 77 other sectors of the economy. Note that the entire NFMM sector directly employed 23,500 workers in 2013-14.[27] This implies that almost twice as many jobs were created in immediate supply industries, compared to the employment directly undertaken within NFMM itself. For aluminium smelting, given its relatively capital-intensive nature and the size and complexity of its input purchases, that ratio will be even higher.

Moreover, this still does not paint the entire picture of the supply chain linkages of aluminium manufacturing. Keep in mind that every supply industry, in turn, requires its own range of input and supply purchases – which in turn support output and employment in all of the 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).

It is already becoming apparent, therefore, that aluminium manufacturing supports a very broad scope of economic activity: much larger than is reflected in direct data regarding its own output and employment. In addition to every direct job in aluminium manufacturing, there are an additional two (or more) positions in the Tier 1 supply industries which sell directly to aluminium producers. And further work exists in Tier 2 and higher-order suppliers, which supply the aluminium suppliers, and which also ultimately depend on the initial stimulus provided by aluminium manufacturing.

DOWNSTREAM EXPENDITURE LINKAGES

The second class of spin-off activity illustrated in Figure 13 above is the output and employment associated with various consumer goods and services industries which depend on the anchor industry for a portion of their market. Without the presence of that facility and its employees (as well as the employees of the supply chain which services it), those "downstream" activities would lose much of their market and have to contract their operations accordingly. This dependence of consumer-oriented industries on the presence of major anchor industries is especially apparent in relatively remote, self-contained communities – such as Portland. There it is obvious that the presence of a major initial employer, attracting initial investment, people, and infrastructure, is critical to the prosperity of the region, and to the viability of all local consumer-oriented businesses. But the same relationships are present (although more complex) in large, more diversified population centres (like Australia's capital cities): they also ultimately depend on the presence of anchor industries to attract investment and people, generate revenue from far-off customers, and support direct and indirect employment.

Downstream expenditure linkages encompass all the components of consumer spending: including homes and residential construction; household and consumer products; and the whole range of consumer services (including utilities, personal services, hospitality, finance, wholesale and retail services, and more). Even public services, financed from tax revenues paid by residents of the community in question, ultimately depend on the initial presence of the anchor industry;[28] the fiscal linkages of anchor industries are discussed further in the next section.

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 58 percent of GDP in the last year; government final consumption (consisting of the direct services provided by government) accounted for another 19 percent.[29] 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 (just over 20 percent) as applies to Australian GDP in aggregate, this implies that about 60 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 services.[30] 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 about 0.6.

The precise magnitude of this relationship, and the time frame within which it is experienced, depends on many factors – such as consumer responses to changes in income, the availability of alternative sources of income in the event of job loss, a more detailed disaggregation of consumer expenditure and import propensity, and other factors. Nevertheless, it is reasonable to trace back a significant volume of output and employment in domestic consumer industries to the initial stimulus provided by the presence of anchor industries; for any anchor facility like a smelter (and its supply chain) which supports, say, a total of $1 million in incremental value-added that otherwise would not have been produced, there will be another $600,000 in downstream consumption demand arising for Australian-produced goods and services, thanks to the downstream spending of people working at the anchor facility and its suppliers. And once again, that is only the first-order effect of the downstream linkages: individuals who then become employed in those downstream sectors, will in turn spend their own incremental incomes, further amplifying the ultimate spin-off effect of the initial activity.

FISCAL LINKAGES

As noted, public services are included among the downstream industries that depend on the initial existence of an anchor industry. Those services ultimately depend on the incomes generated by the anchor industry and its suppliers, expressed through tax revenues collected from the resulting incomes, expenditures, and profits. This is readily apparent in the case of relatively remote communities like Portland. It is obvious that without the aluminium smelter (and other anchor businesses in the community) the need for public infrastructure and services would be reduced – and so would the community’s financial capacity to pay for them.

