A Fair Share for Australian Manufacturing:

Manufacturing Renewal for the Post-COVID Economy

By Dr. Jim Stanford
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The Centre for Future Work at the Australia Institute

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Introduction: A New Opportunity

Since the COVID-19 crisis emerged, Australians have been starkly reminded of the importance of being able to manufacture goods domestically. International shortages of medical equipment and personal protective equipment, exacerbated by restrictions on exports imposed by some governments (including the U.S.), created concern that Australia might not have access to essential supplies. Australia's government and manufacturers scrambled to convert domestic facilities to try to produce some medical equipment and supplies. Even supplying simple products like masks proved to be a challenge for our economy. While thankfully critical shortages did not emerge (thanks mostly to Australia's success in 'flattening the curve'), the crisis reminded Australians that being able to domestically produce a full range of essential manufactures is a matter of national wellbeing. Similar concerns about domestic manufacturing capability for nationally strategic equipment (such as defence products) have also motivated renewed concern about the erosion of Australia's national capacity to 'make stuff.'

For many years the conventional economic wisdom was that as a high-wage, resource-rich economy, Australia was unable to competitively manufacture — nor did it need to. Between digging up raw materials and shipping them to our trading partners (who subsequently manufactured those resources into higher-value products which they sold to us … at a premium) and our success in some service exports (such as higher education for foreign students), it was argued we no longer needed to produce the things we use. The COVID-19 pandemic has shattered that complacency. Even senior government officials, who long trumpeted the virtues of free trade and so-called 'comparative advantage' specialisation, now concede that Australia's domestic manufacturing capability has declined too far.[1] And government bodies (including the National COVID-19 Coordination Commission, or NCCC) are investigating opportunities for revitalising manufacturing as part of Australia's post-pandemic economic reconstruction.

It's true the extraction of our extraordinary mineral endowment made some Australians wealthy, but in a very lopsided way. Our precarious national reliance on resource extraction, combined with the long decline of manufacturing (which traditionally offered decent employment opportunities for working class Australians), has made Australia a far more unequal society. It has also put us continually at the mercy of boom-and-bust cycles in global demand for resources, and undermined our

[1] See, for example, Sas (2020).

national progress toward decarbonisation and meeting greenhouse gas reduction commitments.

Manufacturing is not just 'another' sector of our national economy. For several concrete reasons, manufacturing carries a strategic importance to our broader economy, society and security.

- Australians purchase and use more manufactured goods over time; and manufacturing output is growing around the world. Allowing domestic manufacturing to decline, while our use of manufactured products grows, undermines national output and trade performance.

- Manufacturing is the most innovation-intensive sector in the whole economy. No country can be an innovation leader without manufacturing.

- Manufactured goods account for over two-thirds of world merchandise trade. A country that cannot successfully export manufactures will be shut out of most trade.

- Manufacturing anchors hundreds of thousands of other jobs throughout the economy, thanks to its long and complex supply chain. Billions of dollars' worth of supplies and inputs are purchased by manufacturing facilities, which support many other sectors of the economy.

- Manufacturing offers relatively high-quality jobs, more likely to provide full-time hours and above-average incomes. And thanks to strong productivity growth and the capacity to apply modern technology, manufacturing offers the prospect of rising incomes in the future.

For decades, Australian policy-makers seemed to take manufacturing for granted. Dazzled by the appealing but temporary riches of a resource boom, many concluded Australia did not need manufacturing. Now, however, the strategic importance of manufacturing has become more obvious. A secure and resilient society needs the capacity to produce a broad range of manufactured products. Australian workers and businesses clearly possess the knowledge and skills to do that: but we have mismanaged our economy and undermined the viability of a manufacturing sector that could put those talents to work.

For several reasons, this is an opportune moment to launch a new, multi-faceted effort to revitalise Australian manufacturing:

- There is new public awareness of the importance of domestic manufacturing capability.

- Previous global supply chains have been disrupted by health measures, changes in trade policy, and other factors, forcing us to re-learn how to produce more things at home.

- The depth and speed of the economic contraction associated with the COVID-19 pandemic requires an ambitious strategy to re-start national production and employment after the health emergency, and manufacturing could play a central role in that effort.

- Global economic adjustments, including declines in resource prices and the exchange value of the Australian currency, have substantially enhanced the cost-competitiveness of Australian manufacturing.

- A continuing revolution in the technology and economics of energy is creating a new source of competitive advantage for Australian manufacturing: namely, our abundant resources of renewable energy, unmatched in the industrialised world.

In short, the prospects for revitalising domestic manufacturing are brighter right now, than at any time in recent decades. We need a stronger manufacturing sector, for the well-being of our economy, and the security of our society. This paper will discuss the reasons why manufacturing carries such a disproportionate strategic importance to our overall prosperity. It will provide a profile of the industry's current status, highlighting the underdevelopment of our value-added industries. It will discuss in more detail several factors that have shaped Australia's recent manufacturing performance: including the nature of our international trade engagements, the poor state of our vocational training system, and the new developments in energy that are altering traditional cost models. The paper will then describe the broad principles of active industry policy, and the specific ways in which those policies could be applied to deliver immediate benefits to Australian manufacturing.

The overarching goal of a strategy to revitalise Australian manufacturing should be to ensure that Australia can maintain a footprint in this strategic sector that is broadly proportionate to our growing demand for manufactured products. We define this goal as a 'Fair Share Manufacturing Strategy.' If Australia were to produce as much manufactured output as we consume (just like most other industrial countries do),[2] this would drive welcome and substantial growth and benefits in all areas of our national economy, including:

[2] As discussed below, this does not imply Australia produces everything we use; extensive two-way trade in manufactured products would still play a critical role in facilitating mutual specialization and efficiency. But in aggregate terms, Australian manufacturing would expand to a similar proportion to the scale of our consumption of manufactured products.

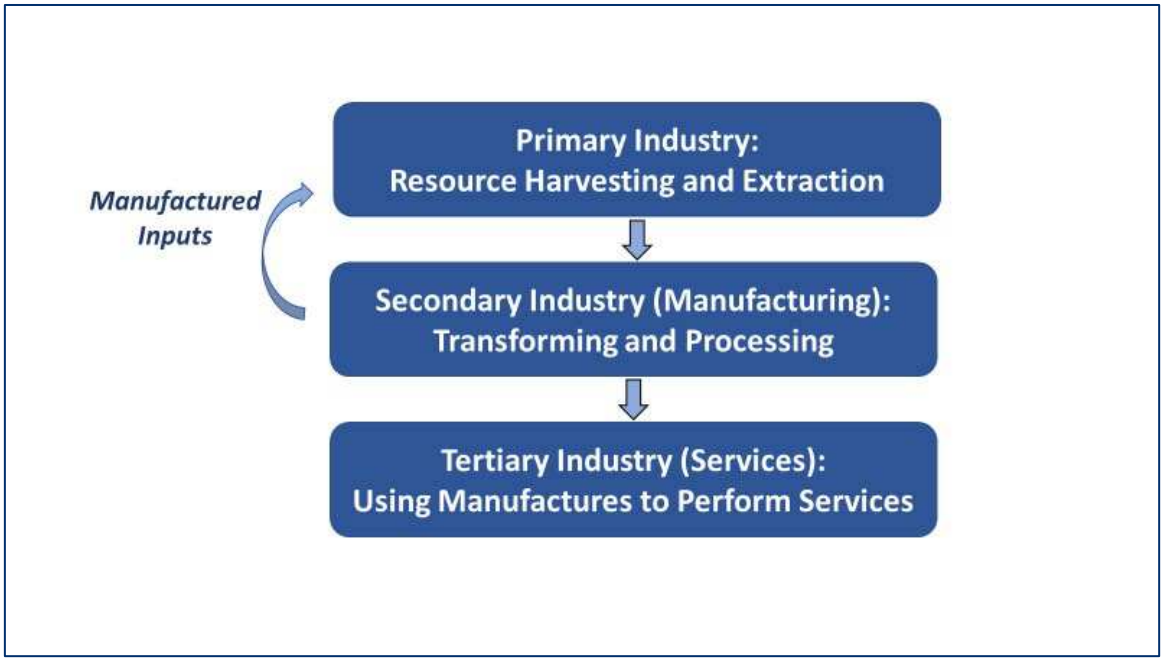
- $180 billion per year in new manufacturing output
- $50 billion per year in new manufacturing value-added
- Over 400,000 new direct jobs in manufacturing
- $115 billion in new purchases from suppliers in other industries
- 265,000 new jobs throughout the manufacturing supply chain
- At least $40 billion per year in additional manufactured exports
- Tens of billions of dollars in additional tax revenue for governments at all levels

It is an ambitious, long-term goal, to be sure, to return to a situation where Australia produces an equivalent amount of manufactured products to what we consume. But it is very reasonable for Australians to expect that we should be able to share in the benefits of the most innovation-intensive sector in the global economy. And government possesses powerful policy tools and levers to begin to move us toward that 'fair share.' The biggest question is whether our leaders have the political will and imagination to seize the opportunity presented by the current moment, and start the process of revitalising our domestic value-added industrial base.

Why Manufacturing Matters[3]

Broadly defined, manufacturing simply refers to the transformation of some tangible, material product, initially harvested from the natural environment (or potentially recycled from previous uses), into something more complex and useful. With this broad conception in mind, it is impossible to imagine an economy *without* manufacturing: human beings will always have material needs and wants that can only be met through the production and transformation of material goods. In this regard, notions about the rise of a 'post-industrial economy' or an 'information economy' are superficial and misleading. While services may increase as a share of total consumption and employment, and information becomes more omnipresent as an input to other types of production (but rarely for its own inherent value), manufacturing remains essential to every aspect of our lives. And the line between services and manufacturing is often blurry, anyway: many services (from computer programming to logistics to motor vehicle repair shops) are focused on supporting or servicing the production and use of manufactured goods.

Figure 1. The Economic Supply Chain



In turn, the production of tangible manufactured products depends on a whole range of different inputs and activities, not just manufacturing. Those related activities also

[3] This section draws on and updates material in Stanford (2016).

add value to the overall chain of production. Manufacturing depends on initial work to collect or harvest the necessary raw materials from nature (in primary industries, such as agriculture, forestry or mining), hopefully in a sustainable manner. Manufacturing also requires inputs of services (or tertiary production), to ensure that manufactured products are useful and workable – including tasks such as engineering and design, transportation, logistics, retail, business, and repair services. But manufacturing (secondary production) is inherently an essential and strategic link in the chain of all value-added activity (see Figure 1). Manufactured products are essential equipment used in the extraction and harvesting of primary resources. And they are also vital to the production of all services. In short, there is no job in society that can be performed without the use of manufactured goods. Manufacturing provides us with buildings to live and work in, clothes to wear, food to eat, vehicles to get around in, information networks to learn from, equipment to be entertained with – and all the other tangible products essential to modern life.

To be sure, thanks to digital technology, communications capacities, automation, artificial intelligence and other revolutionary developments, the nature of manufacturing work is changing. A larger share of work is performed indirectly, rather than in a direct, hands-on production process: including the jobs in planning, engineering, programming, and maintenance. But this does not imply that the work associated with transforming materials into more useful end products disappears – only that it is done differently. Changes in the organization of work, business models, and technology have also affected the process of manufacturing, and even how we *measure* it. But they haven't eliminated the need for manufacturing.

For example, many service functions that used to be performed in-house by major manufacturers (ranging from accounting to cleaning) are now commonly outsourced to independent providers. As a result, the jobs associated with those functions are no longer defined as 'manufacturing' jobs. Instead, they show up in ABS statistics as 'services' job – such as working for contracted suppliers or even labour hire firms. Around one-third of the total value of final manufacturing products in developed countries can be accounted for by services inputs,[4] and an important market for the services sector (especially higher-productivity business services) is tied to the nearby presence of manufacturing. Indeed, Australian manufacturers purchased over $70 billion worth of domestic services in 2016-17.[5] So the boundary line between manufacturing and services is very fuzzy indeed.

[4] See Lanz and Maurer (2015) for more details.

[5] Author's calculations from ABS Catalogue 5209.0.55.001; the size and composition of input purchases by Australian manufacturers is discussed in further detail below.

As economies develop over time, it is normal that manufacturing declines as a *relative* share of total value-added activity, and total employment, for a number of complex reasons. But there is no reason to expect manufacturing to decline in *absolute* terms: that is, to actually shrink. To the contrary, manufacturing should normally grow (along with incomes and population). As income levels rise consumers tend to spend a larger proportion of additional income on services (including private services, like transportation and restaurant meals, and public services, like education and health care). This partly explains why manufacturing shrinks gradually as a relative share of total output. Furthermore, since productivity growth in manufacturing tends to be higher than in other sectors, manufacturing products become cheaper over time (compared to services). Thus manufactured products make up a smaller share of total expenditure. But neither of these factors imply that manufacturing must inevitably contract – only that it will likely *grow more slowly* than other sectors as an economy becomes more advanced. Something much worse than this has happened in Australia: our manufacturing industry has been shrinking in absolute terms, even as our overall economy (*and our own purchases of manufactured goods*) continue to grow.

Therefore, the common assumption that a shrinking manufacturing sector is no cause for concern is quite wrong. And in addition to its continued importance in quantitative terms (measured by real output, employment, and expenditure which should grow over time, not shrink), there are several concrete features of manufacturing that give it a strategic economic importance far out of proportion to its absolute size. In other words, there are many qualitative and structural reasons why 'manufacturing matters':

Innovation: There is a crucial structural link between manufacturing and innovation, which explains why manufacturing is the most innovation-intensive part of the economy – and why most innovation is inevitably manufacturing-oriented. First, the manipulation and transformation of material objects is a task that is especially amenable to technological improvement, mechanisation, and other forms of innovation. Therefore, no other sector of the economy utilizes as much innovation, technology, robotics, and other advanced knowledge as manufacturing. Many services jobs are much harder to automate than goods production. And even when innovations are applied to services production, they almost always require the use of new machinery and equipment – which, of course, are themselves manufactured products. For both reasons, countries which succeed in manufacturing are also more likely to be successful innovators. For example, there are eight OECD countries which allocate over 3 percent of their GDP to research and development (twice or more of Australia's expenditures), and all of them are successful export-oriented

manufacturing nations: Israel, Korea, Switzerland, Sweden, Japan, Austria, Germany and Denmark.[6]

Within Australia, the importance of manufacturing to national innovation performance is also readily apparent. Despite recent challenges, manufacturing allocates more of its income to innovation than any other industry: manufacturers spent $4.6 billion on research and development in 2017-18 (most recent data), equal to over 4% of the sector's total value-added. The share of GDP invested by manufacturing in R&D is four times the economy-wide average. The decline of manufacturing in Australia has thus been a major reason for Australia's flagging innovation performance. Overall, Australian businesses invested less in R&D in current dollar terms in 2017-18 than they did in 2010-11 – and their R&D investments declined by one-quarter as a share of GDP.[7] If this most innovation-intensive sector of the economy contracts, it is inevitable that overall innovation activity deteriorates. At a time when innovation and advanced technology are increasingly critical determinants of national competitiveness, the deterioration of Australia's innovation effort – tied to the contraction in manufacturing – is a huge disadvantage.

Productivity: Thanks to greater potential for applying automation, technology, and other forms of innovation in manufacturing production, manufacturing tends to demonstrate higher ongoing rates of productivity growth than other parts of the economy. This has been true historically in Australia, with manufacturing productivity growth exceeding economy-wide rates in earlier decades when manufacturing was developing and expanding. More recently, manufacturing productivity performance would have been even stronger if the industry were growing, rather than shrinking. Moreover, strong manufacturing productivity growth can spill over into stronger national productivity performance via several channels: by a simple composition effect (lifting the average of all sectors, especially if manufacturing itself is growing), by contributing to stronger exports (thanks to greater competitiveness), and by pioneering productivity-improving technology and machinery that can also be applied to boost productivity in other sectors (including services industries). New vistas in technology and automation hold out great prospect of accelerating productivity growth and quality standards in manufacturing. These include:

- automation and robotics
- applications of artificial intelligence in manufacturing

[6] Listed in descending order of GDP spending; from OECD data, "Gross domestic spending on R&D".
[7] Author's calculations from ABS Catalogues 5206.0 and 8104.0.

- so-called 'Industry 4.0' systems, which rely on digital information connections between all segments of a manufacturers' operations to enhance efficiency.

Australia needs a vibrant, expanding, and well-capitalised manufacturing industry to take advantage of these important developments.

Incomes: Higher productivity and faster productivity growth create a sustainable economic foundation for high and growing incomes. Average incomes in manufacturing (especially those sub-sectors which are especially reliant on new technology, skill, and export markets) are superior to other jobs. On the other hand, the loss of full-time, high-wage jobs in Australian manufacturing in recent years has clearly contributed to the unprecedented slowdown in national wage growth, the loss of decent working class jobs, and the polarisaton of incomes and economic opportunity.

International trade: International trade allows countries to specialize in different varieties of manufactured goods. This allows them to capture the strong efficiency benefits that come with producing at greater scale – so long, of course, as each country retains a fair share of overall manufacturing output in the end. (Unfortunately, as we will discuss below, this condition does not apply to Australia's international trade in manufactures, which has been very lopsided and has resulted in a large and chronic trade deficit.) The efficiency benefits of producing at great scale, along with the physical properties of most manufactures (they are tangible, durable, and transportable), explain why manufacturing remains the dominant component of international trade. Manufactured products accounted for over 70% of global merchandise trade in 2018, with manufacturing trade worth a total of $14 trillion (U.S.).[8] And the dominance of manufactures in total trade has grown in recent years. On this score, too, despite recent challenges, Australian manufacturers still make a disproportionate contribution to national trade performance. Manufactured products accounted for around $95 billion in export sales in 2019, or almost 25% of total Australian merchandise exports.[9] Manufacturing's share of total exports is more than 4 times larger than its 5.5% share of national GDP.

The disproportionate orientation of manufacturing to export markets creates several spillover benefits for the rest of the economy. A larger manufacturing sector automatically boosts exports (and therefore translates into a stronger balance of payments). A better structural capacity to export can also underpin stronger overall GDP growth, ensuring that a country (as it grows) earns enough export revenues to

[8] Author's calculations from World Trade Organization data portal, "Merchandise imports by product group."

[9] Author's calculations from DFTA TRIEC trade.

cover rising import costs.[10] Economic evidence also indicates that export-oriented industries demonstrate higher productivity growth and higher average incomes, because of the discipline imposed in competing for foreign customers.

Supply chains and multipliers: Another channel through which a strong manufacturing presence translates into broader economic activity and employment is through its impact on domestic supply chains. Most manufacturers rely disproportionately on inputs of all kinds (primary, secondary, and tertiary) purchased from outside companies. Those parts, materials and supplies (called 'intermediate purchases') totaled $260 billion in 2016-17, according to the input-output tables published by the Australian Bureau of Statistics.[11] As business models have become more sophisticated and specialized, supply chains have become more complex and interconnected. But they still rely on the domestic presence of a key manufacturing customer to act as an economic 'anchor' to stabilise the whole supply chain. These supply chain relationships explain why, when a major manufacturing facility opens (or, unfortunately, closes), the impact on regional and national labor markets is magnified. Jobs in supply industries (some of which may be several steps removed from the final manufacturing customer) are also ultimately affected. These 'multiplier effects' are especially strong in manufacturing (and much higher than in other sectors) because of the industry's more developed and complex supply chain.

These are all concrete, economic reasons why the importance of manufacturing to the national economy is larger than implied by simple production or employment shares. A successful, vibrant, domestically-based manufacturing sector generates important spillovers that strengthen other parts of the economy, and contribute disproportionately to national performance in innovation, international trade, and productivity. In calling for a revitalisation of manufacturing, to a size proportionate to Australia's collective needs for manufactured goods, we are not motivated by nostalgia for some 'bygone' era of industry. We are motivated by concrete, modern evidence that *manufacturing matters*: to national prosperity, resilience, and well-being.

[10] As explained, for example, by McCombie and Thirlwall (2004).

[11] Author's calculations from ABS Catalogue 5209.0.55.001. In aggregate, the manufacturing sector's value-added accounts for less than 30 percent of the value of total shipments, because of the importance of these intermediate purchases of supplies, parts, and services.

