Submission to the Senate Economics References Committee Inquiry on the Australian Manufacturing Industry

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About the Centre for Future Work

The Centre for Future Work is a research institute located at the Australia Institute (Australia's leading progressive think tank). We conduct and publish research into a range of labour market, employment, and related issues. We are independent and non-partisan. This submission synthesizes some of our previous research on insecure work and related topics. Please see our website at http://www.futurework.org.au/ to read our full reports.

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Introduction and Summary

The Centre for Future Work welcomes the opportunity to make a submission to this inquiry on the manufacturing industry in Australia. Your deliberations are timely, given the need to consider the structural changes in output, employment, and exports that are inevitable as the national and global economies recover from the unprecedented events of the past 18 months.

Manufacturing is a vital component in Australia's economy, and a key source of prosperity and opportunity for families and communities across the country. We were reminded during the COVID-19 pandemic of the structural and strategic importance of maintaining a healthy national capability to manufacture. Australia's public health response to COVID-19 was threatened at times by lack of access to key medical equipment and supplies in the wake of disrupted global supply chains – even for products as simple as masks, let alone more sophisticated machinery and equipment. And our inadequate national capacity to develop and manufacture vaccines has obviously increased our vulnerability to the pandemic, and further slowed a national vaccination strategy that has been delayed and disappointing. There are many other ways in which the precarity of a situation in which Australia depends fully on imported products to meet essential economic and social needs has become more visible and concerning. This is thus an opportune moment for Australians to reconsider the role of manufacturing in our economic future, and start to develop and implement policies which will support a more well-rounded and secure sectoral balance.

There are many dimensions of Australia's manufacturing predicament and outlook that require investigation and understanding: including the causes of the noted deindustrialisation which has been experienced over the past generation, the strengths and weaknesses of the domestic manufacturing footprint that remains, the way that our manufacturing trajectory has been shaped by the structure of our international engagements, and the initiatives and policies that would help to sustain and rebuild Australian manufacturing capability. Investigating the problems and prospects of domestic manufacturing has been a key research priority for our Centre since it was founded over five years ago; our compiled research is available for public inspection on our website.[1] In addition to our research and publishing in this area, the Centre has also played a leading role in strengthening networks among policy-makers and industry leaders concerned with heightening public appreciation of the importance of manufacturing to future prosperity: for example, we were the founder and then co-sponsor of the National Manufacturing Summit, which brought together researchers, industry leaders, trade unionists, and government policy experts to explore and advocate manufacturing opportunities.[2]

In this submission we will review and summarise some of our most recent key research findings regarding the state and prospects of Australian manufacturing. Our submission is organised as follows. The first major section reviews the reasons why 'manufacturing matters' – and why it both deserves and requires pro-active policy attention to ensure a healthy and sustainable proportional presence in Australia. The next section documents the relative decline of Australian manufacturing in the face of both policy neglect domestically, and a highly skewed international trading environment. In fact, relative to our continuing (and growing) consumption of manufactured products, Australia has the smallest manufacturing footprint of any OECD economy. The third major

[1] The 'Industry Policies' tab of our website's publications index provides a listing of all of our manufacturing-related research: https://www.futurework.org.au/industry_policies.
[2] The Summit met annually for three years beginning in 2017; the 2020 and 2021 incarnations were cancelled due to COVID-19, but we anticipate annual gatherings to commence again when possible. See Barnes (2018) for a synthesis of the Summit's initial findings and proposals.

section considers the impact of the accelerating global energy transition on Australia's manufacturing prospects. Far from implying that manufacturing activity (including heavy industry, such as steel or aluminium production) would be unviable without traditional carbon-based energy sources, the accelerating shift to renewables in fact opens unique opportunities for all segments of Australian manufacturing – not least because of Australia's unmatched endowment of renewable energy resources.[3] Finally, our submission also makes several specific recommendations to strengthen the viability and growth of Australian manufacturing, that are summarised in the final section.