It is worth summarizing 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 – hence underpinning the capacity to provide public services and investments in public infrastructure. On average in Australia, about 33 cents of every dollar in GDP ultimately shows up in current gross income of government: 9 cents is received by state and local governments, and just under 24 cents by the Commonwealth government.[31] Of course, these ratios represent the composite effects of a wide variety of different tax and revenue streams. Table 8 summarizes some of the more important government revenue flows that will be affected by the presence or absence of aluminium manufacturing in Australia.

The provision of local government services in the Portland area would obviously be dramatically undermined by the cessation of aluminium smelting, and the resulting loss of direct taxes and fees paid to local and regional authorities by the smelter, its suppliers, and employees.[32] But even the services provided by higher levels of government would be affected incrementally by the loss of incomes and revenues resulting from the loss of the facility. We will apply the aggregate fiscal ratios reported in Table 8 to the estimates of total economic impact developed in the next section of this report, to then estimate the extent to which the public sector would be affected by the loss of the Portland smelter.

Table 8
Aluminium Manufacturing and Government Revenue Streams

Revenue Stream	Rate
Commonwealth Government	
Personal Income Tax (employees)	Up to 47 percent
Medicare Levy (employees)	2 percent
Fringe Benefit Tax (employer)	49 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	
Victoria State Payroll Tax (employer)	4.85 percent
Work Cover Rate (employer)	4.168 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	
Commonwealth	23.7 percent of GDP
State and Local[1]	9.0 percent of GDP

Source: Author's compilation from Australian Bureau of Statistics (2016d) and various government sources.

1. Excludes transfers from Commonwealth.

VI. Estimating the Aggregate Economic Impact of the Portland Smelter

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

Other published research has also attempted to estimate the overall economic impact of aluminium manufacturing, on the basis of input-output parameters and the consideration of both upstream and downstream linkages. The results vary, depending on the scope of the defined direct industry (is the "anchor" industry defined as aluminium smelting only, or does it include other activities such as secondary fabrication?), the regional 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 recently for the Aluminum Association in the U.S. (Dunham, 2016). It defined the direct anchor 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.[33] It estimated that the ultimate impact on U.S. GDP of aluminium production totaled $186 billion (U.S.), or some 2.5 times the direct GDP produced by the defined 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.[34] In general, the smaller is the geographical area considered in the analysis, the smaller will be the estimates of final economic impact, by virtue of the greater "leakage" of supply-chain and downstream expenditure effects out of the regional economy to other regions. National-level studies capture more of these indirect and induced linkages, and hence tend to generate larger estimated impacts.

Other research into the economic impacts of key manufacturing sectors, similarly incorporatinig a range of 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 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 find very strong spillover effects, reflecting the extremely complex supply chain which feeds any automotive assembly operation, and the very capital-intensive nature of its activity.[35] Given these broad 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.

The following section of the report describes simulation results from the use of a quarterly regionally-disaggregated macroeconomic model, with input-output flows modeled on the basis of fixed coefficients, and with output and employment responding to downstream aggregate demand conditions. Analyzing the ultimate economic impact of an industry is naturally a complex and uncertain undertaking. The various linkages between that specific industry and the broader economy can be traced (as we have done above). But simulating what would happen in the absence of a facility or industry is inherently more speculative, depending on assumptions made regarding what would occur after its shutdown.

Some economists have faith that adjustments in prices, spending patterns, and supply linkages following the closure of any particular facility, or even the shutdown of an entire industry, would allow the economy to quickly adjust: overcoming the initial loss of jobs (direct and indirect), and minimizing the ultimate impact on economic aggregates. In this approach, any industrial downsizing is a transitory event, automatically and quickly offset by new job-creation in other sectors. This theoretical approach is never realistic[36] – but it is especially far-fetched in present Australian circumstances of lasting unemployment, weak demand conditions, falling business investment, and large trade deficits.