Taking Stock: Battered but Resilient

Australian manufacturing has endured a difficult period of contraction and dislocation. A complex and daunting set of pressures and crises has buffeted the sector continually for two decades, including:

- A global boom in resource commodities that began in the 2000s, and experienced a second wave in the early 2010s. This resource boom diverted Australian capital, labour, and entrepreneurial energy into resource extraction and export projects, and away from value-adding manufacturing.
- The related over-appreciation of the Australian currency, boosted by temporary surges in global commodity prices and resource industry profits, which artificially (and temporarily) inflated Australian production costs relative to other global manufacturers.
- The impacts of unbalanced globalisation and free trade agreements, which reduced net demand for Australian-made manufactures and contributed to the emergence of large trade deficits in manufactured products.
- Economic and financial disruptions arising from the Global Financial Crisis in 2008-09, which Australia was able to negotiate relatively successfully – but which nevertheless damaged the viability of key Australian manufacturing sectors (including automotive production).
- Most recently, the devastating impacts of the global COVID-19 pandemic, with severe disruption to global supply chains, sharp contractions in output and trade, and unknown consequences for business investment plans.

Australia's manufacturing sector has survived these repeated challenges. It is smaller than in the past, and does not make the appropriate and proportionate contribution to national prosperity that it could and should. Indeed, manufacturing accounts for a smaller share of national employment in Australia (around 7%) than in any other OECD economy.

But despite these rocky times, the industry is still here. It has demonstrated an impressive capacity to adapt and survive. Manufacturing remains a complex, sophisticated, and resilient pillar of the national economy. It is Australia's sixth-largest

employer, providing relatively high-quality jobs to almost 900,000 Australians. It makes a disproportionate contribution to national export and innovation performance. It anchors hundreds of billions of dollars of purchases, and hundreds of thousands more jobs, through a complex supply chain that extends into every sector, and every state, of the national economy. It generates tens of billions of dollars in taxes that contribute to the maintenance of our national infrastructure of public capital and public services. It will play an increasing role in equipping our economy with the necessary technology and equipment to undertake the historic challenges of decarbonisation.

Table 1
Profile of Australian Manufacturing
(2019 unless otherwise indicated)

	Value	Share Australia Total
Sales[1]	$380 billion	
Value-Added	$105 billion	5.5%
Direct Employment	890,000	6.9%
Wages & Salaries Paid	$62 billion	7.4%
Average Annual Income: All Employees Full-Time Employees	 $70,000 $81,000	
Operating Profit (before tax)[1]	$29 billion	
Exports	$95 billion	24.5%
Domestic Supply-Chain Purchases[2]	$240 billion	
Capital Expenditure	$9.7 billion	16.9%[4]
R&D Spending[1]	$4.6 billion	26.4%
Superannuation Contributions[1]	$5.1 billion	
Indirect and Payroll Taxes Paid[1,3]	$8.3 billion	

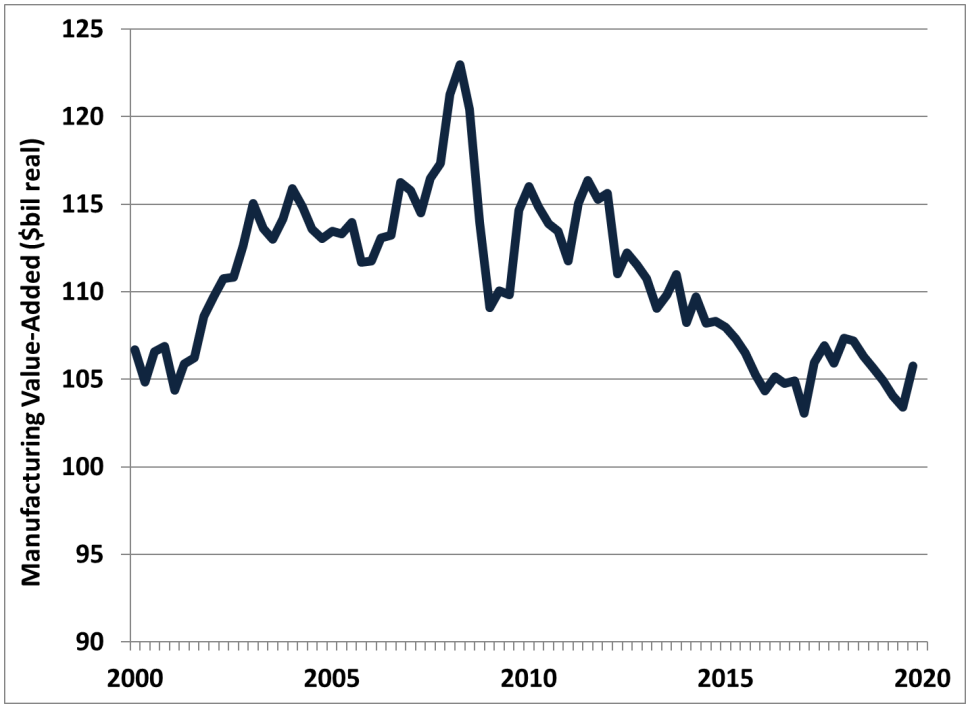
Source: Author's calculations from ABS Catalogues 5206.0; 5209.0.55.001; 5625.0; 6291.0.55.003; 6302.0; 8155.0; and DFAT TRIEC data.
1. 2017-18 data.
2. 2016-17 data.
3. Includes workers' compensation premiums.
4. As share of private industry investment, recorded in ABS Catalogue 5625.0.

In short, manufacturing is vital to Australia's economic and social well-being. This section provides a statistical portrait of Australia's manufacturing sector today, and its

recent history. It will assess the strengths and weaknesses of the industry, and identify the key ingredients of future recovery. A summary of vital statistics describing Australian manufacturing today is provided in Table 1.

Manufacturing accounts for about $105 billion of value-added (or GDP), or just over 5% of the national total. That is among the smallest proportional manufacturing sectors of any industrialised country. Total value-added in the sector has declined since its pre-GFC peak in 2008 (see Figure 2), but has been relatively stable in the last 5 years.

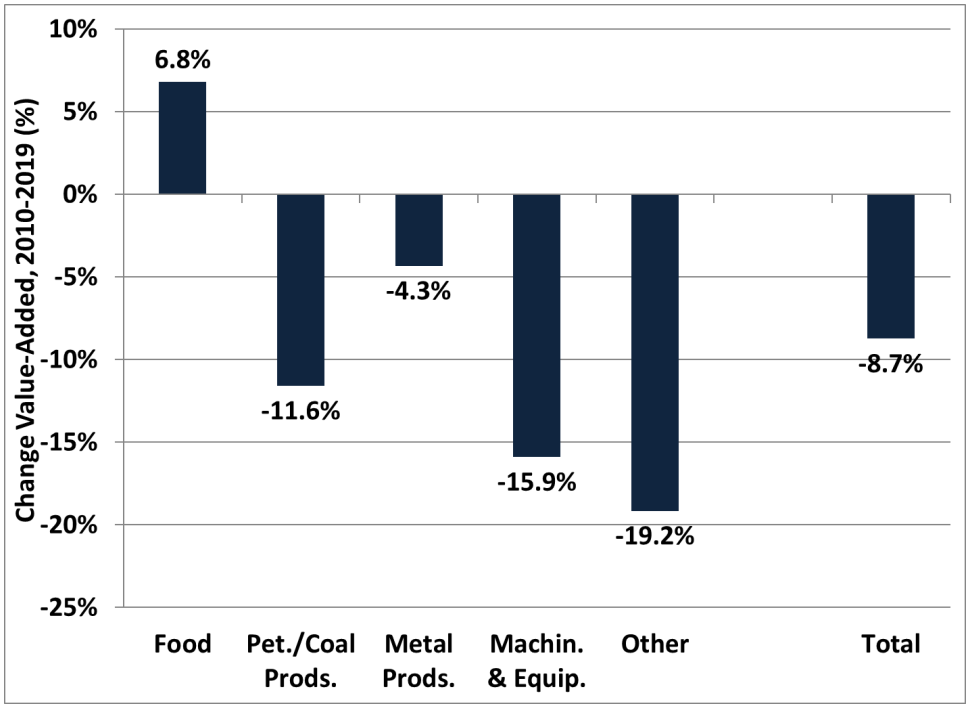
Figure 2. Manufacturing Value-Added, 2000-2019.



Source: Author's calculations from ABS Catalogue 5206.0.

Manufacturing is composed of a wide range of different sub-sectors, with very different economic, technological, and geographic features. And those sub-sectors have experienced varying trajectories, as the overall manufacturing sector negotiated the challenges of the past twenty years (Figure 3). Since 2010, for example, overall manufacturing value-added has declined in Australia by around 9%. The decline was especially severe in machinery and equipment production – including the losses associated with the cessation of mass motor vehicle production here mid-decade. Other sub-sectors, such as primary metal manufacturing, experienced less severe losses. Some manufacturing sub-sectors actually expanded during this time: such as food products, which increased total value-added by 7%.

Figure 3. Manufacturing Value-Added, Change by Sector, 2010-2019

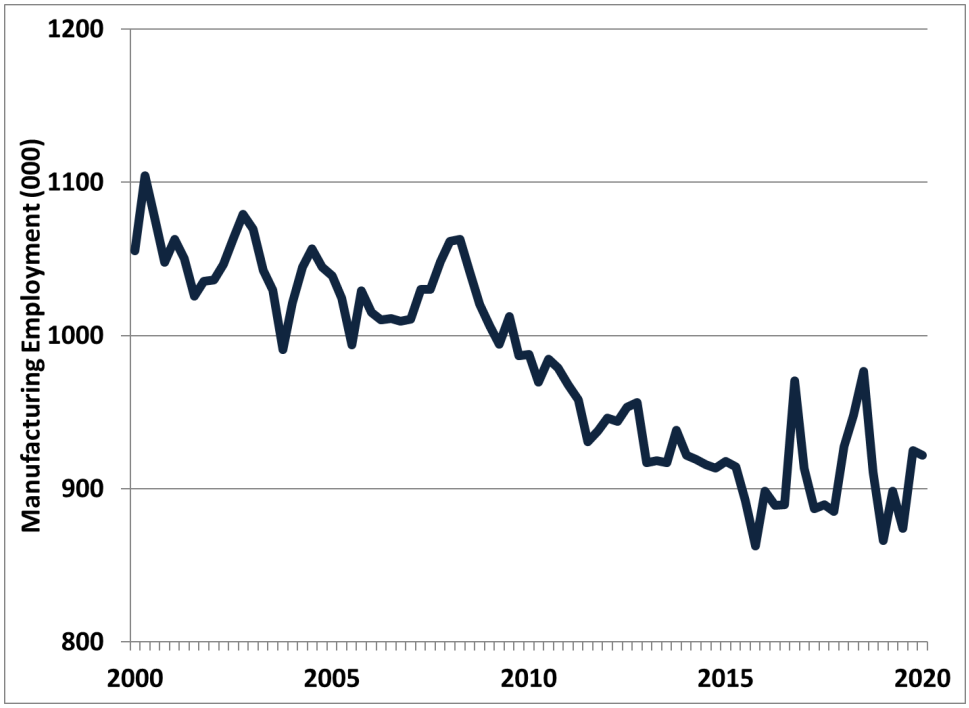


Source: Author's calculations from ABS Catalogue 5206.0.

Manufacturing employment has been held back by the decline and subsequent stagnation of overall manufacturing output. Moreover, since ongoing productivity growth allows manufacturing to produce a given amount of output with less labour input, it will also undermine employment totals – unless the total amount of output grows at least as fast as average productivity. As illustrated in Figure 4, manufacturing has lost close to 200,000 jobs since the turn of the century. Like value-added, employment totals have been relatively stagnant over the past five years at around 900,000 positions.

A relatively large share of manufacturing jobs are full-time: about 85% of jobs in manufacturing were full-time in 2019. The incidence of part-time work in the sector is about half the average level of the national labour market as a whole. Wages are somewhat higher than average, as well: around $70,000 per year across the industry (over $80,000 for full-time workers), which is some 7% higher than economy-wide average earnings. The existence of relatively higher-quality, better-paying jobs in manufacturing is one of the key motivations for maintaining a strong domestic manufacturing sector.

Figure 4. Manufacturing Employment, 2000-2020



Source: ABS Catalogue 6291.0.55.003.

Trends in employment, as with value-added, vary greatly across various sub-sectors of manufacturing. Some sub-sectors have added jobs over the past decade, even as the overall footprint of manufacturing shrank. Table 2 lists employment for each manufacturing sub-sector, and net changes since 2010. Food manufacturing is the largest single source of manufacturing work, and total employment in that sub-sector has grown by 5% over the last decade. Even stronger growth occurred in the smaller beverage and tobacco manufacturing sub-sector. The steepest job losses were incurred in the printing and textile, clothing and footwear sub-sectors, which saw employment decline by 30% or more. Transport equipment and other machinery and equipment sectors are also major manufacturing employers; their employment totals also declined by more than the average for all manufacturing.

Table 2 Employment Change by Sub-Sector, 2010-2019			
	Employment (2019, 000s)	**Change from 2010 (000)**	**Change from 2010 (%)**
Food Products	203.7	9.3	4.8%
Beverage & Tobacco	33.1	8.0	31.8%
Textile. Clothing & Footwear	32.1	-13.2	-29.1%
Wood Products	45.6	3.8	9.0%
Pulp & Paper	15.9	-3.1	-16.3%
Printing	34.6	-19.1	-35.6%
Petroleum & Coal	7.9	1.2	18.7%
Chemicals	48.3	4.2	9.6%
Rubber Products	35.9	3.3	10.2%
Non-Metallic Minerals	37.6	0.7	1.8%
Primary Metal	72.7	-12.8	-15.0%
Fabricated Metal	70.4	10.9	18.2%
Transport Equipment	68.0	-16.9	-19.9%
Machinery & Equipment	112.5	-8.1	-6.7%
Furniture	63.6	4.3	7.2%
All Manufacturing	884.6	-94.1	-9.6%
Source: Author's calculations from ABS Catalogue 6291.0.55.003.			

An important advantage of manufacturing is that its presence is distributed widely and relatively evenly across the entire country. Table 3 summarises data on manufacturing output and employment by state. Manufacturing jobs account for around 7% of total employment in every state: ranging from a low of 6.4% in WA to a high of 7.7% in SA. And all states have suffered from the loss of manufacturing employment over the past decade. Proportional losses have been greatest in SA (with almost one in five jobs lost since 2010-11), where the closure of automotive manufacturing facilities has had an especially painful impact. Tasmania experienced the smallest proportional manufacturing job losses – with manufacturing employment down by just over 5% since 2010-11. In addition to its dispersal across all states, manufacturing also is well distributed between urban and regional areas; many smaller cities and regional towns depend critically on important manufacturing facilities, and the continued health of

manufacturing is vital to the viability and prosperity of regional communities. The broad distribution of manufacturing work across Australia indicates that all parts of the country would benefit strongly from a new policy commitment to strengthening domestic manufacturing.

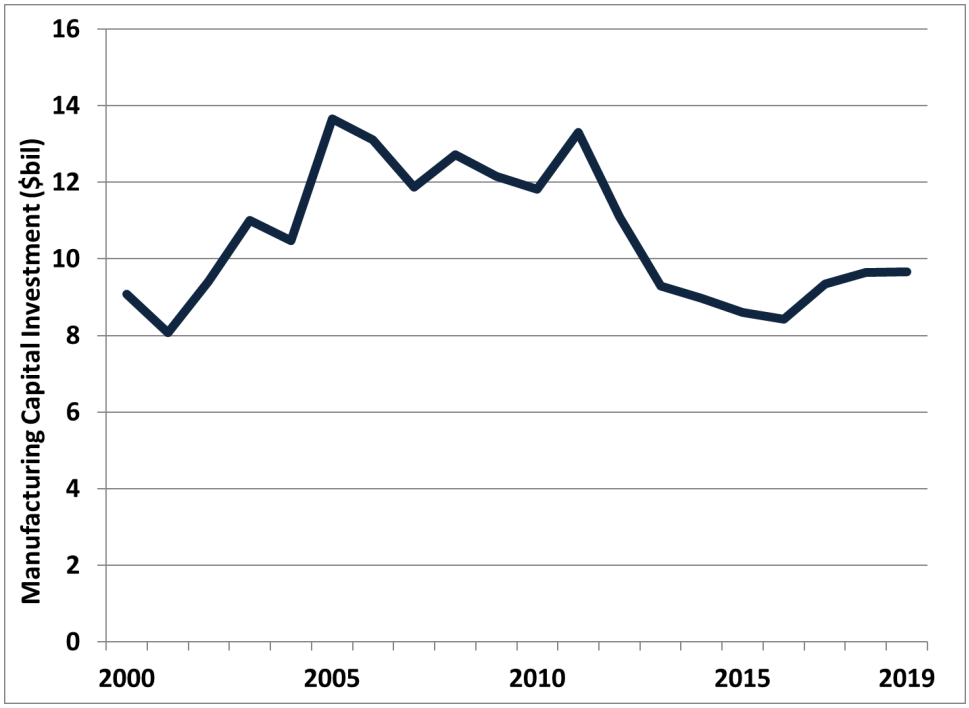
Table 3
Manufacturing Activity by State 2017-18

State	Manufacturing Sales ($b)	Manufacturing Employment		
		Employment in 2017-18 (000)	Change Since 2010-11	Share Total State Employment
NSW	109.9	254.4	-7.7%	6.4%
Victoria	106.4	246.0	-9.4%	7.6%
Queensland	73.1	164.2	-12.1%	6.6%
WA	57.9	84.8	-12.1%	6.4%
SA	23.5	64.3	-19.0%	7.7%
Tasmania	6.7	18.2	-5.5%	7.3%
Australia Total[1]	381.8	840.3	-10.5%	6.7%

Source: Author's calculations from ABS Catalogues 8155.0 and 6291.0.55.003.
1. Includes territories.

The weakness in total output of manufacturing has, not surprisingly, contributed to weakness in capital spending within the industry. Discouraging market and macroeconomic conditions are reinforced, in this regard, by challenges accessing sources of long-term finance for manufacturing capital investments – especially by medium-sized firms which have more difficulty accessing conventional debt and equity capital sources. As illustrated in Figure 5, total capital investments in Australia ranged between $12 and $14 billion per year in the late 2000s. The after-effects of the GFC, and the closure of motor vehicle manufacturing (which is a particularly capital-intensive segment of manufacturing), resulted in an erosion of capital spending, which fell to around $9 billion per year since 2013. Even that reduced level of capital spending, however, constitutes a disproportionate contribution to national capital investment performance. Manufacturing accounts for about one-sixth of all private sector business capital spending, far more than its share of output and employment.

Figure 5. Capital Investment, Manufacturing, 2000-2019

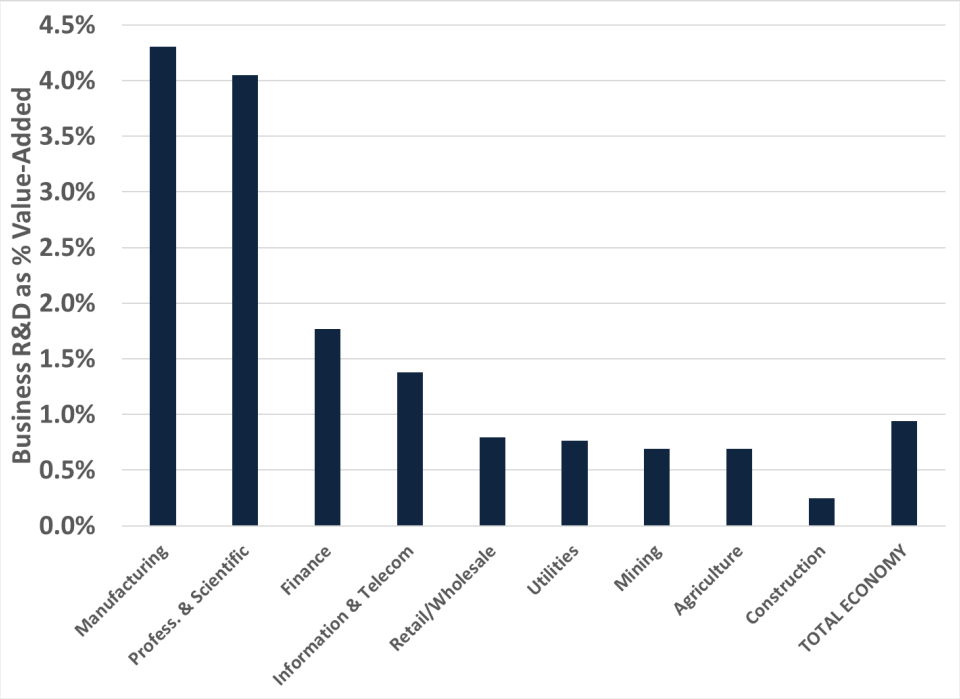


Source: Author's calculations from ABS Catalogue 5625.0.