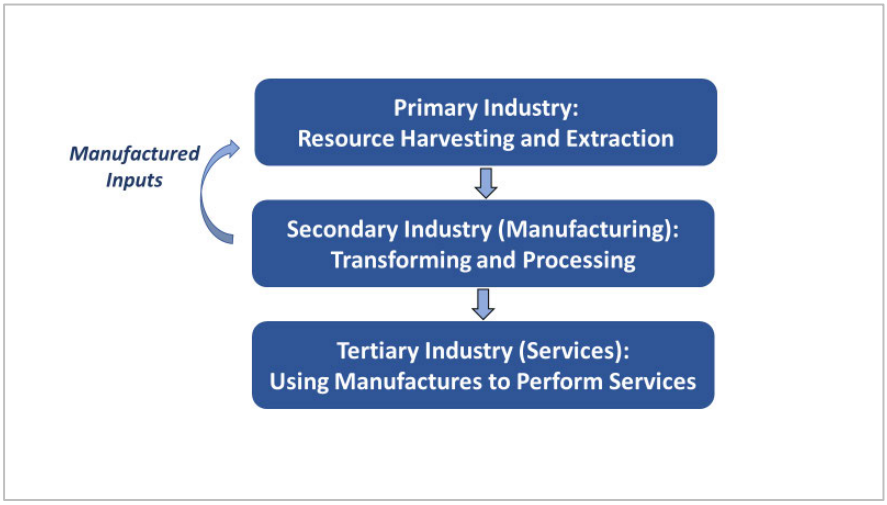
We are grateful for the opportunity to share our findings with this Committee, and stand ready to provide any further information as appropriate. Thank you for your consideration of our views.

[3] We note that our evidence presented in this section is complemented by a separate submission to your Committee from Dr. Mark Dean, Distinguished Research Fellow at the Carmichael Centre (a new initiative which is housed within the Centre for Future Work at the Australia Institute). That submission explores in particular detail the prospects for a revitalization of Australian vehicle manufacturing in light of the rapid restructuring of global vehicle industry toward electric vehicles.

I. The Strategic Importance of Manufacturing

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 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.

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

[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.

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
- 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.

[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.

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 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,

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

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.

II. Australia's Stunted Industrial Base

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 1 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: 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 1. 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.[12] That is a relatively smaller degree of export dependence than typical of the manufacturing industries of other, relatively 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.[13] 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

[12] 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.

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

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 1, 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 countries. Table 2 reports gross manufacturing output for each country, the ratio of manufactured imports to exports, and the resulting trade balance in manufactured products.[14] Of the 36 countries listed in Table 2, 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.

[14] Due to definitional differences and exchange rate adjustments the data for Australia in Table 2 differ from figures reported above for Australian output and trade, but the estimated level of self-sufficiency is similar.

Table 2 Manufacturing Self-Sufficiency, OECD Countries, 2015				
	Gross Manufacturing Output ($US b)	Ratio Manufactured Imports/Exports	Manufacturing Trade Balance ($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: 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.

Incredibly, Australia ranks at the very bottom of Table 2, 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.[15] 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 2 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 be capable of producing necessary machinery and supplies[16]). 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 3.[17] 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

[15] The slight difference between the estimates of Australia's self-sufficiency ratio in Table 1 (68%) and Table 2 (71.5%) are due to the different timing of the relevant data (2017-18 for Table 1, versus 2015 for Table 2) and slight definitional differences between Australian data (Table 1) and OECD data (Table 2).
[16] 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.
[17] The gains reported in Table 3 are estimated on the basis of prevailing relationships between manufacturing output, employment, exports, and supply chain purchases.

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

Table 3
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: 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.

III. Renewable Energy and Australian Manufacturing

Australia enjoys a large landmass with an abundance of renewable energy resources and a low population relative to that landmass. We are the only developed nation to have access to such a large quantity of solar and wind power, and could generate many of our energy needs renewably by using just a very small proportion of our landmass. This means that we enjoy a considerable competitive advantage in the production of renewable energy.

The government's own *GenCost* figures, produced by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), state that the cheapest sources of newly installed power are wind and solar.

Not only are we able to power an expanded manufacturing sector using renewables, but it is cheaper to do so than to continue down the path of an energy grid that favours and subsidises coal. These economic advantages in turn can expedite a broader economic rebalancing, away from extraction towards production, in which value-added manufactures increasingly supplant the export of raw materials in our economic mix. This will be good for Australia's economy—and for the world's emissions.

It would also encourage a virtuous cycle of 'using renewables to make renewables', further allowing the greening of our grid. For example, Australian manufacturers could take advantage of Australia's cheap renewable grid power to produce batteries, solar panels, and wind turbines domestically. In particular, a domestic battery industry would be beneficial in reducing Australia's transport emissions and firming a green grid. Batteries are going to be a huge part of our energy future – the question is whether we continue with the current model of exporting our huge reserves of unrefined lithium, and buying imported batteries back at a very large premium (orders of magnitude), or whether we seek to capture more value from our lithium endowment by bringing it further up the value chain here in Australia. Doing so would create jobs and potentially a significant new export industry.

The Centre for Future Work's *Powering Onwards* research paper (Nahum, 2020), shows that Australian manufacturers could save significantly—in the order of one-fifth—on their energy costs by switching the proportion of their energy supply that is currently met by fossil fuels entirely to renewables. That would mean greater international competitiveness and more high-quality Australian manufacturing jobs.