At the opposite extreme is the assumption that workers and resources displaced as a result of a workplace or industry-wide closure would never be reemployed doing anything else. Under this approach, the upstream and downstream linkages described above (including input-output supply relationships, and downstream consumer expenditure effects) are assumed to be unchanging and permanent. This assumption is not valid in the long-run: even in depressed macroeconomic conditions, some economic adjustments will occur, and some displaced workers will find new jobs (perhaps in other locations, and likely at reduced wages). This approach, therefore, is most appropriate for simulating the shorter- and medium-run impacts of a major change in output and employment in a particular industry, recognizing that in the long-run some adjustments will occur.

Reality lies somewhere between the assumptions adopted by these contrasting schools of economic modelers.[37] However, in current macroeconomic conditions, input-output and expenditure-based simulations (like those reported below) are certainly appropriate. Given chronic unemployment and underemployment, overall output in Australia is evidently constrained by weakness in aggregate purchasing power. The loss of a crucial "anchor" facility, like the Portland smelter, will then translate into sustained reductions in total employment and output – and not just during a temporary process of "adjustment."

The simulation results below were generated by a macroeconomic input-output model constructed and operated by the National Institute for Economic and Industry Research, based in Victoria. We contracted the NIEIR to simulate the direct, indirect, and induced economic effects resulting from the hypothetical closure of the Portland aluminium smelter. The NIEIR model features a high degree of regional disaggregation (to the level of local government areas) and sectoral detail (providing information on output and employment in 86 different industries, broadly matching the same level of detail reported in the ABS input-output database). The results of the simulations can be interpreted as estimates of the potential impacts arising from the closure of the Portland smelter in a medium-run time frame: that is, once supply industries and downstream industries have felt the shock of the loss of business associated with the Portland facility, but before broader macroeconomic variables (including outmigration, wage changes, other price changes, and possible exchange rate and interest rate adjustments) have adjusted to the new situation. Even if and when those broader adjustments do occur (and that would take several years), important economic and social costs will still have been incurred in the meantime – felt particularly acutely, of course, in the Portland region. More details of the methodology used in the simulation exercise are provided in the appendix to this report.

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 the hypothetical change imposed within it: in this case, the model is adjusted to reflect a reduction in output of aluminium from the Glenelg region of Victoria, corresponding to the assumed closure of the smelter there. The impact of the event is then estimated by the difference between the two solutions; in this case the modeler has assumed that the plant closes in 2018, and the results are measured 8 quarters later.[38]

The main simulation case considered below (labeled the "Base Case") assumes the closure of the Portland smelter, and then a corresponding proportional decline in output and employment in the various supply industries which service that smelter. Chief among those is the Kwinana alumina refinery in Western Australia (also operated by Alcoa), which sells some $325 million per year worth of alumina to the Portland smelter (transported by ship); consistent with the assumptions described above, the simulation assumes a proportional reduction in output and employment at the Kwinana refinery (and similar changes at other facilities and industries which supply the Portland operation). The results of this simulation are summarized in Table 9. The simulation includes expected upstream and downstream linkage effects resulting from the Portland closure.[39]

Table 9
Base-Case Scenario: Portland Smelter Closure

	Victoria	Western Australia	Other States	Australia
GDP ($m)	-$558.5	-$130.0	-$121.3	-$809.8
Household Disposable Income ($m)	-$118.6	-$79.2	-$53.4	-$251.2
Employment (Number)	-2257	-716	-668	-3640
Exports ($m)				-$840.0
Direct Tax Revenue ($m)[1]	-$50.3	-$11.7	-$10.9	-$191.8

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 only.