The disproportionate investment contribution of manufacturing is especially visible in the area of research, development and innovation. The manufacturing sector, despite its smaller footprint, still ranks as Australia's most energetic R&D investor. The sector spent $4.6 billion on R&D in 2017-18. That was second in absolute terms to the professional and scientific services sector (which allocated $5.1 billion to R&D the same year). But as a proportion of sector value-added, manufacturing surpasses even professional and scientific services in its R&D effort. Figure 6 ranks major sectors of Australia's economy by R&D spending as a share of sector value-added. Manufacturing invests over 4% of sectoral value-added in new innovation – four times larger than the average proportion experienced across Australia's business sector as a whole.

Australia's innovation performance has weakened in recent years, with a smaller share of our total output invested in research. We are slipping in global rankings of innovation performance – and the undersized presence of manufacturing, the most innovation-intensive sector of the economy, has been a key factor in that erosion. While manufacturing continues to make an outsized contribution to Australia's national innovation performance, it needs a stronger presence here for its full potential contribution to be realised.

Figure 6. Business R&D Spending as Share Sector Value-Added, 2017-18



Source: Author's calculations from ABS Catalogues 8104.0 and 5206.0

Data on the direct output and employment of manufacturing does not fully describe the strategic and structural importance of the industry to Australia's overall economy. As noted above, one of the qualitative advantages of manufacturing is its capacity to anchor a large and far-reaching supply chain: thousands of different enterprises in all parts of the economy, which sell supplies, parts, and services to manufacturing companies. While these companies are not included within the usual statistical definitions of 'manufacturing,'[12] their existence and viability depend directly on the presence of their manufacturing customers.

A portrait of the complex and crucial supply chain which feeds the manufacturing sector, and in turn supports large amounts of activity and employment in other parts of the economy, can be developed on the basis of input-output statistics prepared by the Australian Bureau of Statistics. Table 4 summarises the major categories of supply chain purchases by Australian manufacturers. It is evident that the manufacturing supply chain reaches into every sector, and every region, of Australia's economy.

[12] As noted by Advanced Manufacturing Growth Centre (2018a), many support functions – including those performed both before and after the moment of direct production – are excluded from conventional measures of manufacturing output and employment, yet are vital to the presence and activity of the sector.

Table 4 Australia's Manufacturing Supply Chain, 2016-17		
	$billion	**Jobs (000)**
Direct Value-Added & Employment	104.7	915.0
Intermediate Inputs		
Agriculture & Forestry	40.5	207.7
Mining	44.6	29.8
Intermediate Manufactures[1]	71.3	
Utilities	8.7	7.1
Construction	3.0	8.0
Retail & Wholesale	14.4	28.3
Hospitality	2.7	26.4
Transport	17.1	60.7
Info. & Telecom	4.3	8.7
Finance	6.4	0.0
Property Services	2.4	7.4
Pro. & Scientific	14.2	67.7
Other Private Services	8.2	69.9
Public Services	2.9	35.3
Total Australian Intermediate Inputs	**240.7**	**557.1**
Total Employment		**1472.1**
Imported Intermediate Inputs	**265.6**	

Source: Author's calculations from ABS Catalogues 5209.0.55.001, Table 8; 8155.0; and 6291.0.55.003.

1. Employment associated with supply of intermediate manufactured products purchased by other manufacturers are not listed, as that would constitute double-counting of manufacturing jobs already reported in the table.

Of course, large amounts of agricultural, primary and resource products are purchased by Australian manufacturers, to then be transformed into value-added manufactured products. Manufacturers also buy large amounts of semi-finished goods from other manufacturers, for further refinement and assembly. The manufacturing sector also purchases extensive inputs of services: including transportation, finance, trade, and

business services purchases. Even some public services are directly purchased and financed by manufacturers, such as vocational education.

Across the whole spectrum of supply industries, Australian manufacturers purchased some $240 billion worth of domestically-produced inputs and supplies in 2016-17 (most recent data at time of writing). Those purchases support continued production and employment in those supply industries. Based on sector-average employment intensity ratios, we estimate that over 550,000 jobs in those supply industries depend on purchases arising from the manufacturing sector.[13] Added to the roughly 900,000 direct jobs in manufacturing itself, this suggests that a total of close to 1.5 million Australians owe their employment directly or indirectly to the presence of domestic manufacturing.

This confirms that direct sectoral employment statistics understate the true importance of manufacturing in Australia's overall labour market. Considering the total supply chain that is anchored and supported by the presence of domestic manufacturing, the combined footprint of the sector is much larger.

Unfortunately, over half of all these materials, parts, and supplies ('intermediate inputs') purchased by Australian manufacturers are imported from foreign suppliers ($265 billion worth in 2016-17). This includes most of the more technology-intensive inputs, such as machinery, equipment, and sub-assemblies. The heavy degree of import penetration into Australia's manufacturing supply chain undermines the spin-off employment effects of domestic manufacturing – since the stimulus effect of those purchases is effectively 'exported' to other countries. It also leaves our domestic manufacturing sector vulnerable to disruptions in global supply chains (as have occurred during the COVID-19 pandemic), and to uncertainty in global trade policy and trade patterns.

[13] Those jobs in related supply industries sell their output to Australian manufacturing establishments. Without the domestic manufacturing base, it is certainly possible some of those suppliers would find other outlets for their output (potentially foreign-based manufacturing customers). Nevertheless, it is reasonable to consider these jobs as largely dependent on the health of Australian manufacturing.

Australia's Place in the World

Manufacturing is a global industry that depends critically on world trade flows. The specialised nature of most manufactured products requires that producers be able to produce their output in significant quantities, and then sell that output to a range of global markets. This is particularly true of relatively small economies like Australia's. Indeed, one of the qualitative benefits of manufacturing reviewed above is precisely that it demonstrates an inherently higher export propensity than services. Manufacturing is well-suited to international trade – and it accounts for a strong majority of all international trade. Therefore, having a strong and healthy domestic manufacturing sector automatically ensures that a country can participate more fully and successfully in international commerce.

However, there is never any guarantee that those international interactions will prove to be mutually beneficial. And in Australia's case, failures of both trade policy and industrial policy have undermined the extent to which domestic manufacturers have been able to take advantage of global market opportunities – and have produced dangerously lopsided patterns in our international trade engagement. This section of the paper will review the current state of Australia's manufacturing trade, and consider ways in which it could be improved.

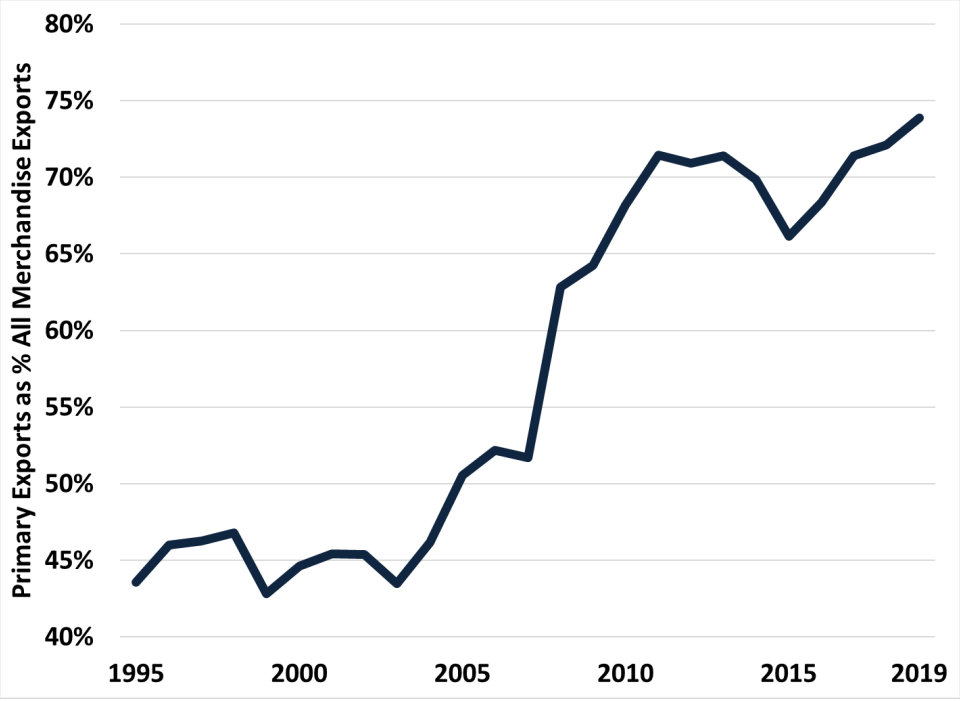
Of course, Australia's economy has always been heavily dependent on the extraction and export of natural resource products: including agricultural goods, timber, minerals, and now energy products. This legacy reflects both our geographical endowment (a large, relatively sparsely populated country with abundant resources) and our colonial heritage (initially seen as a source of raw materials for more developed industries 'back home'). For decades it was a goal of national economic policy to foster a more diversified presence in international trade, with greater participation in value-added industries (diversifying away from raw resource extraction). After the Second World War, in particular, Commonwealth policy aimed to foster domestic industrialisation, based on numerous strategies to tie domestic investment, production, and technology to trade and fiscal opportunities. This led to the emergence of Australia as a major industrial producer: ranking in the top ten countries globally for production of automobiles and several other higher-value products.

Unfortunately, over the past generation the composition of Australia's merchandise exports has regressed notably, as government policy has shifted to emphasise other goals, and domestic manufacturing began to decline (in both absolute and relative terms). Australia's export focus shifted back to the extraction and export of mostly

unprocessed natural resources. Iron ore, coal, and liquified natural gas are our largest exports. Global sales of Australian-made manufactured goods have declined. And a very large, chronic trade deficit in manufactured products undermines our international balance of payments year after year.

The growing dependence of Australian merchandise exports on unprocessed or barely processed resource products is visible in Figure 7. It illustrates the share of total merchandise exports accounted for by primary (unprocessed and barely processed goods). By the 1990s, on the strength of postwar industry-building policy, that share had declined to under half of all Australian exports. While Australia was still more dependent on resource extraction than other industrial countries, that dependence had been successfully reduced over time. Australia's industrial and export presence was more diversified. Since the early 2000s, however, in the wake rising global commodity prices and a retreat from active industrial policy-making by Australia's governments, Australia has gone 'backwards' in structural terms. The country has become far more dependent on resource exports, as domestic manufacturing declined.

Figure 7. Primary Product Reliance in Australian Exports, 1995-2019



Source: Author's calculations from DFAT TRIEC data. Includes LNG and non-monetary gold.

By 2019, primary products (including LNG and non-monetary gold) accounted for almost 75% of total Australian merchandise exports – the highest share in decades.[14] With such a heavy reliance on a relatively narrow group of unprocessed export products, Australia's economy faces significant risks:

- Exposure to dramatic swings in global prices for resource commodities, which are inherently volatile.
- Exposure to changes in global demand for basic commodities, which can shift dramatically due to changes in technology and taste.
- Competition from other suppliers of the same resource products.
- Revenue losses arising from the long-run historical trend of natural resource prices to decline relative to prices for other value-added products.
- Changes in global environmental policies, which are reducing global demand for fossil fuels.

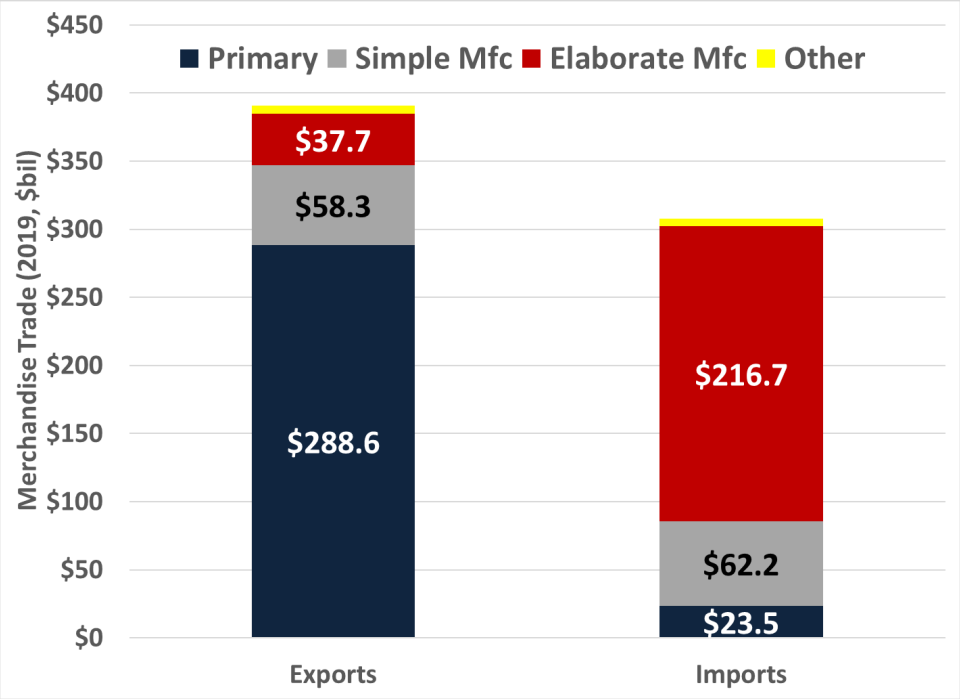
The flip side of the coin of Australia's reliance on unprocessed resource exports in our international trade is a precarious dependence on imports of value-added manufactured products from other countries. These two personalities of Australia's trade are illustrated in Figure 8, which portrays the composition of Australia's merchandise trade.

Trade data published by Australia's Department of Foreign Affairs and Trade (DFAT) distinguishes four broad categories of merchandise: primary goods, simply transformed manufactures (including food ad bulk basic manufactures such as primary metals), elaborately transformed manufactured goods (such as machinery and equipment, transportation equipment, and pharmaceuticals), and 'other'.[15] As is clear in Figure 8, Australia's exports are dominated by primary products, but our imports are dominated by elaborately transformed manufactured products: such as sophisticated machinery, motor vehicles, electronics, medical equipment and drugs, and more.

[14] Figure 7 and subsequent analysis utilizes the Department of Foreign Affairs and Trade's TRIEC classification of commodity trade flows, with some adjustments. We reclassify most basically 'processed primary products' as defined in the TRIEC system (including food products, refined minerals, and pulp) as manufactured goods, since those products are treated as manufactures in other industrial statistics (such as those reported above). We treat LNG exports, which have been a major source of new exports for Australia, as a primary product (TRIEC considers LNG to be 'processed'), along with non-monetary gold (which is categorised separately in the TRIEC system).

[15] As noted in the previous footnote, the TRIEC data is adjusted to consider processed primary products (other than LNG, which is considered here as a primary export) as simply transformed manufactured goods, and to include non-monetary gold as a primary export.

Figure 8. Composition of Australian Merchandise Trade, 2019



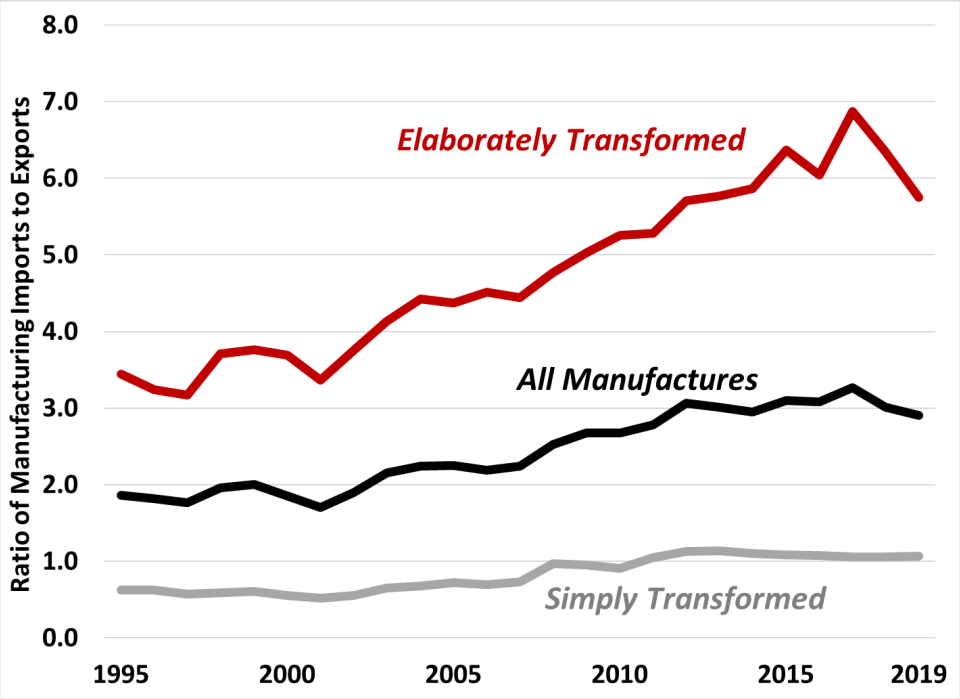
Source: Author's calculations from DFAT TRIEC data. 'Other' includes non-monetary gold.

Our trade in simply transformed manufactures (such as food products, refined minerals, and pulp) is broadly balanced, with imports only slightly exceeding exports. But we import almost six times as much elaborately transformed manufactured products as we export. On a combined basis, our imports of all manufactures are about three times bigger than our exports, producing a manufacturing trade deficit of over $180 billion in 2019 (equal to a shocking 9% of national GDP).

Trade is supposed to be a two-way process that allows each participating country to specialise in specific varieties of output, and permitting producers to tap intospecialised markets. Where high-value manufactured goods are concerned, however, Australia's international trade is largely a one-way street. In structural terms, Australia exports unprocessed resource products, which other countries then transform into high-cost sophisticated manufactures – which are then sold back to us, but at a premium price. The work, profit, and income associated with that value-adding manufacturing process are largely lost from Australia's economy.

The deep imbalance of Australia's manufacturing trade is further depicted in Figure 9. For both simply and elaborately transformed manufactures, this figure indicates the ratio of Australia's imports to its exports. A ratio of 1 indicates broadly balanced two-way trade. A ratio above 1 indicates a net trade deficit in that product category. And a ratio below 1 indicates a trade surplus.

Figure 9. Imbalance Ratios, Australian Manufacturing Trade, 1995-2019



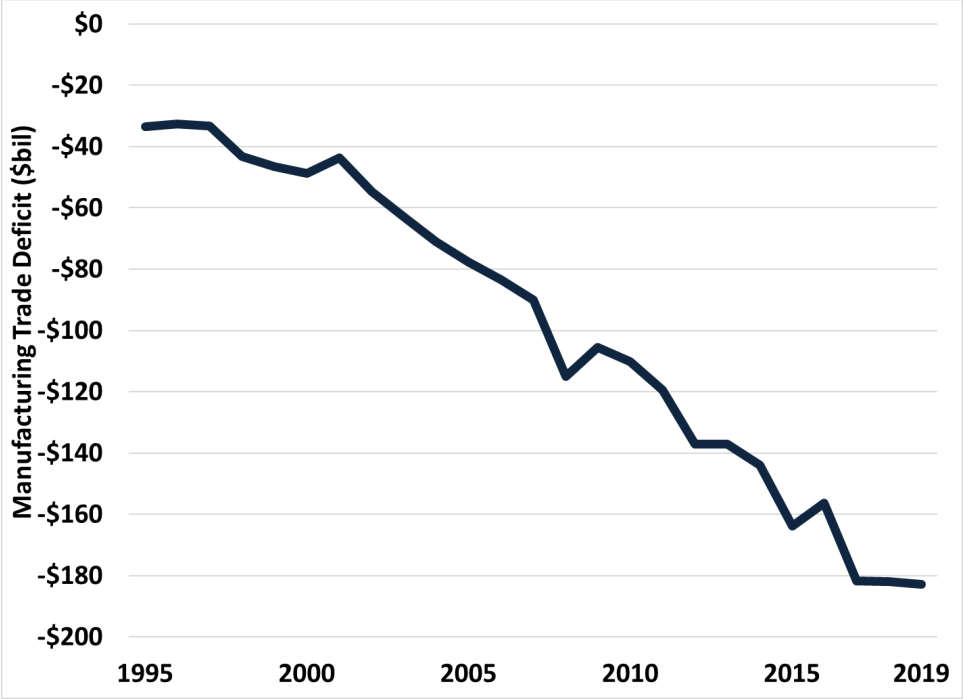
Source: Author's calculations from DFAT TRIEC data.