National GDP is expected to decline by just over $800 million, and national employment shrinks by 3640 positions. About two-thirds of those losses, not surprisingly, are expected to be concentrated in Victoria. However, because of the spillover impact on demand for alumina produced in Western Australia, that state also experiences significant negative impacts from the Portland closure (including over 600 direct, indirect, and induced job losses, and over $100 million in lost GDP). Household disposable income declines by $251 million across Australia. Governments also experience a significant revenue hit as a result of the closure: direct state revenues in Victoria (based on the average assumed state tax share in GDP of about 9 percent) fall by over $50 million, and the Commonwealth government (which collects a much larger share of total GDP in various taxes) loses $192 million. National exports decline by $840 million (recall that the Portland smelter exports all of its output), adding incrementally to Australia's already-large balance of payments deficit. The Portland region, of course, is the most devastated by the closure of the smelter. The simulation results suggest that over 1500 jobs, and over $70 million in household disposable income, are lost from the Glenelg local government area alone.

These "Base Case" simulation results confirm that the Portland smelter holds national economic significance. The loss of a large, high-productivity, export-oriented, capital-intensive manufacturing facility produces visible losses in national economic aggregates, and incrementally exacerbates already-existing challenges of government deficits, trade deficits, and unemployment. However, in practice it is possible that the consequences of the smelter closure could be even worse. The Kwinana alumina refinery is the oldest and smallest in Australia. About one-third of its business depends on sales to the Portland facility. Australia has already experienced one recent alumina refinery closure (at Gove, in the Northern Territory), in the face of daunting global economic challenges. Alcoa, the major owner of the Portland and Kwinana facilities, is in the midst of a major corporate restructuring aimed at cutting costs, shedding assets, and focusing capital and management attention on certain sub-sectors deemed more promising in the long-term – in particular, focusing on more profitable "value-added" activities. It is not far-fetched that the closure of the Portland smelter could have a domino effect on the Kwinana refinery, which in turn could conceivably close entirely – rather than trying to survive a one-third decline in its sales (with concomitant impacts on efficiency and unit cost).

In that event, described below as a "Worse Case" scenario (see Table 10), the overall impacts on Australia's economy (and Western Australia in particular) would be much worse. The total loss of national GDP reaches $1.75 billion (including a $2.5 billion hit to exports, swollen by the loss of Kwinana's previously exported output and a loss of exports from other sectors). Over 8000 jobs are lost in total. The impact on state GDP, disposable income, and employment is now worse in Western Australia than in Victoria: since the Kwinana facility employs more people than the Portland refinery, its closure would be even more damaging there. The Commonwealth government experiences a revenue loss of over $400 million per year, and Western Australia alone loses over $75 million in annual state revenue. Given that state's already challenging economic predicament (in the wake of a sharp downturn in other mining activity), this would be a serious additional blow.

Table 10
Worse-Case Scenario: Portland Smelter and Kwinana Refinery Closures

	Victoria	Western Australia	Other States	Australia
GDP ($m)	-$690.7	-$855.2	-$205.1	-$1,751.0
Household Disposable Income ($m)	-$131.4	-$571.0	-$96.9	-$799.3
Employment (Number)	-2473	-5106	-1240	-8819
Exports ($m)				-$2,493.5
Direct Tax Revenue ($m)[1]	-$62.2	-$77.1	-$18.5	-$414.7

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 only.

Perhaps most worryingly, the loss of another aluminium smelter and another alumina refinery would confirm and accelerate the dramatic and ongoing retreat of Australia from value-added aluminium manufacturing. Our aluminium activity would become all the more intensely focused on the extraction and export of raw, unprocessed resources – abandoning the value-added work of refining, processing, and manufacturing those resources to other countries. And the spillover impact of these closures on the remaining alumiunium operations in Australia should also be considered carefully. Manufacturing industries experience well-known "cluster" spillovers, whereby success by one producer can encourage and support the expansion of others (through various channels, including the impact of one facility's demand on the efficiency of the associated supply chain); by the same token, failure and contraction can be echoed across the whole sector. This relationship was demonstrated painfully with the consecutive announcements by all three major automotive manufacturers to exit Australian manufacturing. With the critical mass of value-added aluminium manufacturing in jeopardy, and other aluminium producers also experiencing financial challenges, the consequences of the closure of the Portland facility could be catastrophic for the whole sector.

Tables 9 and 10 confirm that the impacts of the loss of the Portland facility would be felt in all states of the country – all the more so, in the “Worse Case” scenario including the closure of the Kwinana refinery. As indicated in Table 11, the spillover effects are also experienced throughout all sectors of the economy. The biggest losses in output are experienced in aluminium production and its largest supply industries (mining and electricity). But significant losses are incurred in all other goods- and services-producing sectors of the economy. Those industries all experience a loss in sales formerly destined for the aluminium industry (from both Tier 1, and higher-order suppliers); and they also lose work as a result of the generalized contraction in spending power which results from the closure(s). This confirms that the future of aluminium manufacturing, like other anchor industries, is a matter of importance for the whole Australian economy – not just that industry and the communities where it operates.

Table 11
Decline in Gross Output per Sector, $million

	Base-Case	Worse-Case
Primary Metal	-$400.8	-$473.1
Electricity	-$58.7	-$85.4
Metal Ore Mining	-$44.4	-$337.8
Other Primary	-$58.5	-$109.3
Other Manufacturing	-$30.0	-$62.9
Transport & Warehouse	-$48.9	-$88.7
Finance & Insurance	-$58.5	-$130.5
Other Services	-$149.9	-$373.7

Source: Economic simulations as explained in text.

VII. Analysis and Conclusions

The gloomy picture described above of an important, value-added industry entering a terminal downward trajectory, is certainly possible, but hardly inevitable. The aluminium industry is experiencing a period of global uncertainty and losses, as it adjusts to China's slowdown – and as both producers and policy-makers respond to the resulting surge in Chinese aluminium exports. 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. Environmental challenges associated with aluminium production can be confronted in the course of a broader strategy to develop sustainable, secure energy supplies (since electricity generation is the major cause of greenhouse gas emissions associated with aluminium production). This is an industry that will become more important in the future, not less. And it is still contributing disproportionately to productivity, incomes, and exports for Australia's national economy – all the more so in the wake of the recent damaging erosion of Australia's overall manufacturing base. Other countries are responding to the current 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, favourable domestic procurement rules, and more.

Australia can and should remain a significant player in global aluminium manufacturing. Our natural resources, our industrial experience, our know-how and innovation potential, and our important domestic market all justify such a role. The existential question facing the country is whether our presence in this industry will be limited to the extraction and export of non-renewable ore, or whether we are intent on preserving a more diversified and value-adding role for our national economy.

After several years of instability and downsizing, Australian aluminium manufacturing (at all stages, from refining to smelting to fabrication) is damaged and fragile. The industry cannot afford the loss of another "anchor" facility. As described here, the consequences of the loss of the Portland facility would be regionally devastating and nationally significant. Its closure would have meaningful impacts on national output, employment, and export performance. It would undermine Commonwealth, state, and local government revenues, when government needs every dollar to finance needed public services. And given current regulatory structures, it cannot even be assumed that the closure of the Portland operation would reduce Australia's greenhouse gas emissions. (At any rate, the transfer of aluminium production from Australia to other regions which are adding new smelting capacity, such as China or the Middle East, would not reduce aggregate global emissions.) Most frighteningly, the Portland closure could set off a structural chain reaction that culminates in the closure of a major refinery – and perhaps even worse.

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

Trade remedies

Australian aluminium manufacturers (both primary smelters, and secondary fabrication operations) have been negatively affected by a growing surge of 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 are already underway in the U.S.), this would send a strong message that the current condition of oversupply within China cannot be allowed to result in the destruction of this important industry elsewhere.

Discouraging exports of unprocessed bauxite

Other countries (most recently including Indonesia and Malaysia) have imposed quantitative limits or taxes on exports of bauxite, as a response to China's escalating demand for the raw product – and in order to stimulate more refining and smelting within their own borders. The continuing deindustrialization 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).