For simply transformed manufactures, Australia broadly 'holds its own' in global commerce: the imbalance ratio has increased slightly in recent years, but is only slightly greater than 1 (implying a relatively small trade deficit). However, flows of those simply transformed manufactures are smaller than for more sophisticated goods: two-way trade totalled $120 billion in 2019, compared to two-way trade of $250 billion in elaborately transformed manufactures. And within that much larger flow of elaborately transformed product trade, the ratio of imports to exports has almost doubled since the turn of the century. Australia now imports almost $6 of these high-value products for every $1 we export. This enormously unbalanced structural position in trade for the most valuable and dynamic products sold in the global economy substantially undermines our innovation, our current account balance, and our incomes.

Since Australia imports so much more than it exports in manufactured products, the inevitable result is a large and chronic trade deficit in manufactures – one that is concentrated, as we have seen, in the most sophisticated and technology-intensive products. The rise of this manufacturing trade deficit is pictured in Figure 10. The deficit has more than quadrupled in absolute terms since the turn of the century. The manufacturing deficit has stabilised at around $180 billion in the last three years. However, that is more a reflection of national macroeconomic weakness, than an indication of improving trade fortunes: even before the COVID-19 pandemic and

resulting economic crisis of 2020, a significant slowdown in Australian economic growth (held back by weak business investment and consumer spending) reduced purchases of (mostly imported) manufactured products such as motor vehicles, business machinery, and others. This reduced the growth of high-tech imports: but it's a sign of our failure, not our success.

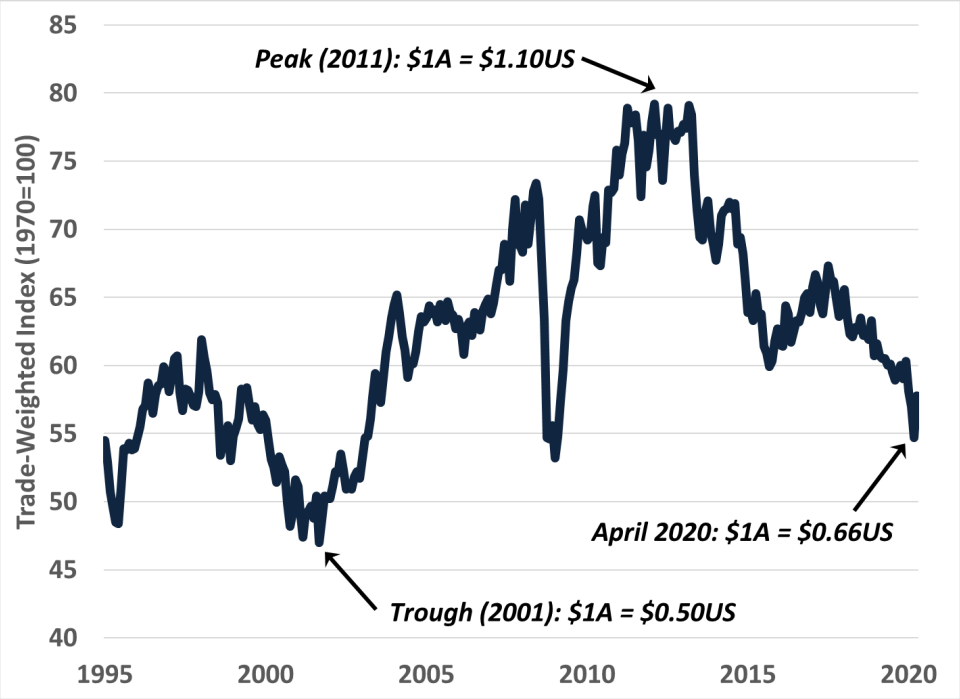
Figure 10. Manufacturing Trade Deficit, 1995-2019



Source: Author's calculations from DFAT TRIEC data.

One crucial factor that has affected Australia's manufacturing trade has been dramatic swings in foreign exchange values. And this pattern also reflects another risk of Australia's undue resource dependence. The Australian dollar has experienced some of the most dramatic fluctuations in exchange rates of any industrial country. Figure 11 illustrates an index (calculated by the Reserve Bank of Australia) of exchange rates of the Australian dollar compared to the currencies of our most important trading partners; each partner currency is weighted in this index according to its share in Australian trade.

Figure 11. Trade-Weighted Exchange Rate Index, Australia, 1995-2020



Source: Reserve Bank of Australia.

The Australian dollar reached a historic trough early in this century, reflecting depressed prices for natural resource commodities at that time. In 2001 the Australian dollar traded as low as 50 cents (U.S.). Inflated by a strong but temporary boom in global commodity prices, the dollar then appreciated strongly over the next decade, reaching a peak of over $1.10 (U.S.) in 2011. The currency more than doubled in value in U.S.-dollar terms; its increase was somewhat smaller in trade-weighted terms (since our dollar appreciated somewhat less dramatically against the currencies of our other major trading partners, such as China and Japan). Where global commodity prices are concerned, however, what goes up inevitably comes back down. Sharp declines in prices for energy and other unprocessed resources after 2013 sent the Australian currency plunging back down. By April 2020, amidst global uncertainty caused by the coronavirus pandemic and dramatic declines in global resource prices (especially energy), the dollar was trading back in the mid-60-cent range (U.S.). Subsequently it rebounded (at time of writing) to close to 70 cents (U.S.), so the financial volatility affecting this most important relative price indicator is set to continue.

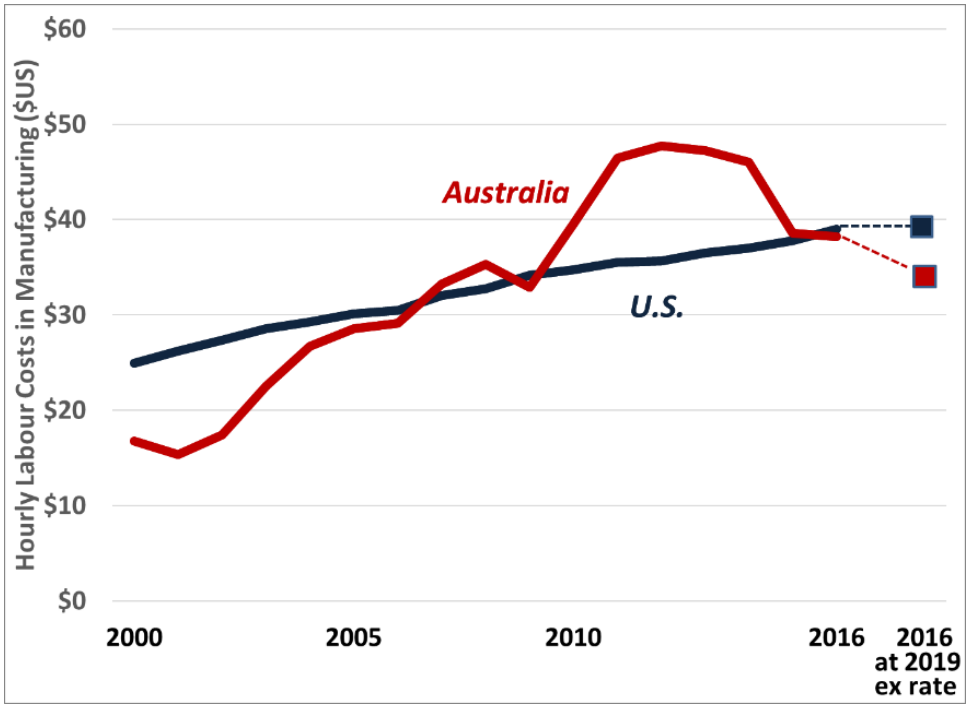
It is interesting to note that according to OECD estimates, the 'purchasing power parity' (PPP) value of the Australian dollar is around 68 cents (U.S.).[16] This means that at 68 cents (U.S.), the dollar represents an appropriate and equivalent 'fair value'

[16] Author's calculations from OECD 'Purchasing Power Parities' data.

relative to our domestic consumer prices. When the exchange rate trades above its PPP value, Australian-denominated products (including manufactures) look unduly 'expensive' in the eyes of foreign purchasers. The reverse is true when the dollar is lower than its PPP benchmark. On that basis, the current trading range of the dollar (around 70 cents U.S.) is not 'low' in fundamental economic terms (even though it may seem low, relative to recent history). And assuming that global commodity prices eventually recover as the pandemic abates, the Australian dollar is likely (in the absence of countervailing policy actions) to rebound along with them, in light of the tendency of currency traders to identify (and speculate on) our currency as a resource-linked asset.

The roller-coaster pattern of Australia's dollar therefore highlights another risk of our extreme resource dependence. When times are good in resource industries, the resulting upward pressure on the national currency (which is treated by international financial traders as a proxy asset for placing 'bets' on resource price fluctuations) causes enormous challenges for other export industries: including manufacturing, tourism, and other tradeable services. Prices for their output do not skyrocket along with global commodity prices – but the competitiveness of Australian production on cost grounds is dramatically harmed by resource-driven surges in the value of the currency.

Figure 12. Hourly Manufacturing Labour Costs ($US), 2000-2019



Source: Author's calculations from Conference Board, Manufacturing Hourly Labour Compensation Costs.

Our industrial vulnerability to exchange rate fluctuations is highlighted in Figure 12, which portrays the evolution of Australian manufacturing labour costs relative to U.S. levels. Wages are not high in Australia relative to other industrial countries, when measured at PPP exchange rates. And non-wage labour costs are lower in Australia than most industrial countries, due to relatively low payroll taxes. So domestic manufacturing should be generally competitive on labour cost grounds with comparable industrial jurisdictions. However, that competitiveness can be quickly and dramatically squandered by resource-driven over-appreciation of the currency.

As illustrated in Figure 12, Australian labour costs were unusually low relative to U.S. levels around the turn of the century, when the Australian currency was undervalued. The reverse was true during the resource-driven appreciation of the 2000s and early 2010s (interrupted by a temporary depreciation associated with the GFC in 2008 and 2009). At peak in 2011, hourly labour costs in U.S. dollar terms were 50% higher in Australia than in the U.S. – due solely to the inflated value of the currency (which traded at peak more than 60% higher than its PPP fair value). This artificial and unsustainable increase in apparent Australian production costs was a major factor in the major decline in manufacturing employment during that period – including the fateful decisions to close down motor vehicle assembly operations here. The more recent return of the dollar to more reasonable levels has erased that apparent but misleading labour cost disadvantage. At the average 2019 exchange rate (70 cents U.S., just slightly above the PPP level), hourly labour costs in Australian manufacturing were about 10% lower than in the U.S. Ensuring that temporary resource booms, and their distorting impact on exchange rates and relative costs, do not damage the viability of domestic manufacturing in the future will be a critical priority for a more effective policy framework for manufacturers.

Another crucial and damaging dimension of Australia's international manufacturing trade has been the one-sided impact of trade policy on the domestic manufacturing footprint. Australia began to substantially and, to a large degree, unilaterally liberalise its international trade policy in the 1980s. While high tariffs and other policies to promote domestic manufacturing activity (like offsets and domestic content rules) were important to Australia's successful post-war industrialisation, it was felt by the 1980s that a more subtle and flexible approach was required – in part to provide less costly imported products for Australian consumers. In theory, it was argued, Australian manufacturing sectors could continue to thrive in this liberalised environment, by reorienting production toward global product lines (rather than the domestic market); both imports and exports of manufactured products would increase, according to this conventional story. Tariff and non-tariff liberalisation was furthered with subsequent

free trade agreements: including the formation of the WTO in 1995, and a series of bilateral free trade agreements signed beginning in the mid-2000s.

Today most manufactured imports enter Australia without tariffs, under the provisions of a free trade agreement. There is no doubt that trade liberalisation (including Australia's unilateral reduction of tariffs in the 1980s and 1990s, the subsequent bilateral FTAs, and multilateral initiatives through the WTO) has facilitated greater import penetration in domestic markets. However, the impact of this trade liberalisation on Australia's exports of manufactured products has not been positive. Contrary to predictions, the expansion of manufactured imports was much faster after FTAs were implemented than the growth in manufactured exports. Table 5 reports the growth in manufactures trade (both exports and imports) recorded during the first five years of Australia's eight longer-standing bilateral free trade agreements: with Singapore, the U.S., Thailand, Chile, Malaysia, Japan, Korea and China.[17]

Table 5 demonstrates that manufactured imports were stimulated far more significantly by FTAs than manufactured exports. In six of the eight cases, the average annual rate of growth of manufactured imports was faster than the average annual growth of manufactured exports. In two of the cases (with the U.S. and with Chile) Australia's manufactured exports actually *declined* in the first five years the FTAs were in effect. The average annual growth rate of manufactured imports in the first years of the eight FTAs (over 8%, on an unweighted basis) was 2.6 times faster than the average growth rate of our manufactured exports (just over 3%).

[17] Table 5 does not include the Australia-New Zealand Closer Economic Relations Trade Agreement, implemented in 1983, which built on previous long-standing trade arrangements between the two countries, and did not at the time possess the same features as are regularly contained in modern FTAs. It also excludes three recent FTAs signed by Australia (with Hong Kong, Indonesia, and Peru), which were not yet in force by 2019. Due to their recent implementation, Table 5 reports results from only the first four years of the Australia-Korea FTA (implemented in December 2014), and the first three years of the subsequent FTAs with Japan and China.

Table 5 Manufacturing Trade Effects of FTAs First Five Years in Effect					
	Growth in Exports		Growth in Imports		Cumulative Change Trade Balance ($b)
	Avg. Ann. Growth	Cumulative Change ($b)	Avg. Ann. Growth	Cumulative Change ($b)	
Singapore	6.47%	$0.9	24.28%	$10.5	-$9.6
US	-2.23%	-$0.9	1.28%	$1.6	-$2.5
Thailand	3.67%	$0.3	17.25%	$5.6	-$5.2
Chile	-2.68%	$0.0	4.00%	$0.2	-$0.2
Malaysia	1.17%	$0.2	8.24%	$3.1	-$2.9
Korea[1]	1.19%	$0.3	-0.48%	-$0.3	$0.5
Japan[2]	2.83%	$0.9	4.28%	$3.9	-$3.0
China[2]	14.79%	$5.9	6.56%	$17.6	-$11.7
8 FTAs	3.15%[3]	$7.5	8.18%[3]	$42.0	-$34.5
Ratio Import Growth/Export Growth			2.6	5.6	

Source: Author's calculations from DFAT TRIEC trade pivot tables. Manufacturing includes processed primary goods (but excludes LNG).

1. First 4 years in effect.
2. First 3 years in effect.
3. Unweighted average of growth rates.

The two exceptions to that general pattern were Korea and China, for which Australia's manufactured exports grew faster after the FTA than manufactured imports. In Korea's case, neither manufactured exports nor imports changed much after the FTA came into effect: imports from Korea declined slightly, while exports to Korea (much smaller to start with) grew by just 1% per year. This stagnation of two-way trade flows suggests the FTA had little impact on manufacturing trade at all.

In China's case, Australia's manufactured exports grew relatively quickly (almost 15% per year) in the first three years of the Australia-China FTA, compared to a 6.5% annual growth rate for manufactured imports. However, even this seemingly positive experience reveals the structural weakness of Australia's manufacturing trade position. Almost all of the expansion in Australian manufactured products to China consisted of processed food products: primarily meat products and beverages. Excluding food, other manufactured exports to China grew more slowly: 4.7% per year. And because of the lopsided imbalance in bilateral manufactures trade at the time the FTA was implemented (Australia's manufactured imports from China were 7.6 times larger than

manufactured exports to China in 2015 when the FTA came into effect, with a manufactured trade deficit of over $50 billion), the absolute growth in imports from China still exceeded the absolute growth in exports by a 3-to1 ratio (despite the faster proportional growth of exports). Hence the bilateral manufacturing trade deficit with China widened, even though exports were growing proportionately faster; that deficit reached a $64 billion imbalance in 2019. Even in the case of this one FTA, therefore, which seemed to stimulate exports of Australian manufactures, the resulting pattern of trade nevertheless reveals Australia's narrow and fragile base, and the continuing importance of primary inputs (in this case, meat and beverages).

Across the eight agreements, the absolute increase in manufactured imports over the first years of the FTAs' implementation was more than five times greater than the absolute increase in manufactured exports from Australia. Combined manufactured imports grew by $42 billion in the first years of the eight FTAs, compared to a combined increase in exports of just $7.5 billion. The combined manufacturing trade deficit thus worsened by some $35 billion.[18] The deterioration in bilateral manufacturing trade balances after FTAs was most severe with China (down by $12 billion), Singapore (down almost $10 billion), Thailand (down over $5 billion), and Japan (down $3 billion).

Australia now incurs a manufacturing trade deficit with every one of those eight FTA partners.[19] And across the eight FTAs in total, the combined annual manufacturing trade deficit reached $127 billion in 2019. That represents over two-thirds of Australia's overall $180 billion trade deficit in manufactures last year. Based on average employment-to-output ratios in Australian manufacturing, the bilateral manufacturing trade deficits across these eight FTA partners corresponds to the loss of over 300,000 Australian manufacturing jobs.[20] It is clear, in general, that those FTAs have exacerbated Australia's broader trade failures in manufacturing – not ameliorated them. The claim that more trade liberalisation will somehow open up markets for Australian manufactured products, and improve our foothold in international trade, has thus been firmly disproven by realised experience. While international trade is critical to the maintenance of strong manufacturing industries

[18] Since the FTAs were implemented at different times, that combined $24 billion widening of the trade deficit did not occur contemporaneously.

[19] That was not always the case. Prior to these FTAs, Australia experienced occasional manufacturing trade surpluses with most of the countries in Table 5, including Singapore, Thailand, Malaysia, Chile and even Korea.

[20] The $127 billion combined bilateral manufacturing trade deficit with the eight FTA partners represents a value of gross output equal to about one-third of total Australian manufacturing shipments. An equivalent amount produced in Australia, on average, would therefore support the creation of about 300,000 jobs (one-third of current total Australian manufacturing employment).

(given the economies of scale and specialised nature of manufactured goods), a different strategy is clearly required to attain a more balanced and mutually beneficial engagement with our trading partners.

Box: Australia's Trade in Medical Equipment

Concerns over Australia's ability to ensure reliable supplies of health care machines and supplies during the COVID-19 pandemic have sparked renewed concern with our domestic manufacturing capabilities. Australia demonstrates a high quality of primary medical research, engineering capacity (related to medical devices and machinery), and medical services. And there are some domestic businesses which have successfully entered global markets for some categories of medical devices, pharmaceuticals, and other products. However, as with other manufactured products, Australia's domestic capacity to manufacture high-value medical supplies and equipment is badly underdeveloped relative to our needs.

DFAT trade data identifies two broad categories of medical manufactures at the 3-digit level of disaggregation: diagnostic equipment and instruments; the latter represents a larger amount of two-way trade, worth over $5 billion in 2019. These categories capture only a portion of total trade in medical supplies and equipment; many other medical-related products are reported within other broader trade categories. In both these sectors, Australia's imports are much larger than our imports: by a ratio of 7-to-1 one for diagnostic equipment, but only 2-to-1 for instruments (see Table 6). The combined trade deficit in those two sectors amounted to some $2.6 billion in 2019.

Table 6
Medical Equipment Trade, 2019
($ billion)

	Exports	Imports	Balance
Medical diagnostic equipment	0.14	0.98	-0.84
Medical instruments	1.70	3.45	-1.75
Total	1.84	4.43	-2.59

Source: Author's calculations from DFAT commodity trade pivot tables.

Australia's strong research and engineering capacities, and our large and sophisticated domestic market for advanced medical products and services, gives us a decent starting point

to develop further capacities and investments in advanced manufacturing of medical equipment. This specialised sector could thus constitute a good example for applying pro-active sector development strategies to industries with strategic national importance.

Making the Most of Our Minerals: Adding Value

Because Australia's merchandise trade has been so narrowly specialised – with exports dominated by unprocessed resources, and imports dominated by sophisticated value-added products – Australia fulfils a role in global commerce more typical of a developing country, rather than an advanced industrial nation. This pattern of trade undermines the extent to which Australia's economy can incorporate innovations and modern technology in both products and processes. To be sure, some aspects of resource extraction rely heavily on new technologies (such as automated extraction and transportation techniques), and large resource firms do make significant investments in new technology. But in proportion to its size, the resources sector undertakes far less innovation and research than manufacturing: as indicated in Figure 6 above, the mining sector invests just 0.7% of sector value-added in new research and development, one-sixth the share of manufacturing. The growing focus of Australia's economy on resource extraction, matched by the erosion of innovation-intensive manufacturing, has thus undermined our overall national innovation performance. And by exporting resources, and then re-importing the value-added products manufactured from those resources, Australia forgoes the income and employment potential associated with that value-added work.

Here we consider just two examples of the long-run economic losses associated with Australia's perverse specialisation in resource extraction, combined with our under-developed manufacturing capacity. Australia possesses the world's most abundant reserves of two vital minerals that are playing a growing role in modern industrial society:

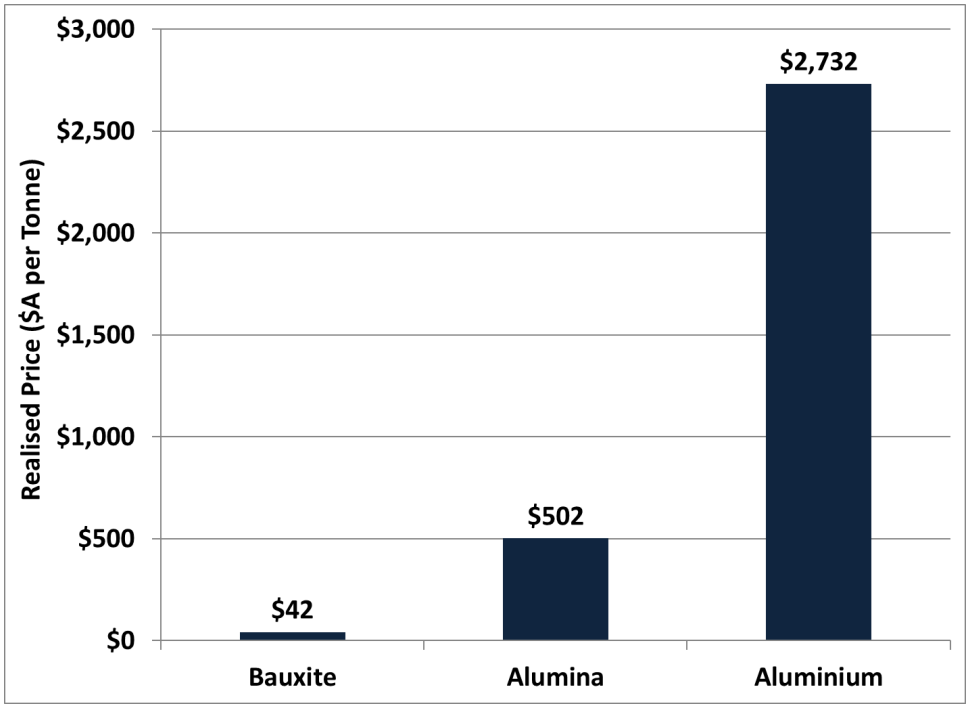
- Bauxite, the raw ingredient in making aluminium, used in an enormous array of transportation, construction, and equipment applications
- Lithium, the crucial component of modern lithium-ion batteries used in stationary and mobile batteries of all sizes.

Both minerals will be used in increasing amounts. One reason for this long-run increase in demand is their attractive environmental properties: aluminium is lighter in weight than other metals, and achieves superior energy conservation results in both transportation and construction uses, while lithium is a crucial input in renewable energy and transportation systems. Australia, however, is squandering much of the

potential benefits that could be generated as a result of its fortunate endowment of both minerals. Instead of leveraging its abundant resources to foster value-added processing, refining, and manufacturing of products containing those minerals, Australia has largely limited its role to extraction. This forgoes enormous income-generating opportunities associated with value-added industry.

Figure 13 illustrates the average price attained for different stages of aluminium manufacturing. Australia's exports of raw unprocessed bauxite have grown substantially in recent years: rising over 50% between 2010 and 2019. However, raw bauxite is a low-value commodity: it sells for around $40 per tonne. Bauxite must be processed first into alumina (which sells for about $500 per tonne), and then smelted into aluminium (recently selling for around $2700 per tonne). Australian alumina refining has been stagnant, even as exports of raw bauxite boomed; in fact, alumina production declined slightly over the last decade (with one major refinery in Gove, NT closing in 2014). And aluminium smelting has declined significantly in Australia, with two smelter closures in the last decade – and the future of another (in Portland, Victoria) under threat. Meanwhile, the use of smelted aluminium to manufacture aluminium products (such as auto parts, building materials, and electronic equipment) has also declined in Australia in recent years, along with the general contraction in domestic manufacturing. Australia is thus increasingly concentrating its activity in this valuable, critical industry to the lowest-value rung of the economic ladder.

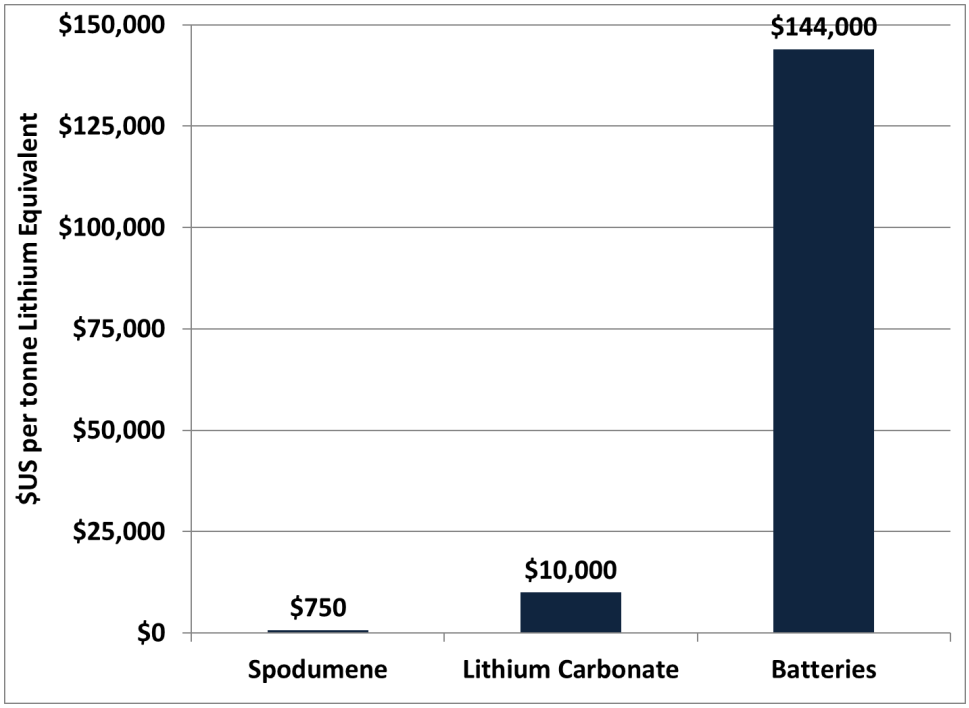
Figure 13. Average Prices for Aluminium Products, 2019



Source: Author's calculations from Dept. of Industry (2019); average prices for first 9 months of 2019.

A similar, even more concerning pattern has emerged in Australia's production of lithium. This mineral has enormous prospects for playing a central role in the development of a decarbonised global economy. Australia has the world's third largest proven deposits of lithium – and the form of Australia's reserves (in hard rock form, rather than brine) is superior for both processing costs and quality. Australia has quickly become the world's largest producer of raw lithium, exporting $1.2 billion of spodumene (the raw form of mined lithium) in 2018. Spodumene sold in 2019 for an average of around $750 per tonne (U.S.). Global prices for raw spodumene have fluctuated dramatically, in line with experience of global commodity markets for other bulk, undifferentiated resource products; recently they have declined dramatically.

Figure 14. Average Prices for Lithium Products, 2019



Source: Author's calculations from U.S. Geological Survey (2019) and industry sources.

Despite the potential represented by our unmatched reserves of lithium, if Australia's ambitions are limited to extracting and exporting raw lithium, then we will simply repeat the mistakes of history, and consign ourselves once again to a stunted, low-value role in the global value chain of batteries and products which contain them. Spodumene must first be refined into intermediate chemical products (either lithium carbonate or lithium hydroxide[21]). Lithium carbonate sells for around $10,000 (U.S.)

[21] Lithium hydroxide is more valuable, and another advantage of Australia's high-quality hard-rock lithium is that it can be processed directly into lithium hydroxide rather than first into lithium carbonate (as must occur with brine-extracted lithium).

per tonne. It is then manufactured into batteries; that processes amplifies the total value of the output many times again. For example, if ultimately manufactured into medium-sized batteries for electric vehicles, 1 tonne of spodumene would correspond to close to $150,000 (U.S.) worth of total batteries. Those batteries, installed in electric vehicles (using the Tesla Model S, retailing for around $100,000, as an example), would then correspond to some $1.2 million worth of final product. This value-chain is illustrated in Figure 14.

A similar story can be told about Australia's other major resource exports. By focusing on extraction and export of raw minerals and other primary products, Australia forgoes the potential benefits of advanced manufacturing for our productivity, our innovation, our incomes, and even our environmental performance. Conventional trade theory often suggests that countries should pursue a specialisation in international trade that matches their 'comparative advantage': assumed to reflect some natural or inherent talent or resource abundance.[22] But no country was ever naturally 'endowed' with an innate ability to produce high-value innovation-intensive manufactured products. Those industries were built in other countries (like Germany, the Nordic countries, Japan, Korea, and now China), with the support of deliberate, pro-active industry policy interventions. Accepting an assigned role as supplier of raw materials to other countries, which in turn can build more dynamic, innovative, and diversified economic structures (partly with the help of our raw resources), imposes unnecessary and unsustainable constraints on Australia's future prosperity.

A shocking insight into Australia's underdeveloped role in world trade, and our precarious dependence on exports of unprocessed raw materials, can be gleaned from the work of the Growth Lab at Harvard University in the U.S.[23] This research body analyses the direction and composition of trade for virtually all countries, and then develops measures of *economic complexity* for each nation: based on the intensity of technology, reliance on innovation, and connection to other complex economies. The most recent edition of this work (for 2017) ranks Australia as the 93rd most complex economy in the world (see Table 7). We ranked just above Pakistan and Mali, but behind Morocco, Uganda, and Senegal. Since the turn of the century, when the global

[22] There are many other theoretical assumptions that are essential to comparative advantage models of international trade (and policy prescriptions arising therefrom), but which are not valid in real-world settings: including assumptions of full employment, competitive product and factor pricing, and the assumption that an entire country can be described by a 'representative' household. See Stanford (2015), Ch. 22 for discussion.

[23] See Growth Lab at Harvard University (2019) for details and methodology. A similar analysis and ranking is published annually by the observatory of Economic Complexity (2019), based at MIT; it also shows Australia with a low and declining global rank according to economic sophistication, far out of step with other industrial countries.

commodities boom and our own policy passivity redirected our national economy to once again focus unduly on extraction rather than value-adding, Australia has fallen 29 places in this ranking. By this structural indicator, therefore, Australia is rapidly regressing in technological and structural terms. We are becoming structurally more similar to developing countries, rather than leading industrial economies. In turn this squanders our collective potential to use our full productive and innovative capacity as a nation.

Table 7
Global Rankings of Economic Complexity, 2017

Country	Rank	Rank Change Since 2000	Score
Japan	1	0	2.28
Switzerland	2	+1	2.14
South Korea	3	+16	2.05
Germany	4	-2	2.02
Singapore	5	+6	1.81
Czech Republic	6	+7	1.79
Austria	7	+1	1.71
Finland	8	-2	1.69
Sweden	9	-5	1.67
Hungary	10	+12	1.64
* * *			
Morocco	90	+3	-0.50
Uganda	91	+34	-0.55
Senegal	92	-9	-0.56
Australia	93	-29	-0.60
Pakistan	94	+8	-0.62
Mali	95	-11	-0.62

Source: Growth Lab at Harvard University (2019).

This is a very worrisome indication of the extent to which Australia has come to depend on extraction and export of raw materials. While resource exports can support some good jobs, and generate strong incomes (when global commodity prices are

high, at least), it is a narrow and precarious basis for long-term economic development. Most countries aspire to fulfil a larger, more balanced, and ultimately more prosperous role in the global economy. Australia should do likewise. If we want to have access to the same technological and economic opportunities as countries like Japan, Germany, or even Singapore, we will need to consciously reshape our role in the world economy, and aspire for a more promising and diversified economic future. Revitalising our manufacturing sector, and ensuring that Australia can participate proportionately in the activity of this most innovation-intensive of industries, is an essential precondition to achieving this goal.

Making the Most of Our People: Skills and Training

A crucial barrier holding back the potential revitalisation of Australian manufacturing is the inability of our present vocational education and training system, damaged by years of underfunding and failed policy experimentation, to meet the need for highly-skilled manufacturing workers. The skills challenge facing manufacturing is all the more acute because of the transformation of the sector toward more specialised and disaggregated advanced manufacturing processes. New technologies (including Industry 4.0 and the 'internet of things,' additive manufacturing and 3D-printing, and broader application of robotics and automation) allow for many manufacturing processes to take place in smaller, customised volumes and in more remote locations. Those trends will enhance the opportunities for Australian-based facilities to participate in global production chains (often undertaking particular stages of production, rather than start-to-finish vertically integrated assembly). These models of advanced manufacturing naturally result in more challenging demands for highly-trained workers, in all occupations: production workers, skilled trades people, technology specialists, and managers.

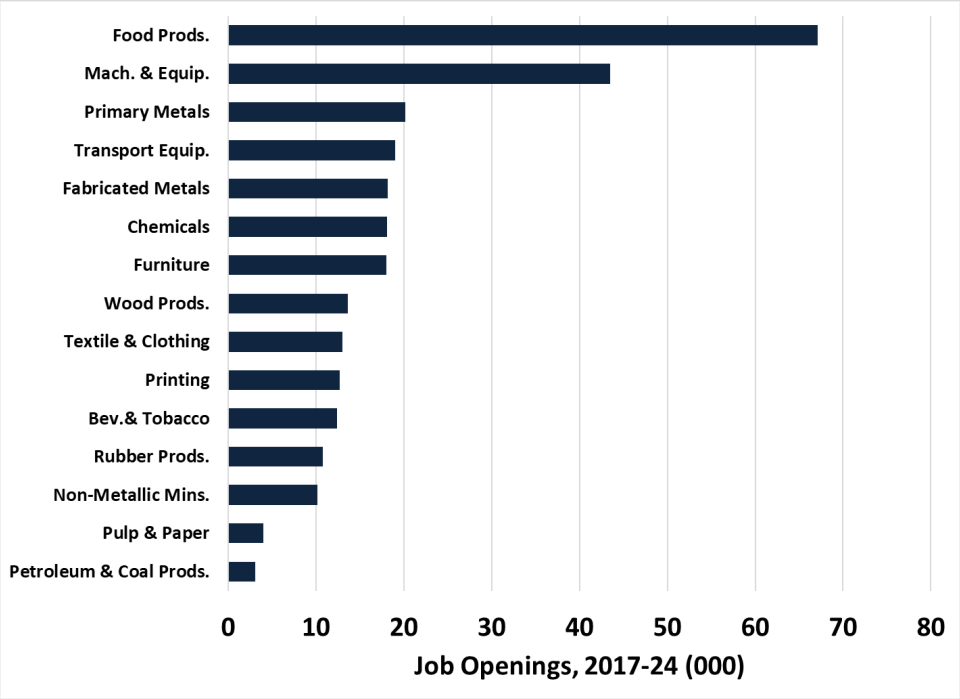
Despite the downsizing of manufacturing employment over the last decade, employers regularly report difficulties in finding workers with the right skills for openings that do arise. Openings may arise both because of newly-created positions, and because of the need to replace retiring workers. Indeed, the manufacturing workforce is one of the oldest of any sector in Australia. The average age of manufacturing employees in 2018 (most recent data) was 42 years old, more than two full years older than the average for the overall Australian workforce. 45% of Australian manufacturing workers are over age 45. One-fifth are over age 55.[24] So there will be a surge of retirements from the industry in coming years, requiring an ambitious and pro-active effort to ensure an inflow of adequately trained younger workers. And if a successful 'Fair Share' strategy for Australian manufacturing was implemented (as proposed below), resulting in a significant expansion of total employment over the coming decade, then the need for a steady flow of well-trained entrants would be all the more pressing. One pragmatic way to ease the staffing pressures arising from the coming wave of retirements would be to develop and implement new models for phased retirement. By allowing older

[24] Age statistics based on author's calculations from ABS Catalogue 6306.0.

workers to stay on the job, even on a part-time basis, more opportunities will be created to recruit and train the next generation of skilled manufacturing workers.

Even under status-quo economic conditions – with manufacturing operating at far below its proportional 'fair share' potential – the National Council for Vocational Education Research (NCVER) projects that the manufacturing sector will need to recruit almost 300,000 workers in the coming eight years.[25] The distribution of those expected openings (both to offset retirements and fill new openings) is illustrated in Figure 15. The relatively strong food products sector accounts for the largest number of projected openings, followed by machinery, metal products (both primary and fabricated), and transportation equipment.

Figure 15. Job Openings by Manufacturing Sub-Sector



Source: Data from Shah and Dixon (2018).

Of course, if government committed to a strong and ambitious 'fair share' manufacturing strategy, expanding the total sector to a size proportionate with Australian consumption of manufactures, then the required flow of new workers to the industry would be more than twice that estimate.[26] This would put enormous pressure on Australia's vocational training system, which has suffered badly in recent

[25] See Shah and Dixon (2018).

[26] As explained below, a 'Fair Share' strategy to expand total domestic manufacturing to a size commensurate with Australian use of manufactures would imply new job creation of over 400,000 positions, on top of NCVER's forecast for (mostly replacement) job openings.

years from a combination of underfunding and failed experiments with market-based delivery models. Employers, too, share come of the blame for their current challenges recruiting skilled labour: they clearly did not invest enough in training to develop an ongoing pipeline of new skilled workers and apprentices. Without strong efforts to improve vocational education, the recovery in manufacturing envisioned in this report could be cut short by inadequate availability of skilled labour.

In short, the manufacturing sector has an urgent need for a concerted and cooperative effort to strengthen the sector's vocational education and training system. To succeed, this effort will require cooperative participation by all stakeholders: government, industry, educational institutions, and unions.

It may seem counter-intuitive that an industry that has lost over 100,000 positions in the past decade could be experiencing a 'shortage' of workers. But there are key structural reasons for the emergence of potentially binding skills shortages, even in an industry which has shrunk in absolute terms. It is not just a potential increase in total manufacturing employment (under the policy vision described in this report) that could create skills shortages. The reorientation of manufacturing production around more specialised and skills-intensive production strategies reinforces the need for more highly trained and technology-capable manufacturing workers. Moreover, the coming demographic transition within the manufacturing workforce will be particularly acute among highly skilled tradespeople, technicians, and other specialised workers, many of whom joined the industry during the 1980s and hence are rapidly approaching retirement age. Finally, the sectoral, occupational and geographical diversity of manufacturing employment means that shortages can arise in specific fields, even when overall labour demand conditions are inadequate.