Leveraging public infrastructure

With aluminium, as with steel, there will be considerable demand in future years for basic metal products as inputs to future public infrastructure investments. These include buildings, railways, and other transportation projects that utilize large amounts of aluminium. 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, are converted to the fullest possible extent into demand for Australian-made aluminium.

Stable, secure energy pricing

The Portland smelter was deliberately located in that community as part of a broader state initiative to develop the whole southwest region of Victoria – including to provide the region with modern electricity transmission facilities and hence more reliable, affordable energy. The past practice of directly subsidizing electricity use by the smelter is no longer practical for multiple reasons: including the fact that the electric utility has been privatized, and the need for economic incentives to promote power conservation and greenhouse gas reduction. However, measures to ensure stability and affordability in energy pricing across all modes of generation, and to recognize the importance of stable, affordable energy as an input to trade-exposed industries (like aluminium), are still valid and important. One especially promising initiative in this regard would be the implementation of a national gas reservation policy, in order to regulate natural gas exports. The current practice of allowing unregulated bulk LNG exports is already pushing up prices across all forms of energy, and those impacts will get worse in coming years without explicit protection for Australian consumers (and in particular for major industrial users).

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. With a direct payback through the tax revenues generated by incremental economic activity, this support can genuinely be considered an investment – not a "hand-out." Taxpayers and budget deficits will both be worse off, if this industry continues to migrate out of Australia. Fiscal support could be structured in many different forms. Tax incentives should be focused on leveraging incremental Australian investment and production (such as investment tax credits or similar structures, rather than across-the-board corporate tax cuts). Public equity co-investments, to support the recapitalization and modernization of existing facilities, could also be helpful.[40]   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 – let alone helping to preserve needed jobs and incomes.

These are just a few 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 there are no doubt other policy responses that could be added to the list. Ensuring the future of the Portland smelter is the most pressing test of government's willingness to play an active role in supporting value-added aluminium manufacturing.

There is no shortage of policy tools which government could invoke to make a positive difference to this industry's future Australian footprint. 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.

Appendix

Economic impact analysis: The Portland smelter

Study objective

The objective of this study is to investigate the impact on the Australian, State and regional economies of the closure of the Portland (Victoria) aluminium smelter. Two scenarios were investigated. The “Base case” scenario consisted of the smelter closure and the proportional contraction of alumina production at the Kwinana refinery (equivalent to its input into the Portland smelter). The “Worse case” scenario is developed on the assumption that if the Portland smelter closes the Kwinana refinery will also close entirely, as a result of the loss of a major portion of its sales.

The basic descriptive statistics for the two facilities covering:

- employment;
- income; and
- sales,

were supplied to NIEIR by the client, and used as input to our model.

The modelling framework

The modelling framework is based on NIEIR’s Local Government Area (LGA)-based inter-regional input-output quarterly model of the Australian economy. Each of the 567 LGAs is described with its own input-output sub-model at the 86 industry 2-digit level. Each industry in a given LGA is linked to the same industry in any other LGA by a 567 by 567 inter-regional trade flow matrix. The model also incorporates macroeconomic and expenditure effects, recognizing that output and employment over the forecast horizon depends on the level and composition of aggregate expenditures.

The database has been updated with ABS data up to and including the December quarter 2015. The data base includes the 2016-17 NIEIR/ALGA “State of the Regions” report of June 2016.

The modelling results for the two scenarios are compared to initial model outcomes to generate an estimate of the impact of the simulated shocks. The shocks are imposed effective in the first quarter of 2018; the estimated impacts are then measured after two years.

This type of model is well-suited for simulating the short- and medium-run path of the economy under conditions of imperfect market-clearing, imperfectly flexible prices, and the existence of unemployment. Under these conditions changes in aggregate or sectoral expenditure flows translate relatively directly into changes in output and employment in affected industries. The model's regional and sectoral detail also makes it well-suited for disaggregating inter-regional and inter-industry impacts of simulated economic or policy changes.