The current operation of the VET system is certainly not meeting the needs of Australian manufacturers, as confirmed by abundant published research.[27] In addition to failing to provide manufacturing employers with an adequate pipeline of top-quality skilled workers, the system is also failing to meet the needs of the wider community for access to high-quality training – and for corresponding pathways to decent work. At present, training delivery is increasingly oriented around fragmented packages of knowledge: 'micro-credentials' and other narrow training units, most often packaged and delivered by private training providers. These packages may address immediate, narrow, enterprise-specific requirements, but they do not permit workers to accumulate the comprehensive, recognised, and portable qualifications necessary to fulfil all the requirements of a trade, and to adapt to new assignments and technologies. This focus on a very narrow vision of qualifications reinforces a culture

[27] See Carney and Stanford (2018) for a recent summary of the evidence.

of 'training for the enterprise,' whereby employers primarily commission training to meet specific requirements without investing in more comprehensive and flexible capacities. This then inhibits the overall ability of the manufacturing workforce to respond, adapt and redeploy in a variety of situations – such as shifting jobs within an enterprise, moving to other firms or sub-sectors, or responding to changes in wider economic conditions.[28]

Failed experiments with market-based delivery models, contestable training programs, and outright privatisation of VET services have all added to the malaise of vocational training. The outsized role in the present VET system played by private training providers, subsidised with poorly-supervised public payments, has also damaged credibility and trust in the value of vocational education that is so important in eliciting commitments (from both employers and students) to ongoing investments in skills acquisition. At the same time, the capacity of public 'anchor' institutions (and the TAFE system in particular) has been eroded by funding cutbacks and misplaced faith in market-based competition. For all these reasons, the vocational training system in Australia has been in full-blown crisis for years – and the accelerating drop-off in enrolments and apprenticeships that has resulted from the COVID-19 economic downturn now risks pushing the whole system into terminal decline.

The crisis in Australia's VET system affects all industries and sectors, not just manufacturing: however, manufacturing is among the industries most dependent on a regular flow of qualified, certified vocational graduates. Without urgent efforts to rebuild VET and restore the capacities of the TAFE institutions, the inadequacy of vocational education in Australia will limit the future expansion of manufacturing as envisioned in our 'fair share' revitalisation plan.

There are several specific steps that must be taken to strengthen and reorient the VET system in manufacturing, in the face of these urgent concerns. Of course, addressing the skills crisis in manufacturing can only occur in the context of broader efforts to reform vocational education more generally – since most of the problems (including the failure of subsidised market delivery of VET services) are system-wide in nature. At the same time, however, numerous measures must also be taken to address the particular skills challenges facing manufacturing. They include:

- Shift the emphasis of curricula and training programs toward comprehensive and complete qualifications, rather than micro-credentials.
- Enhancing the capacities of TAFE teachers in manufacturing fields, and investing in modern capital equipment for training.

[28] The importance of this flexibility is emphasised by Buchanan and Jakubauskas (2010).

- Encouraging partnerships on customised joint training initiatives between specific TAFEs and firms or groups of firms.
- Developing and implementing higher-level and multi-disciplinary qualifications to reflect emerging skills and composite capacities in advanced manufacturing (in areas such as digital machine control, composite and carbon materials, robotics, and Industry 4.0/internet-of-things applications in manufacturing).
- Integrate basic literacy and numeracy training into VET offerings at all levels.

In addition to repairing and strengthening the activities of VET providers (centred on resuscitating the TAFE system), measures are also needed to support the expansion of apprenticeships in manufacturing with fiscal measures, instruction resources, and mentoring. The number of apprentice positions in manufacturing has declined dangerously in recent years. This largely reflects the short-sightedness of employers, and the perverse effects of competition between manufacturing employers for scarce skilled workers (with the result that many employers would rather 'poach' skilled workers from other firms, rather than invest in developing their own skilled workforce over time). This myopic and self-interested approach contrasts with the success of other countries (Germany being a prime example) in which the responsibility to organise and fund comprehensive initial and ongoing training is accepted as a normal feature of business, and engages contributions by all stakeholders (including employers, training institutions, unions, and governments). The lack of consistent public support for apprenticeships in manufacturing is another factor behind the erosion of on-the-job training; government has a major role to play here, too.

The fragmentation of vocational training activity – between competing employers, competing private training providers, and various levels of government – hampers Australia's ability to develop and manage a consistent, integrated VET system. One practical step that could assist in achieving a more coherent and effective VET framework would be the establishment of a leadership-level multi-partite Manufacturing VET Policy Board to gather better information about future needs for and shortages of skilled workers, coordinate VET initiatives in the sector, and represent the interests of manufacturing in broader VET processes and dialogues.

Making the Most of Our Energy: A New Industrial Synergy

Manufacturing needs energy. The industry spends around $5 billion per year on electricity, and another $1 billion for natural gas (used both for energy and as a feedstock in chemical processing). Manufacturing investments have always been centrally linked to availability of reliable, competitive energy. But now there is a new dimension shaping the energy choices of manufacturers: the environmental sustainability of competing energy sources. To meet government regulations on greenhouse gas emissions, and fulfil the expectations of customers, consumers and financial investors regarding sustainability concerns, manufacturers are increasingly focused on the need to transition to renewable energy sources (including hydro-electricity, solar, wind and geothermal).

Australia's inconsistent, volatile, and fragmented energy policies have been a major source of financial distress and uncertainty for the manufacturing sector over the past two decades. Electricity prices have skyrocketed due to privatisation, lack of integrated national planning, and supply disruptions. Gas prices have also been driven up by policies such as the unrestricted flow of gas supply to export LNG projects – which has led to inflated prices for domestic consumers (who often pay more for Australian gas than foreign customers do[29]). The Australian government has failed to implement a stable and consistent policy framework for energy security and sustainability, and continues to be influenced by narrow sectional demands to protect fossil fuel industries.

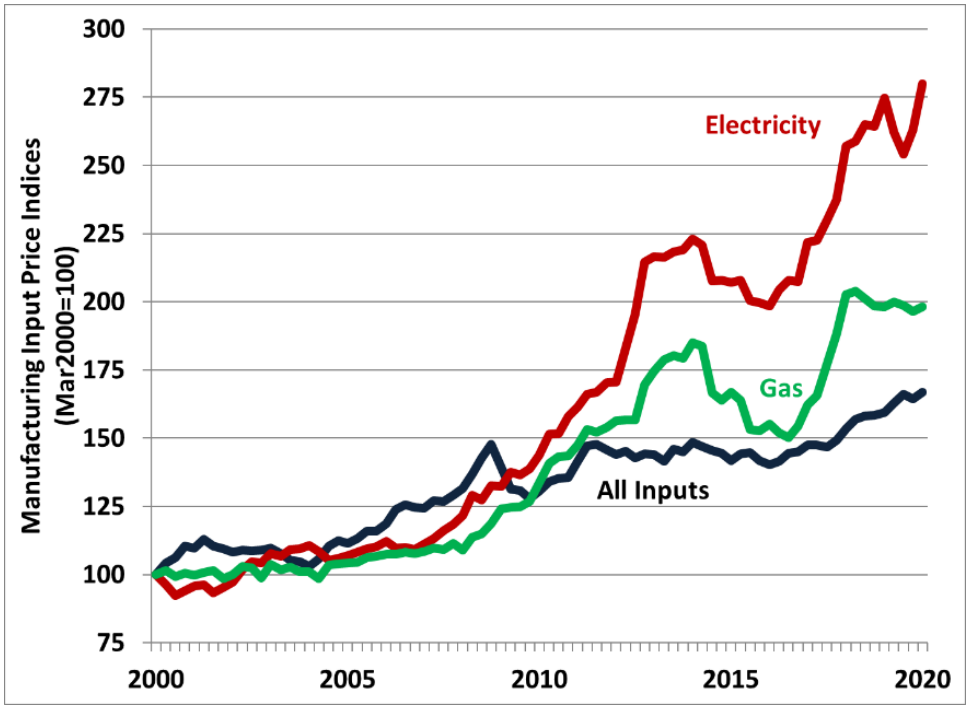
This chaotic status quo has not served manufacturers well. As indicated in Figure 16, electricity prices for manufacturing industrial users have skyrocketed by 180% since 2000. Electricity prices have grown three times as fast during this period as overall input costs for the manufacturing sector. Gas prices – driven upward by the misguided allocation of most of our domestic supply to offshore LNG markets – have doubled in the same period, also rising far faster than other input costs to manufacturing. High prices and unreliable supply (coal-fired electricity facilities, in particular, have demonstrated the worst reliability of any energy form in recent years[30]) have significantly damaged the competitiveness of Australian manufacturing. Despite this sorry record, Commonwealth government policy-makers continue to try to reinforce

[29] See Institute for Energy Economics and Financial Analysis (2019).

[30] See Quicke and Brown (2020), for example.

and even expand the reliance of our energy system on fossil fuels. Most recently this perverse bias has been reflected in far-fetched proposals to publicly subsidise the construction of new coal-fired electricity generation facilities, and to dramatically expand natural gas infrastructure and consumption.

Figure 16. Input Prices for Manufacturing, 2000-2020



Source: Author's calculations from ABS Catalogue 6427.0, Table 13.

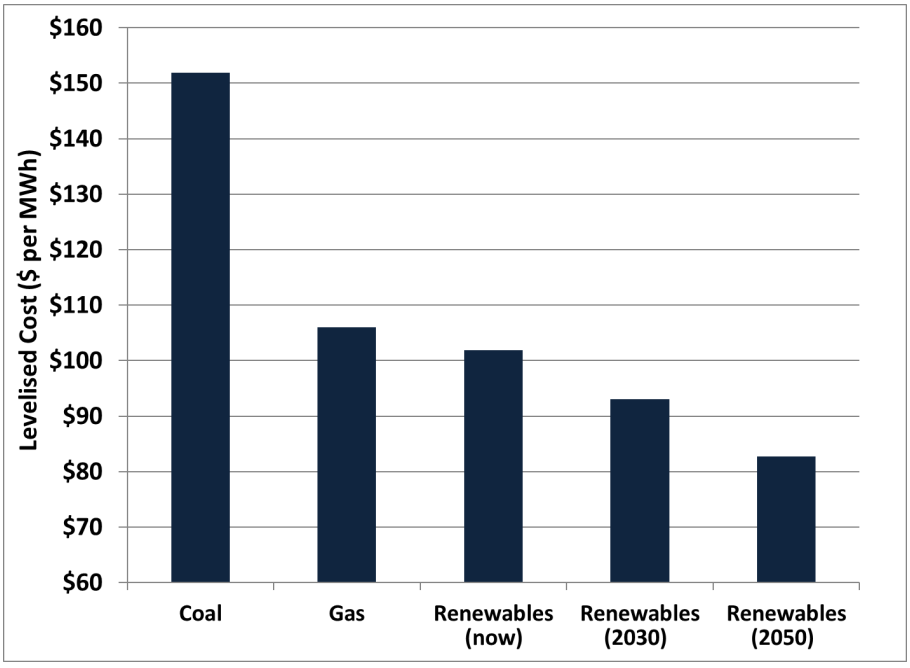
The vested interest of fossil fuel industries in maintaining and subsidising the continued expansion of fossil fuel production and use, despite the overwhelming global trend away from carbon-based energy sources, is badly distorting both our energy system and our industrial foundation. A worrisome recent example was the overwhelming but misplaced emphasis placed on accelerating and subsidising natural gas projects as part of the Commonwealth government's National Covid-19 Coordination Commission (NCCC).[31] The unfounded hope that massive developments in fossil fuels (an industry that will inevitably shrink and disappear within the next two or three decades) could somehow ignite national economic recovery not only misunderstands the fundamental change in the economics of energy; it also squanders an important new source of competitive advantage which *could* be imparted to Australian manufacturing, through development of our unmatched endowments of renewable energy. Charging ahead with government-mandated and publicly-subsidised gas projects will only result in huge stranded capital assets and further

[31] The undue focus on gas projects in the NCCC's work is detailed by Morton (2020).

distortion in energy markets. Pushing more gas supply into the system will not even reliably reduce energy prices paid by manufacturers. After all, Australian gas production increased by 150% between 2013 and 2019[32] – yet prices skyrocketed for domestic industrial users. Almost all the new production was exported. So simply increasing gas supply (without a strong domestic gas reservation policy, curtailments on gas exports, and price controls – measures all fiercely opposed by the gas industry) provides no assurance at all of more affordable or reliable energy, and constitutes a distraction from the true energy opportunity facing Australian manufacturing.

Instead, renewable energy is a far more promising avenue to strengthen the energy supply base for Australian manufacturing, and foster new competitive industries and exports. The technology and economics of renewable energy has been dramatically transformed in recent years. Renewable energy has become significantly less expensive than fossil fuel generation – even with extra costs for energy storage (such as batteries or pumped hydro). Australia has unmatched potential to supply renewable energy, given our large land mass and superior solar and wind resources. Rapid roll-out of renewable energy supplies thus has great potential to provide manufacturers with inexpensive, reliable and sustainable power. This is more promising than misleading claims about fossil fuels – including proposals to use gas as a so-called 'transition fuel'.

Figure 17. Levelised Generation Costs



Source: Graham et al. (2018). Renewables includes six hours pumped hydro storage.

[32] Author's calculations from Dept. of Industry, Science, Energy and Resources, *Resources and Energy Quarterly*, Table 31.

Figure 17 illustrates comparative costs of different energy sources for electricity generation, on a full lifetime cost basis.[33] Renewable energy sources already enjoy a cost advantage relative to fossil fuel generation: especially compared to coal, but even cheaper than natural gas. More importantly, the cost of renewables is falling rapidly, for various reasons: improvements in technology, new methods of generation (such as offshore wind), and economies of scale in production and operation. Over the next 30 years, the full-cycle cost of renewables will fall by at least another 20% – whereas the costs (both financial and environmental) of fossil fuel use will become more burdensome.

Nahum (2020) has estimated annual power cost savings to manufacturers if the sector's current use of fossil fuel-fired power is fully transferred to renewables (as existing generating facilities are retired and replaced). The manufacturing sector's power bill would decline by an estimated $1.6 billion per year, or 23 per cent, compared to the current fuel mix. The saving swells to $2.2 billion (in constant dollars) by 2050. This comparison includes the costs of six hours of pumped hydro energy storage. The calculations do not factor in a price on carbon, which would increase the cost of coal and gas-fired power; if one is included, the savings are commensurately greater. Similarly, if the need for storage is reduced over time,[34] then the cost of renewable supply is substantially reduced even further.

Many manufacturers have already identified the huge potential savings of renewable energy to their operations, and are moving ahead with expanded projects that leverage Australia's unmatched renewable energy resources. Some firms are contracting with renewable energy suppliers through power purchase agreements (PPAs) to underwrite new renewable generation, and slash their own energy costs (by up to 50 per cent in the process of doing so). Examples of manufacturers using this strategy include Bluescope Steel and Carlton United Breweries.[35] These renewable facilities are not co-located with manufacturing, nor do they need to be; rather, the PPAs match incremental power inputs to the grid with an equivalent demand from manufacturers elsewhere on the grid.[36] Meanwhile, heavy manufacturers including primary metals producers (like Liberty House Group and Sun Metals) have installed dedicated and co-located solar arrays to power their manufacturing facilities.

[33] See Graham et al. (2018) for details on methodology of levelized cost comparisons.

[34] As renewable energy becomes more commonplace across a better-integrated electricity grid, and hence generation of solar and wind power becomes more diversified (with respect to region, time of day, and grid connectivity), it is not clear that much storage capacity will be required at all; see Diesendorf and Elliston (2018).

[35] Nahum (2020) discusses several examples.

[36] Requisite transmission and storage infrastructure must also be developed as this strategy becomes more popular.

Improvements in the technology of renewables generation, transmission and storage now allow renewable energy to be used in even the most demanding of heavy industrial applications.

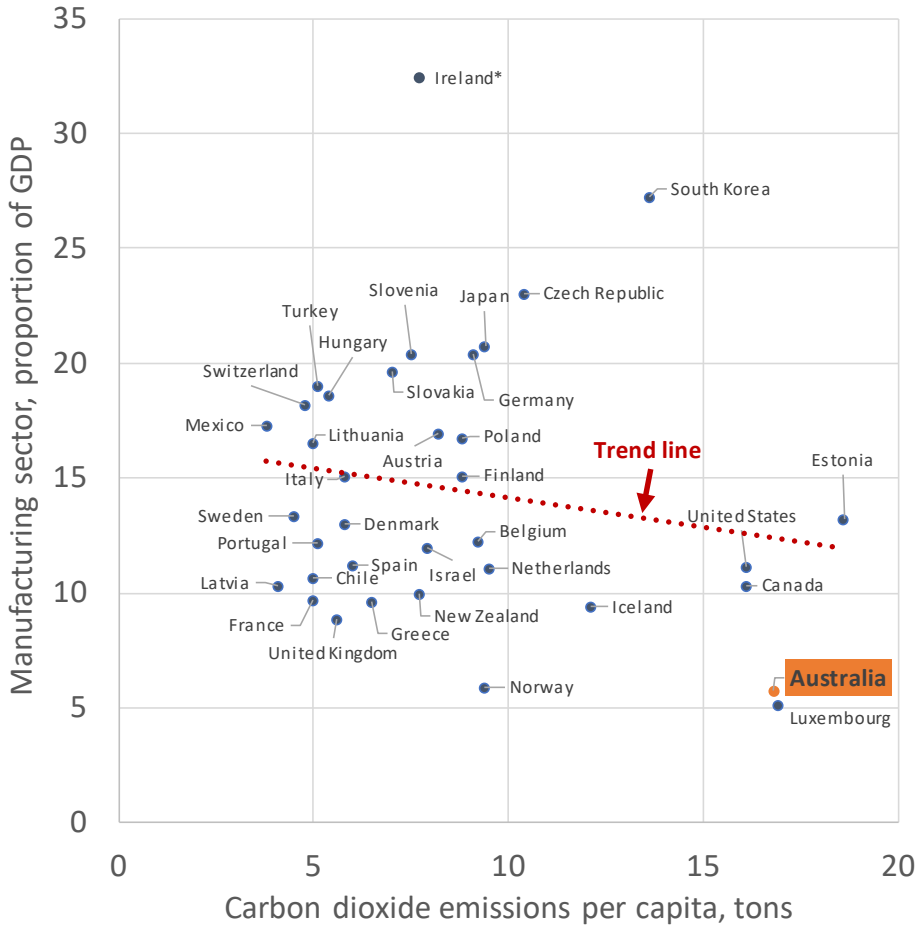
Australia's unmatched renewable energy endowment thus has the realistic potential to power a revitalised and prosperous domestic manufacturing industry. Possibly the most exciting opportunities to leverage renewable energy to power a renaissance of domestic manufacturing involve a virtuous cycle of using our renewable resources to manufacture products and equipment, that in turn are used as inputs in the further development of that renewable endowment. By connecting manufacturing investments with renewable energy developments, Australia has the possibility to simultaneously accelerate the roll-out of renewable energy systems (with great economic and environmental benefits), while expanding Australian manufactured inputs to those projects. Examples of this new industrial synergy include:

- Using domestically-produced 'green' steel and aluminium to build wind turbines, in turn supporting the transition of our energy mix to renewables
- Expanding production of solar panels in Australia
- Using renewable electricity to process and manufacture lithium in a domestic battery industry, which in turn could support expansion of domestic electric vehicle (EV) manufacturing.

International evidence shows that countries which have reduced greenhouse gas emissions per capita have attained greater success in manufacturing output (as a proportion of GDP) and exports than Australia. Figure 18 illustrates the negative correlation between emission intensity and manufacturing success. Perhaps counterintuitively, countries that emit less, manufacture more. Australia's unusual position in the OECD as a uniquely high-emissions, low-manufacturing economy is particularly alarming and puzzling – given the bounty of renewable resources which we, uniquely among developed economies, enjoy.

Australia thus faces an extraordinary opportunity to embrace and develop our unmatched renewable energy endowment to power high-value industrial and technological development. Doing so could make Australia a 'sustainable manufacturing superpower,' as proposed by the eminent economist Ross Garnaut (2019). This opportunity will be squandered, however, unless Australia quickly establishes a consistent, stable and comprehensive policy framework to guide decisions in both the energy and the industrial realms of our economy.

Figure 18. Manufacturing Success and Carbon Intensity, OECD Nations, 2018.



Source: Nahum (2020).

Several critical policy principles would confirm and accelerate the energy transformation of Australian manufacturing, thereby helping our industry to make the most of the renewable energy opportunity before it:

- Australia desperately needs clarity and stability in energy policy, to affirm to all stakeholders that our commitment to emissions reduction is meaningful, permanent and consistent with international targets. Even the business sector has made clear its desire for the federal government to institute a firm Paris-consistent policy mechanism, so that businesses can make informed investment decisions that will not subsequently be undermined by unexpected changes in policy and politics.

- Governments at the federal, state and local levels can and must play an active role, partnering with both renewable energy firms and manufacturers to develop Australia's sustainable manufacturing potential. These efforts should include:

- Fiscal and investment strategies to accelerate renewable energy initiatives linked to domestic manufacturing opportunities; these could include fiscal support for the production and use of renewable energy (eg. through the Clean Energy Finance Corporation and the Australian Renewable Energy Agency), direct equity investments and co-investments in new manufacturing projects, and favourable tax treatment of sustainable manufacturing investments (such as investment tax credits)
- Provision of public goods to assist these firms to facilitate training for workers in transitioning industries (noting that the future prosperity of regional Australia will be tied up in the success of these workers and businesses)
- Leveraging government procurement to favour domestic manufacturers who are actively engaged with the renewable energy transition.

- Sector-specific industrial policy strategies must be developed in key identified manufacturing sectors that can benefit from inputs of renewable energy, and/or that can then provide Australian-made manufactured inputs to renewable energy developments. Potential sub-sectors which could benefit from such strategies include:
  - Primary metal production (including 'green' steel and aluminium production)
  - Lithium-ion battery production
  - Electric vehicle manufacturing
  - Public transit equipment
  - Wind and solar generation equipment.
- A key factor in the successful roll-out of renewable energy in Australia will be upgrading and strengthening transmission and exchange facilities, which have been badly damaged by years of short-sighted profit-seeking and regulatory failures in Australia's largely privatised electricity system.[37] Federal and state regulators must move urgently to facilitate improvements in transmission capabilities and interconnectivity with spatially decentralised renewable power projects. This will require greater accountability and long-range planning from private utilities, and expanded public ownership.

[37] See Richardson (2019) for an overview of the economic consequences of Australia's failed experiment with electricity privatisation and deregulation.

- Hydrogen is likely to be a major output from, and input into, manufacturing processes in years to come—both in Australia and internationally. This is a critical moment to get the settings right for this future hydrogen industry. Proposals to develop a hydrocarbon-based hydrogen industry (including with the use of unproven carbon capture technologies) would not advance the goals of either decarbonisation or revitalised domestic manufacturing—and Australians would be stuck with huge sunk costs that would make it even harder to reorient hydrogen production in the future. Instead, Australia needs policy clarity and targeted government co-investments in a green hydrogen strategy, with priority placed on maximising the potential manufacturing spin-offs. Those spin-offs can be achieved both through greater use of hydrogen in domestic manufacturing processes, and through maximisation of the domestic manufacturing content in hydrogen projects.

- The expansion of renewable energy supplies for manufacturing will provide many exciting opportunities for employment and job-creation: both in building and operating the energy projects themselves, and in the manufacturing industries which are supported by them (as energy users, and as suppliers of manufactured inputs to renewable energy projects). However, the employment transitions associated with the shift to renewable energy must be supported and facilitated with active measures to avoid job displacements and support regional communities which have been previously dependent on fossil fuel industries – industries which are now shrinking, and will continue to do so. These transition supports should include:

    - Planning to locate renewable energy and related projects in regions with current fossil fuel industries, to make employment transitions into growing industries more accessible

    - Fiscal and regulatory encouragement to locate new manufacturing projects, tied to renewable energy expansion, in regional areas facing especially challenging employment situations

    - Application of strong standards regarding training and qualifications, labour standards, job quality, and union representation to renewable power developments, to ensure that the jobs created there are of high quality

    - Generous supports for early retirement, retraining, and relocation for workers in fossil fuel industries so they can either transition to retirement or take up alternative career possibilities (including, under our proposals, in a growing manufacturing industry)

Making the Most of Our Firms: Size and Capacity

Another important and limiting feature of Australia's present manufacturing sector is the preponderance of very small enterprises, and the failure of those smaller firms to survive and grow over time. Table 8 provides data on the number of businesses in Australian manufacturing, by size category. The table compares 2019 to 2007: one year before the Global Financial Crisis and resulting economic downturn, which marked the beginning of the sustained downturn in absolute levels of manufacturing output and employment which has been experienced ever since.

Table 8
Count of Manufacturing Businesses by Size

	Zero employees	1-19 Employees	20-199 Employees	Over 200 Employees	Total Firms
2019	38,430	40,998	6,513	487	86,428
Share Total	44.5%	47.4%	7.5%	0.6%	100.0%
2007	41,182	44,177	10,191	756	96,306
Change, 2007-2019	-6.7%	-7.2%	-36.1%	-35.6%	-10.3%

Source: Author's calculations from ABS Catalogue 8165.0. Data as of June each year.

As of June 2019 there were over 86,000 registered businesses operating in the manufacturing sector. The total number of firms has declined by almost 10,000 since 2007. It might seem impressive that there are that many firms still active in this vital part of our economy. However, the large absolute number of manufacturing businesses belies a profound weakness in the structure and capacity of those firms. Almost half of those firms (47%) have less than 20 employees (and three-fifths of those had less than four employees). Another 45% of manufacturing firms had *no employees* at all: only the proprietor, often running an unincorporated business, often from their own home. Only 7.5% of all manufacturing businesses fell into the 'middle sized' category: some 6,500 firms, with employment between 20 and 200 workers. Meanwhile, less than 500 companies (0.5% of all manufacturing firms) had over 200

employees. So the overwhelming majority of manufacturing businesses are very small, with few if any employees. That inevitably limits their capacity to undertake innovation, invest in sophisticated capital equipment, and try to sell their products into export markets.

Worse yet, the contraction in Australian manufacturing over the past decade has been felt most severely by medium-sized enterprises. The number of firms with 20-200 employees fell by 36% between 2007 and 2019. Almost 3700 medium-sized businesses disappeared. The number of larger manufacturers also fell by over one-third. In contrast, solo shops (with no employees) and those with a handful of employees managed experienced less dramatic decline over the last decade: the count of these very small firms declined by about 7% since 2007. As a result, the industrial structure of the industry which remains today (after a decade of contraction) is even more fragmented across very small businesses, with limited technological and export capacities.

In discussing the importance of research, innovation, and entrepreneurship to Australia's future economic development, much attention naturally focuses on the potential of new start-up companies to lead future growth and job-creation. For example, in announcing a new Business Growth Fund (funded partly by government and partly with initial investments from major banks), the Commonwealth government pledged to foster the creation of 250,000 new small and family-run businesses over the next five years (or an average of 50,000 per year).[38] Curiously, there are routinely about 350,000 new businesses formed in Australia *every year* – the vast majority of which have few if any employees. There are also almost 300,000 businesses which disappear every year. So the pledge to help facilitate 50,000 new business formations each year may have no visible impact on the national economic trajectory at all.

To be sure, starting new businesses represents an important vote of confidence and optimism in the future. However, it is hard to argue that manufacturing is being held back by a shortage of start-up businesses or entrepreneurial energy. Indeed, about 10,000 new businesses are created in the sector each year – but almost all of those new firms have few if any employees. And less than half of them survive their first five years of operation.

The bigger structural problem facing businesses in manufacturing is the failure of small businesses to *survive* and *grow* – to become larger, more capable firms with the potential to innovate, accumulate capital, adopt new technologies, boost productivity, and sell into export markets. Comparative international studies have confirmed that

[38] See Koehn (2019).

the presence of a vibrant economic 'ecosystem' of growing, innovation-intensive medium-sized enterprises is vital to international success in specialised advanced manufacturing. For example, the continuing success of Germany's medium-sized industrial sector (commonly called the *Mittelstand*) reflects effective management, generally collegial and participatory industrial relations, strong vocational training and jobs pathways, and openness to innovation and export opportunities.[39] Other successful manufacturing countries with vibrant medium-sized industrial ecosystems include Switzerland, Austria, Sweden, Korea, and Japan. In many cases mid-level firms cooperate in rich networks which share information and experience around new technologies, training and apprenticeship systems, and other mutually beneficial practices. Networks of mid-sized firms also develop mutual relationships with the larger firms which have outsourced work around inputs and sub-assemblies to a community of capable, dynamic suppliers.

Australia's declining population of mid-sized industrial firms, and the inadequate capacity of those businesses to innovate, export, and grow, poses a major challenge to the future recovery of domestic manufacturing. A key focus of future policy interventions must be providing mid-sized manufacturers with support of all kinds (including sources of long-term capital, innovation and research support, and partnerships to increase exports) to help them survive and grow. This focus on nurturing medium-sized firms is reflected in the recommendations discussed later in this report.

Management expertise is another area in which Australian manufacturing businesses must lift their performance. International economic evidence confirms that management knowledge and technological capacity is a critical factor in explaining lags (relative to global leaders) in total factor productivity performance.[40] And qualitative and quantitative data indicate that the education level, technological expertise, and leadership qualities of Australian managers are behind those of their peers in other countries with superior productivity and innovation performance.[41] Investments in management training, leadership development, and faster diffusion of technical and economic knowledge among top managers and executives may be among the most cost-efficient of strategies for enhancing the capabilities of Australian manufacturing enterprises in the future.

[39] Audretsch and Lehmann (2016) provide a recent account of the flexibility and enduring success of the German mid-sized industrial sector.

[40] Recent evidence is provided by Andrews et al. (2015), and Iacovone and Crespit (2010).

[41] See Green et al. (2009) for a representative analysis.

A ‘Fair Share’ for Manufacturing Renewal

As noted above, Australia incurs a large and chronic trade deficit in manufactured products: with manufactured imports currently exceeding our exports by $180 billion per year. Our imports of elaborately transformed manufactured goods (the most sophisticated, technology-intensive products) overwhelm our exports by a 6-to-1 ratio. Australia produces far less manufactured output than we consume.

Table 9 Australian Apparent Consumption of Manufactures 2017-18, $billion	
Domestic Output	381.8
Exports	85.5
Imports	267.4
Apparent Consumption	563.7
Domestic Output as Share Consumption	68%
Source: Author's calculations from ABS Catalogue 8155.0 and DFAT TRIEC data.	

An indication of this imbalance between our use of manufactured goods, and our production of them, is provided by the analysis in Table 9. According to the Australian Bureau of Statistics, the domestic manufacturing sector produced and sold just over $380 billion worth of output in 2017-18 (most recent year for which this data is available). Of that total, some $85 billion was destined for export markets – representing about 22% of total production.[42] That is a relatively smaller degree of export dependence than typical of the manufacturing industries of other, relatively

[42] Some analysis measures export intensity as the ratio of manufactured exports to the sector’s value-added (around $105 billion), which would imply a much higher export orientation. That comparison, however, is invalid, because the total *shipment value* of a manufactured product includes a significant quantity of value-added produced in *other sectors*, and then supplied as inputs to manufacturing. Value-added within manufacturing thus represents only a small share (under 30%, according to the ABS input-output tables) of total manufacturing output. International trade statistics represent the gross value of traded manufactures, not the value-added, so export intensity should be measured as the ratio of (gross) exports to the sum of (gross) output.

small industrial economies. Indeed, according to comparable OECD data for 2015 (most recent available), the export share of total manufacturing output was smaller in Australia than almost any OECD economy.[43] The relatively small share of exports in manufacturing output is partly due to the disappearance of many globally-oriented manufacturing activities (such as motor vehicles) from Australia over the past generation. It also reflects other negative pressures (including one-sided trade deals and currency fluctuations) which also discouraged manufacturing exports from Australia. As a result, those manufacturing sectors which better retained their foothold in Australia (such as food processing and building materials) are those sub-sectors which are oriented more closely around the domestic market.

The amount of domestic manufacturing output which is *not* exported (about $300 billion in 2017-18), can then be added to the gross inward flow of imported manufactures ($267 billion in the same period), to generate an estimate of total Australian purchases of manufactured products. On this basis, some $564 billion in manufactured goods was purchased in Australia that year. That represents our domestic consumption of manufactured products. Note that our total use of manufactures is equal to about 30% of national GDP. The share of manufactured goods purchases in total GDP is much higher than the share of manufacturing value-added in GDP (around 7%) because of two factors:

- Manufacturing purchases embody a great amount of value-added produced in other sectors of the economy, not within manufacturing itself
- A large share of Australian purchases of manufactured goods is imported.

By comparing Australian output of manufactured products to Australian use of manufactured products, a broad measure of the degree of self-sufficiency of Australia with respect to manufactured products can be developed. On this basis, as summarised in Table 9, in 2017-18 Australia produced only 68 cents of manufacturing output for every $1 which we collectively purchase. That large imbalance between output and use (equivalent to the size of the manufacturing trade deficit) confirms that Australia has a much smaller-than-proportionate share of the jobs, incomes and innovation associated with manufacturing.

Relative to other industrial countries, Australia's disproportionately small manufacturing sector ranks as an extreme outlier. In fact, using comparable international data for 2015 (most recent available) from the Organization for Economic Cooperation and Development, it is clear that Australia's very weak degree of manufacturing self-sufficiency is in fact the lowest of any of the OECD's 36 member

[43] Author's calculations from OECD 'Statistics on Trade in Value Added.'

Table 10 Manufacturing Self-Sufficiency, OECD Countries, 2015				
	Gross Manufacturing Output ($US b)	Ratio of Manufactured Imports/Exports	Manufacturing Trade Balance ($US b)	Self-Sufficiency Ratio
Ireland[1]	$215.4	0.30	$109.4	203.2%
Germany	$2,013.9	0.61	$347.1	120.8%
Luxembourg	$12.6	0.73	$2.1	119.7%
Netherlands	$329.5	0.67	$51.5	118.5%
Korea	$1,467.0	0.55	$227.4	118.3%
Switzerland	$334.4	0.78	$40.5	113.8%
Hungary	$99.9	0.84	$10.9	112.2%
Sweden	$203.0	0.78	$21.8	112.0%
Finland	$117.1	0.77	$11.3	110.7%
Czech Rep.	$169.4	0.83	$16.1	110.5%
Slovenia	$26.3	0.86	$2.3	109.8%
Italy	$995.5	0.75	$85.4	109.4%
Austria	$194.3	0.85	$15.2	108.5%
Slovak Rep.	$79.9	0.88	$6.0	108.2%
Denmark	$100.5	0.87	$7.1	107.6%
Iceland	$6.6	0.88	$0.5	107.5%
Belgium	$236.3	0.88	$15.0	106.8%
Japan	$2,616.5	0.77	$115.8	104.6%
Lithuania	$21.3	0.94	$0.6	103.1%
Israel	$110.4	0.93	$2.9	102.7%
Portugal	$90.4	0.95	$2.1	102.3%
Spain	$613.7	0.97	$6.2	101.0%
Poland	$302.7	1.00	-$0.5	99.8%
France	$802.4	1.07	-$23.0	97.2%
Estonia	$12.3	1.06	-$0.4	96.6%
Mexico	$699.7	1.11	-$30.2	95.9%
New Zealand	$64.1	1.16	-$3.5	94.8%
Turkey	$483.8	1.32	-$38.2	92.7%
U.S.	$5,744.5	1.77	-$711.4	89.0%
Canada	$596.0	1.35	-$74.4	88.9%
Greece	$57.9	1.55	-$10.2	85.0%
U.K.	$744.3	1.59	-$149.8	83.2%
Latvia	$9.2	1.46	-$2.0	82.2%
Norway	$100.1	2.08	-$30.8	76.5%
Chile	$83.5	2.33	-$27.5	75.2%
Australia	$269.2	2.76	-$107.2	71.5%

Source: Author's calculations from OECD, 'Statistics on Trade in Value Added'.

1. Irish data regarding value-added and trade flows suffers from well-known measurement and comparability problems arising from the large impact of intra-corporate transfers by multinational enterprises and other measurement issues, so these figures (and Ireland's ranking in the table) should be interpreted with caution.

countries. Table 10 reports gross manufacturing output for each country, the ratio of manufactured imports to exports, and the resulting trade balance in manufactured products.[44]

Of the 36 countries listed in Table 10, 22 produce at least as much manufactured output as they consume – hence resulting in self-sufficiency ratios in excess of 100%. This group includes well-known manufacturing 'success stories,' such as Germany (121%), the Netherlands (119%), Korea (118%), Switzerland (114%), Sweden (112%), Finland (111%), Belgium (107%), and Japan (105%). The experience of these countries confirms that the goal of producing at least as much manufactured output as a country consumes is not a 'pipe-dream': it is a normal state of affairs, even for higher-wage industrial economies. Pseudo-economic arguments that countries like Australia are somehow 'not suited' for manufacturing are false.

Australia ranks at the bottom of Table 10, with manufacturing self-sufficiency of just 71.5%. That places Australia even below Chile and Mexico, semi-developing countries with relatively limited industrial and technological capabilities.[45] The common idea that manufacturing 'naturally' migrates away from higher-wage developed economies is disproven by the experience of most other industrialised countries, which have retained proportional (or even disproportionately *large*) manufacturing industries.

In terms of international trade, Table 10 also indicates that the ratio of Australia's manufactured imports to its manufactured exports (almost 3-to-1) is higher than for any other OECD country. Our uniquely and precariously unbalanced international trade relationships in manufactured goods are thus a key factor behind our uniquely underdeveloped and small manufacturing sector.

Because manufactured products are specialised, and usually demonstrate strong economies of scale (such that production at small volumes is often unviable), participation in two-way international trade is essential to the viability of most manufacturing sectors. The goal of industrial strategy is not to become self-sufficient in any autarkic sense: that is, having a 'do-it-yourself' attitude to everything we use (although in some cases, like nationally strategic products, it is essential that Australia

[44] Due to definitional differences and exchange rate adjustments the data for Australia in Table x differ from figures reported above for Australian output and trade, but the estimated level of self-sufficiency is similar.

[45] The slight difference between the estimates of Australia's self-sufficiency ratio in Table 9 (68%) and Table 10 (71.5%) are due to the different timing of the relevant data (2017-18 for Table 9, versus 2015 for Table 10) and slight definitional differences between Australian data (Table 9) and OECD data (Table 10).

be capable of producing necessary machinery and supplies[46]). Rather, a more reasonable goal would be to work to build a domestic manufacturing sector that is broadly proportionate to the size of our purchases of manufactured products. To be sure, our exports would reflect our stronger-than-proportional presence in particular sub-sectors where Australian firms have particular advantages (related to cost competitiveness, availability of key inputs, proprietary technologies, energy intensity, etc.). And our imports would reflect a relative lack of domestic presence or capability in certain sub-sectors. Broadly balanced two-way trade in manufactures would facilitate that useful process of mutual specialisation. But across the entire portfolio of manufactured products, Australia would retain a level of manufacturing output and employment that was broadly proportional to the scale of our national needs.

On this basis, we define a 'fair share' as being a level of total manufacturing output comparable to Australian use of manufactured products, in aggregate value terms. By that definition, Australian manufacturing output would need to grow by close to half. Since in 2017-18 we produced barely two-thirds as much manufactured output as we consume, domestic output would need to expand by 47% to reach a level compatible with Australia's collective purchases of manufactures.

That is an ambitious, long-term goal. It would require consistent alignment of several powerful policy levers to re-energise manufacturing investment, innovation, output, employment and exports. And the benefits of stronger manufacturing production would flow through to many other economic indicators, as summarised in Table 11.[47] Total manufacturing output would need to grow by close to $180 billion to attain that 'fair share' benchmark. That would translate into $50 billion in new value-added – representing a 2.5% increase in national GDP. Over 400,000 direct jobs would be created in manufacturing, supporting some $30 billion per year in additional wages and salaries. Another 265,000 jobs would be created in the various supply industries which would experience spill-over opportunities as a result of the increase in domestic manufacturing output. Those new supply chain purchases would be worth an estimated $115 billion per year. Cautiously assuming the same export intensity of current manufacturing production, exports of manufactured product would grow by around $40 billion. However, that estimate is conservative: in reality, improving Australia's access to and success in international markets will be a key part of attaining

[46] The potential shortages of essential medical equipment and supplies during the COVID-19 pandemic provide a timely reminder of the importance of strategic and national security factors in industry policy formulation.