Regular updates of this model incorporate behavioural functions describing household consumption expenditures, hours of labour demanded, and other variables. In contrast, this impact study "freezes" the structure of the economy as reflected in the 2015 database, and hence the results are typical of "pure" textbook input-output inter-regional multipliers. Specifically, the following parameter settings are held constant within the model based on 2015 data:

(i) the prevailing consumption to disposable income ratio by LGA;

(ii) consumption expenditure share at 2-digit ANZSIC industry by LGA;

(iii) hours demanded per $m of output by 2-digit ANZSIC industry by LGA;

(iv) employment in numbers demanded for 1,000 hours worked by 2-digit ANZSIC industry by LGA;

(v) $/hour wages by 2-digit ANZSIC industry by LGA;

(vi) international imports per $m of demand by 2-digit ANZSIC industry by LGA; and

(vii) the inter-regional trade flow matrix fixed at average 2015 values by 2-digit industries by 567 LGAs.

Other variables assumed held constant at the macroeconomic level include business capital investment, interest rates, and exchange rates. Variations and behavioural responses in any of these fixed coefficients would affect the adjustment of the overall economy to the simulated shocks. Hence the results reported here should be interpreted as first-order medium-run impacts of those shocks.

The impact estimates described above reflect "Type II" multiplier effects, and incorporate both the inter-industry flow-on effects resulting from the simulated shocks, as well as income-expenditure flow-on effects in the household sector (assumed to result from the changes in output and employment simulated by the input-output portion of the model).

A more detailed disaggregation of the simulation results across sectors and regions is available on request from the authors of this report.

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Notes

[1] All of these estimates depend on key methodological assumptions which are explained fully in the text.
[2] Aluminium smelting is a very electricity-intensive process, with energy costs typically accounting for about one-third of the total cost of production.
[3] Realized prices for primary aluminium were therefore 58 times greater than prices for bauxite. It is not meaningful to report the value of fabricated aluminium products in equivalent weight-based terms, given their immense diversity in form and complexity.
[4] Of course there are dozens of other manufacturing sub-industries which also use aluminium as an important input; these two are the only sub-sectors reported by the ABS which concentrate in aluminium products.
[5] While value-added and labour compensation data are not reported for bauxite mining, on the basis of total shipments and employment levels it is safe to conclude (on the basis of average productivity and incomes in other mining activities) that bauxite mining adds more than $1 billion in additional GDP, and close to $0.5 billion in labour incomes.
[6] That explains why the total employment levels reported for aluminium smelting in Table 1 above exceed the sum of direct employment levels at the four smelters.
[7] While the Tomago and Boyne Island smelters began initial operations before Portland, they have been substantially expanded with additional capital expenditure within the last 15 years, so it would be incorrect to conclude that they are "older."
[8] Author's calculations from ABS catalogue 5302.0, "Balance of Payments and International Investment Position." The current account deficit has since widened further, to $85 billion over the four most recent quarters ending June 2016 – the largest nominal payments deficit in Australian history.
[9] 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.
[10] International Aluminum Institute (2016).
[11] See, for example, Phillips et al. (2015), Exhibits 23 and 28.
[12] Recent trends in steel markets reflect a similar but more advanced chain of events: a slowdown in growth of Chinese consumption being outstripped by still-strong expansion in domestic production, with the resulting surplus exported – and putting enormous downward pressure on world steel prices.
[13] Australia Department of Industry, Innovation and Science and Westpac Bank (2016), p. 38.
[14] The U.S. may "pass" Australia in this dubious distinction in 2016 on the basis of additional closures announced for later this year.
[15] Demand for primary aluminium in OECD countries has been growing at an average of 4 percent per year since 2009; Phillips et al. (2015).
[16] See Stanford (2016) for a full description of all data reported in this section.
[17] Chile has a land border with other Latin American countries but geographical barriers (mountains and jungle) prevent effective bulk land transportation of manufactured products.
[18] According to the OECD (2015) the purchasing power parity value of the Australian dollar is 65 cents (U.S.). Interest rates that are higher than other industrial economies, and strong inflows of foreign capital (including for real estate purchases), are supporting the dollar at levels well above this bench-mark despite a large and growing international payments deficit.
[19] Author's calculations from Conference Board (2016).
[20] An illustration of the structural separation between aluminium smelting and electricity generation has been provided by the experience of the AGL electric utility which currently supplies the Portland smelter. It has recently notified its investors of the termination of electricity hedging contracts associated with the Portland facility, but stressed that due to the "strong futures market outlook for wholesale electricity prices" it did not anticipate any negative impact on earnings. The company clearly anticipates being able to sell its output to the broader market regardless of its future sales to Portland; see AGL Energy Ltd. (2016).