[47] The gains reported in Table 11 are estimated on the basis of prevailing relationships between manufacturing output, employment, exports, and supply chain purchases.

a ‘fair share’ manufacturing footprint, and hence the increment in exports would likely be significantly larger than this.

Table 11 Benefits of a Fair Share Manufacturing Plan	
Increases Resulting from Proportional Production	**$/year or jobs**
Manufacturing Sales	$181.9 billion
Direct Value-Added	$50.0 billion
Direct Jobs	424,000
Direct Wages	$29.5 billion
Input Purchases	$114.7 billion
Supply Chain Jobs (000)	265,000
Exports	$40.5 billion
Source: Author's calculations from ABS Catalogues 8155.0; 5209.0.55.003; 5206.0; 6291.0.55.003; and DFAT TRIECD data.	

In short, the attainment of a proportional presence for manufacturing production in Australia, in line with our own needs for manufactured goods, would generate a wide range of economic benefits: for output, for employment, for incomes, and for our international balance of payments. This is not a goal that can be attained overnight, and it will require a determined, consistent, multi-dimensional effort by all manufacturing stakeholders to make it happen. But it is not unrealistic to suppose that Australia could achieve a fair share of the benefits of modern manufacturing, in line with our overall purchases. And it is not unreasonable to expect – as do most other industrial countries – that Australians should be able to participate proportionately in this important and dynamic sector of the modern economy.

Principles for Modern Industry Policy

Manufacturing has a strategic importance that extends throughout the economy: anchoring innovation, productivity, and exports. But Australia's economic history confirms we cannot assume that global markets and private business decisions alone will ascribe to us a proportional footprint in this vital sector. Rather, pro-active policy attention and dedicated resources are required to nurture a viable and successful manufacturing sector, and achieve a 'fair share' of the resulting jobs, output, and benefits.

The spillover benefits from a strong manufacturing sector into the rest of the economy motivate and justify focused efforts by government to stimulate manufacturing investment and production. The positive externalities of a vibrant domestic manufacturing sector represent a healthy economic and social return to investments made by government in supporting manufacturing investment, innovation, employment, and exports. Modern economic theory recognises these externalities, in explaining why governments should indeed legitimately intervene in markets to expand the domestic footprint of desirable, strategic industries. Strategic industries are those with the positive qualitative characteristics identified above: export orientation, innovation intensity, strong supply chains, and superior productivity and income potential. Conventional assumptions that government should steer clear of pro-active efforts to nurture strategic industries, often derided as 'picking winners,' have been refuted by modern theoretical and empirical research confirming the benefits of well-designed sector development strategies.[48]

Once it is accepted that government has legitimate authority and rationale to actively stimulate a larger domestic manufacturing sector, the challenge becomes to identify the necessary policy tools and levers to facilitate that effort. There are several general principles of policy intervention that guide the overall effort to revitalise manufacturing. Specific applications must then consider the details of particular products, technologies, and sub-sectors.

[48] Influential examples of recent research confirming the benefits of strategic sector-focused development policy interventions include Stiglitz, Lin and Monga (2013), Rodrik (2008), and Mazzucato (2013).

These are the general principles of modern sector development policies. They can all be invoked in a multi-dimensional strategy to ensure Australia's manufacturing sector grows and thrives in decades to come:

Sector Strategies: Government needs to identify those manufacturing sub-sectors with the right criteria and best chances for success, and then co-ordinate its interventions with other sector stakeholders for maximum impact on investment and growth. These sector strategies must engage all relevant sector stakeholders: business, workers and their unions, educational institutions, research organisations, state and local governments. Even businesses which compete with each other can benefit when the whole sector succeeds. The Commonwealth government's NCCC process has already identified several promising targets for this type of focused attention (including food, rare earths processing and manufacturing, biotech, and defence equipment). Other specialised sub-sectors are also good candidates: such as carbon and advanced materials, medical equipment and devices, renewable energy equipment and technology, and lithium battery technology and applications.

Domestic Content in Public Procurement: Australian governments are massive purchasers of manufactured goods. Governments buy manufactured products for many purposes: including for infrastructure projects (in transportation, utilities, and other public facilities), major specialised equipment purchases (such as submarines and railway rolling stock), and to support public services like health care and education (which also rely on purchases of necessary manufactured inputs). Estimates of total annual procurement purchases by Australian government range between $100 and $200 billion per year, or close to 10% of national GDP;[49] much of that spending goes to manufactured products. An obvious way to support domestic manufacturing is to ensure those expenditures generate the maximum possible boost to domestic industry. A strong 'Buy Australia' program can even help to reduce the final net cost of procurement purchases. Since governments collect additional revenues through the new work spurred by domestic procurement purchases, a share of the initial public expenditure is offset by greater economic activity and automatic inflows of tax revenue. Other countries regularly utilise domestic content targets in procurement to support domestic producers; the U.S. is particularly effective (despite its supposed faith in 'free markets') in directing public sending to benefit U.S. manufacturing firms (through Buy America, defence procurement, Department of Energy grants, and more). Australia can clearly do the same, even within the (limited) constraints imposed by existing trade agreements. Domestic procurement strategies and rules are being utilised in Australian defence and shipbuilding contracts, but they need to be stronger. And the same logic should be applied to other procurement decisions (including in

[49] See Stanford (2018), pp. 31-34 for discussion and estimates.

construction, transportation, and technology projects). In addition to a 'Buy Australia' commitment to purchase more domestic manufactures, procurement decisions must also set ambitious requirements for supporting medium-sized businesses, hiring qualifying apprentices, and extending employment opportunities to hard-hit segments of the labour market (including women in non-traditional roles, Indigenous Australians, linguistic and cultural minorities, and workers with disability).

Networks, Eco-Systems, and Clusters: Successful modern industrial policy relies centrally on connections and collaboration among different firms, agencies, and stakeholders. Research shows that spillovers among these diverse sector participants, and the sharing of knowledge between them, are crucial to the development of 'critical mass' in any high-tech industry. Often, these networks and clusters are geographically concentrated. Government cannot simply 'create' clusters, but it can facilitate their emergence: with support for concentrated 'hubs' of research, commercialisation, and training; partnering between industry clusters and key public institutions (including universities, TAFEs, and CSIRO centres), and seed capital to help establish networks and joint ventures in identified priority sub-sectors.

Innovation: Empirical evidence shows successful innovation must be embodied in a hands-on process of 'learning by doing'; it cannot occur solely, in abstract, in the controlled conditions of a laboratory. And there is no other sector more directly connected to the practical innovation process than manufacturing. Government needs to provide tangible, direct support to innovation in manufacturing. We need better systems for linking public innovation activity with commercial applications. We need more effective fiscal supports for industrial innovation efforts, that reward Australian research and commercialisation more directly and powerfully. And we can emulate successful public equity investments in innovation-intensive businesses in other countries (like the effective methods for financing innovative firms used in Israel, Finland, and Ireland).

Targeted Fiscal Supports for Investment: International and Australian experience has shown that no-strings-attached company income tax cuts for corporations do not actually stimulate new investment, innovation, or employment. Rather, fiscal incentives are more effective when they are linked directly to investment. Only companies which invest concretely in Australian capital (including machinery, equipment, technology, and intangible capital) should be rewarded through fiscal incentives. Examples of fiscal measures which are conditional on incremental investment include accelerated depreciation provisions (allowing companies to write off the cost of new investments faster), investment tax credits, and public co-investments in specific strategic projects.

Industrial Infrastructure: Government investments in public capital assets of all kinds are critical in fostering manufacturing growth. Infrastructure investments help to offset the sustained weakness of private investment, and to improve weak macroeconomic conditions. They will be especially important in coming years as the Australian economy tries to rebuild after the COVID-19 pandemic and associated recession. One key focus of infrastructure investment should include facilities and services which support manufacturing: ranging from transportation infrastructure, to utility connections (like transmission upgrades related to renewable energy), to modern training facilities (to better integrate TAFE and university training with industry). As always, we should maximise the use of Australian-made manufacturing content in those (and all other) infrastructure projects.

Mobilising Capital: As discussed above, medium-sized companies in Australia's manufacturing sector have suffered the biggest decline over the past challenging decade; their constrained access to sources of long-term, 'patient' capital is a key factor in their inability to survive and grow. International experience confirms there are many ways that public and social pools of capital can leverage investment and development in targeted sectors. These include placements by state-owned development banks (as in Japan and Korea) or other forms of sovereign wealth (as in Singapore, the UAE, and Norway). Public investment vehicles have been used successfully — indeed profitably — in numerous applications in Australia (for example, the CEFC's important role in sustainable energy projects). The same principles can apply in manufacturing investment. Additionally, industry super funds could play a larger role in financing the development of strategic products and sectors, including specialised financial vehicles to assist in channelling capital to medium-sized firms. Government pressure and regulation could also facilitate greater attention by private financial institutions to providing more accessible sources of capital for medium-sized manufacturing firms.

Leveraging Energy: Manufacturing requires energy. And manufacturing facilities have always been located to take advantage of accessible energy sources: from water-powered mills in the early years of the Industrial Revolution, to the attraction of coal-fired electricity in Australia's initial postwar industrialisation. What has changed, of course, is the source and geography of energy. Thanks to Australia's superabundance of renewable resources, and the rapid decline in the cost of that energy (discussed above), renewable energy will be a powerful new lever for attracting new manufacturing investment to Australia. This potential advantage must be accelerated in coming years, and supportive and consistent policy can play a crucial role: including fiscal incentives for renewable energy investments, upgrades in transmission and electrical infrastructure to facilitate expanding renewable sources, and a steady

commitment to meeting our targets for emissions reduction and eventually attaining net-zero emissions status.

Skills and Capacities: Enhancing the future skills and capacities of workers must be a vital component of future sector strategies. Consistent funding for skills training at all levels is essential, as are efforts to more closely link training programs with future workforce needs in strategic sectors. As described above, the crisis in Australia's vocational education and training system will hold back a renaissance in domestic manufacturing, without urgent attention and repair. Other countries (such as Germany) have been far more successful in linking vocational training investments to manufacturing job pathways, and leveraging top-quality schools as a vital asset in advanced manufacturing. A plan to reconstruct Australia's crisis-ridden vocational training system must start with major investments to restore and upgrade the physical infrastructure and teaching capabilities of the TAFE system. The clear majority of public training funds must be channelled through public providers (and the TAFE system, more specifically). New collaborative vocational training initiatives can better link TAFEs with the specific needs of particular manufacturing clusters and firms.[50] Manufacturers must be pushed to utilise more apprentices (including through apprenticeship targets in publicly-funded infrastructure and procurement projects), and rewarded for doing so with appropriate fiscal supports.

Trade that Goes Both Ways: International trade is essential to the viability of most manufacturing, due to the importance of economies of scale in production and the specialised nature of both products and markets. But Australian trade negotiators need a very different strategy to unlock the potential of mutually beneficial trade in manufactures. Their past reliance on simple-minded tariff reduction and 'cookie-cutter' free trade deals has clearly done more harm than good to domestic manufacturing. We need trade arrangements with other countries that make access to Australian markets conditional on comparable purchases of Australian-made output, or other measures (such as domestic offsets or joint-venture production arrangements) to stimulate exports of Australian-made manufactured products. And Australian trade agencies (like Austrade) can be much more proactive in promoting Australia's exports, through initiatives like expanded credit financing, initiatives to leverage Australian participation in global supply chains, and government support for international marketing. Support for export promotion must be especially focused on medium-sized enterprises, which are critical to our ecosystem of innovative advanced

[50] A good example of this synergy between cluster development and training is the emerging concentration of carbon fibre and material manufacturing in Victoria, linked closely to specialized industrial training programs at Deakin University and other facilities.

manufacturing, but which on their own face formidable financial and logistical barriers to developing international markets for their output.

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A thriving manufacturing sector confers important benefits across the whole economy. Even more importantly, a large and flexible manufacturing sector enhances our national security and resilience – including in cases of periodic crises, such as COVID-19. By ensuring we have the national capacity to produce essential supplies and equipment (from medical supplies, to military equipment, to renewable energy technologies), a revitalised manufacturing sector strengthens our economic, social, and geopolitical well-being. We can and must build a manufacturing sector that is economically and ecologically sustainable, and that adds complexity and resilience to Australia's economy.

This catalogue of broad policy levers confirms that governments have ample capacity to strengthen Australian manufacturing, and work towards a situation whereby Australian once again possesses a domestic manufacturing base that is proportionate to our needs. The main issue is whether our governments have the political will to make that goal a national priority – or whether they will continue to be influenced by outdated and discredited assumptions that Australia can prosper on the basis of resource extraction alone.

Action Plan: Six Immediate Priorities for Industrial Rejuvenation

The preceding section described the main policy tools in the overall toolbox of modern industry policy. Instead of passively accepting Australia's presently unbalanced and underdeveloped role in the global economy, government has the capability to foster an all-round revitalisation of domestic value-adding manufacturing activity. The policy levers identified above – sector planning and strategising, active government procurement, better vocational training, improved access to capital, leveraging Australia's energy resources, and rethinking international trade policy – will all need to play a role in an over-arching effort to restore manufacturing, and attain a 'fair share' of its benefits for Australians. By implementing a multi-dimensional, internally consistent policy strategy, featuring both 'carrots' and 'sticks', government can enhance the incentive to invest in domestic manufacturing, nurture strategic sectors and sub-sectors, and establish a positive momentum for this vital sector.

Of course, every major change has to start with incremental steps. A holistic strategy to achieve a 'fair share' manufacturing renaissance cannot be simply willed into existence with a magic stroke. To provide a start to this larger, long-lasting reorientation of manufacturing policy, we identify here six of the most important, incremental measures that would make an immediate difference to the prospects of domestic manufacturing. This short-list of measures thus constitutes a 'down payment' on the bigger, broader efforts required to achieve a more proportionate domestic manufacturing industry in Australia. And by moving quickly to start that industrial renewal, government can also ensure that manufacturing makes its maximum possible contribution to the coming post-COVID reconstruction of Australia's economy.

1. Establish a network of Advanced Manufacturing Sector Councils, supported by a broad infrastructure and secretariat at the Department of Industry, Science, Energy and Resources, to:

    a. Identify the most promising sub-sectors of Australian manufacturing

    b. Engage all stakeholders in each sub-sector

    c. Develop investment and innovation plans

    d. Oversee implementation of these plans, supported by other agencies described below.

2. Capitalise a new Advanced Manufacturing Investment Fund, with $1 billion in initial Commonwealth share capital, to make strategic equity investments in new projects identified and developed as part of the Advanced Manufacturing Sector Councils, with a special focus on access to finance for medium-sized manufacturing enterprises.

3. Establish a Manufacturing VET Policy Board, composed of leadership level executives from manufacturers, trade unions, TAFEs, federal and state governments, and other relevant stakeholders, to identify and begin implementing immediate measures to develop a more coherent and constructive framework for manufacturing VET.

4. Implement an Australian-Made Medical Equipment Strategy, that would:

    a. Designate essential medical equipment and supplies as being of strategic importance to national security

    b. Set priorities for fostering made-in-Australia production of key categories of equipment over 1-year and 5-year timetables

    c. Establish procurement rules for publicly-funded health facilities and services, to transition their purchases to suppliers complying with the strategy.

5. Establish a Buy Australian Infrastructure Council, with representatives from the federal and state governments, supported by Infrastructure Australia, that would:

    a. Compile catalogues of publicly-funded infrastructure projects

    b. Work with project sponsors to develop expected supply timetables for purchases of manufactured inputs to those projects

    c. Set targets for domestic Australian content in overall procurement purchases

    d. Work with project sponsors to monitor and report on domestic procurement performance.

6. Implement accelerated depreciation provisions in the federal corporate income tax code, to foster faster investment spending by Australian-based manufacturing firms, including:

a. 100% depreciation rate for intellectual property and advanced manufacturing machinery

b. 50% depreciation rate for other machinery and equipment.

These six measures could not, on their own, achieve the fulsome and lasting renewal of manufacturing envisioned in the 'fair share' benchmarks defined and described above. Achieving that bigger transformation of manufacturing would require a powerful, multi-dimensional and lasting set of bigger policy interventions: including in tax and fiscal policy, redesigning trade agreements, transforming the VET system, and fostering a new culture of applied innovation among Australian manufacturing firms.

But this short-list of immediate, practical steps would constitute an important step in the right direction. Together, they would directly achieve an incremental improvement in the sector's investment, innovation and training performance. Perhaps most importantly, they would help to develop a new sense of multi-partite commitment and cooperation, that will be an essential ingredient in subsequent work to define and implement that broader policy agenda essential to achieving the 'fair share'. Implementing these six immediate actions would show Australians that the primary stakeholders in manufacturing can come together, identify key actionable policy priorities, build effective working relationships, and start to shift the trajectory of our long-neglected and underdeveloped industrial base.

Conclusion

Australia's manufacturing sector has experienced a very challenging decade. Its economic footprint (measured by output, employment, and investment) has diminished. It confronts a vastly unbalanced international trade arena, hamstrung by misguided policies that have privileged imports far more than promoted exports. It is held back by a litany of other flawed policy experiments: in vocational education, innovation policy, and energy and climate policy. Perhaps most damagingly, it has been taken for granted by governments and leaders convinced that Australia doesn't need the capacity to 'make stuff' anymore. Instead, we should simply rely on the mineral wealth buried beneath our feet … along with a few other industries that are equally dependent on our natural endowment (like tourism and food) to pay our way in the global economy. That complacency has left Australia with the most under-sized manufacturing industry of any industrial country in the world.

Given these daunting obstacles, it is remarkable that Australian manufacturing has survived at all – yet it continues to make an outsized contribution to Australia's economic prosperity and potential. It is the most vital source of innovation. It accounts for disproportionate shares of our capital investment, exports, and decent full-time jobs. It anchors a supply chain worth hundreds of billions of dollars of annual sales of parts, supplies, materials and services. Its benefits spread across all states, and are especially important in anchoring regional communities. The continuing resilience of this sector, despite a disastrous decade, is testament to the tenacity and talents of manufacturing workers, businesses, educators, and innovators.

There are many reasons for Australia to accept the need for deep change in our approach to industrial policy – and to implement that change quickly and powerfully. The economic and environmental limits to resource extraction as a base for prosperity are becoming more apparent and binding. The social consequences from the erosion of decent working-class jobs are causing political and cultural ferment in many of our communities. Most recently, the COVID-19 pandemic and resulting recession has highlighted that Australia must retain the capacity to produce a full range of sophisticated manufactured goods and equipment. The recession has also created an economic void that can be partly filled in coming years by a resurgent manufacturing sector.

Australia has proven in the past that it can be a global manufacturing leader, despite our small population and geographical remoteness. It didn't happen by accident, nor was it the result of automatic market forces and private business decisions. It

happened because Australians made it a national priority. We wanted an economy that was diversified and sophisticated, and less subject to the vagaries of international commodity prices and shifts in foreign appetites for our various resource-based staples.

At present Australians are fighting a war: a war against infection and disease. Like previous wars, we are committing vast economic and human resources, and making enormous sacrifices to ensure that we win. After the last global war that Australia fought, in the 1940s, our government designed and implemented a National Reconstruction Plan to ensure the economy did not slip back into Depression. That Plan was set in motion years before the end of hostilities: by late 1942 a new Department of National Reconstruction had already been established, and plans were being readied for a post-war mobilisation of economic resources to create jobs and build new industries.

Manufacturing played a central role in that post-war reconstruction effort. Government placed top priority on building national industries, including high-technology sectors (like automotive, aerospace, and aluminium production) that had been previously absent from our remote, resource-based economy. Thanks in large part to that ambitious, well-resourced effort, Australia experienced a remarkable industrial transformation – and entered an unprecedented three-decade period of vibrant, inclusive growth.

We believe that similar potential exists today, for a renewed manufacturing industry to play an equally central role in the post-COVID reconstruction of Australia's economy. For many reasons, the old recipes of resource extraction and business-led growth are clearly inadequate to the challenges of the present moment. We have described a goal – ensuring that Australia produces a 'fair share' of manufactured output, proportionate to our (growing) needs for manufactures – that would generate enormous benefits flowing to all parts, and all sectors, of Australia's economy. And we have catalogued the rich range of policy tools and levers that are available to achieve that goal. What is now needed is for policy-makers to pick up those tools, and use them.

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