[21] In June 2016 Victoria committed to a target of 25 percent renewable electricity generation by 2020, and 40 percent by 2025.
[22] For more details on the facility's history see Portland Aluminium (2006).
[23] Because of the small sample sizes used to compute these regional labour force data, they tend to be more volatile than state- or national-level series.
[24] The precise concordance of sub-sectors contained within the ABS input-output aggregations is described in Australian Bureau of Statistics (2015), Table 2.
[25] This total does not include additional purchases by the NFMM sector of imported inputs which compete with Australian-made products; those imported inputs were worth another $3.4 billion in 2013-14.
[26] This approach assumes that work done for NFMM customers is reflective of the same general labour intensity as the overall output of the industry.
[27] Author's calculations from Australian Bureau of Statistics (2016c), "Manufacturing industry by ANZSIC class."
[28] Unless those public services could be financed indefinitely by fiscal transfers paid in by taxpayers in other regions, which seems unlikely in the long-term.
[29] All data in this section reflects author's calculations from Australian Bureau of Statistics (2016d).
[30] More precisely, the sum of the average private consumption propensity (57.8 percent) and government consumption propensity (18.8 percent) times 1 minus the aggregate import propensity (21.4 percent) equals 60.2 percent. Those propensities reflect averages of GDP by expenditure at current prices reported by the ABS over the latest four quarters.
[31] State and local revenues do not include transfers received from the Commonwealth. Author's calculations from Australian Bureau of Statistics (2016d).
[32] As noted above, the Portland smelter is the largest single rate-payer to the Glenelg local government, accounting for about one fifth of total rate revenue in that local government area.
[33] In this study downstream spending related to direct aluminium producers and their Tier 1 suppliers increases total output by a factor of just 0.35, but increases total employment by a larger multiple (0.69) reflecting the greater average labour-intensity of downstream consumer industries.
[34] See, for example, Conway (2006), Flynn (2005), Kunin (2003), and Von Nesson (2015).
[35] Hill et al. (2015) and Barbara and Spoehr (2014) report very strong upstream and downstream linkages for automative manufacturing in the U.S. and Australia, respectively, with final supported employment (including direct, indirect, and induced effects) equal to as much as 8 times original vehicle manufacturing employment.
[36] These assumptions of self-adjusting markets are built into most computable general equilibrium simulation models, of the sort commonly used to analyze the effects of trade agreements, tax changes, etc. See Stanford (2003) for a review of the methodological and operational weaknesses of these models.
[37] See Denniss (2012) and Gretton (2013) for recent overviews of the application of economic models to current policy debates.
[38] The timing of this simulation is purely arbitrary and does not reflect any expectation regarding the possibility or timing of such an event.
[39] In the parlance of the NIEIR modelers, these upstream and downstream linkages correspond to "Type I" and "Type II" multiplier effects, respectively.
[40] Recall that public equity co-investments were essential to the initial establishment of many aluminium manufacturing facilities in Australia, including the Portland smelter.