The existing fleet of aging fossil generators needs replacing on engineering and maintenance grounds; AEMO expects that 60% will need to be retired by 2040, and a consistent, ongoing stream of closures is expected in the interim. The cost of renewable energy is also already less than the cost of newly-installed gas, which has been described erroneously as a 'transition fuel'. The current policy question is: will Australia pursue the least-cost, least-externalities (emissions) path, or will Australian households and businesses subsidise fossil fuel interests to keep plants going longer than is practical, economic, or in line with our climate commitments?

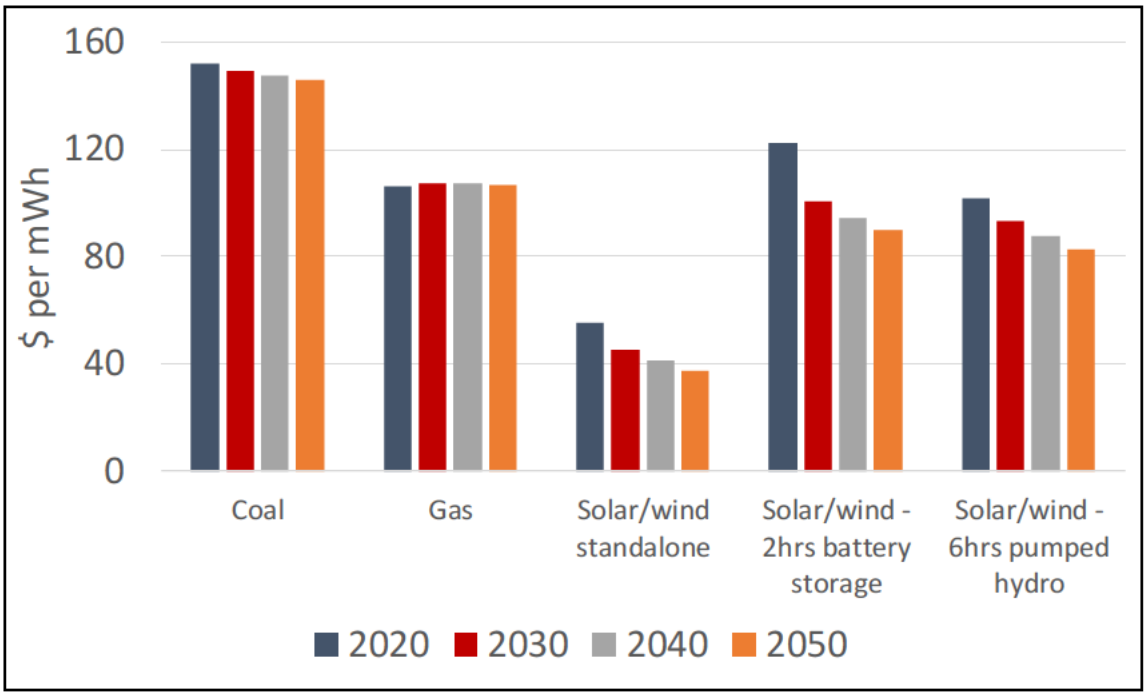
Manufacturers spent A$5.4 billion on electricity in 2017–18. If we assume that manufacturing uses an energy mix representative of the broader Australian economy, then 60 per cent of that was coal and another 19 per cent was gas power. In the short- to medium-term the existing fossil fleet will need to be retired as units reach the end of their useful life. If Australia's coal and gas electricity was

replaced with renewables (even allowing for six hours of pumped hydro storage)[18], rather than more fossil fuel generation, the Australian manufacturing sector could save $1.6 billion per year, or 23% of its current energy bill.

Over time, those savings would get even larger – because the cost of renewable energy production is falling rapidly and steadily. By 2050, such a transition would save $2.2 billion per year.[19]

This comparison includes a small risk premium on fossil fuel use (to reflect the fundamental uncertainty facing fossil fuel projects) but no carbon price or carbon border adjustments—levies charged to Australian exporters to put them on a level playing field with importing counterparts who have implemented a carbon price—which would shift the comparison even further in favour of renewables.

Figure 2. Comparative Electricity Generation Costs.



Source: Calculations from unpublished data from Graham et al., 2018.
Notes: Energy costs for different sources reflect the averages of high and low estimates in the CSIRO data. Coal costs assume the introduction of high-efficiency 'supercritical' units, hence the modest fall in costs without a carbon price over time. Coal and gas costs without carbon prices assume a 5% risk premium. The analysis does not assume a carbon price.

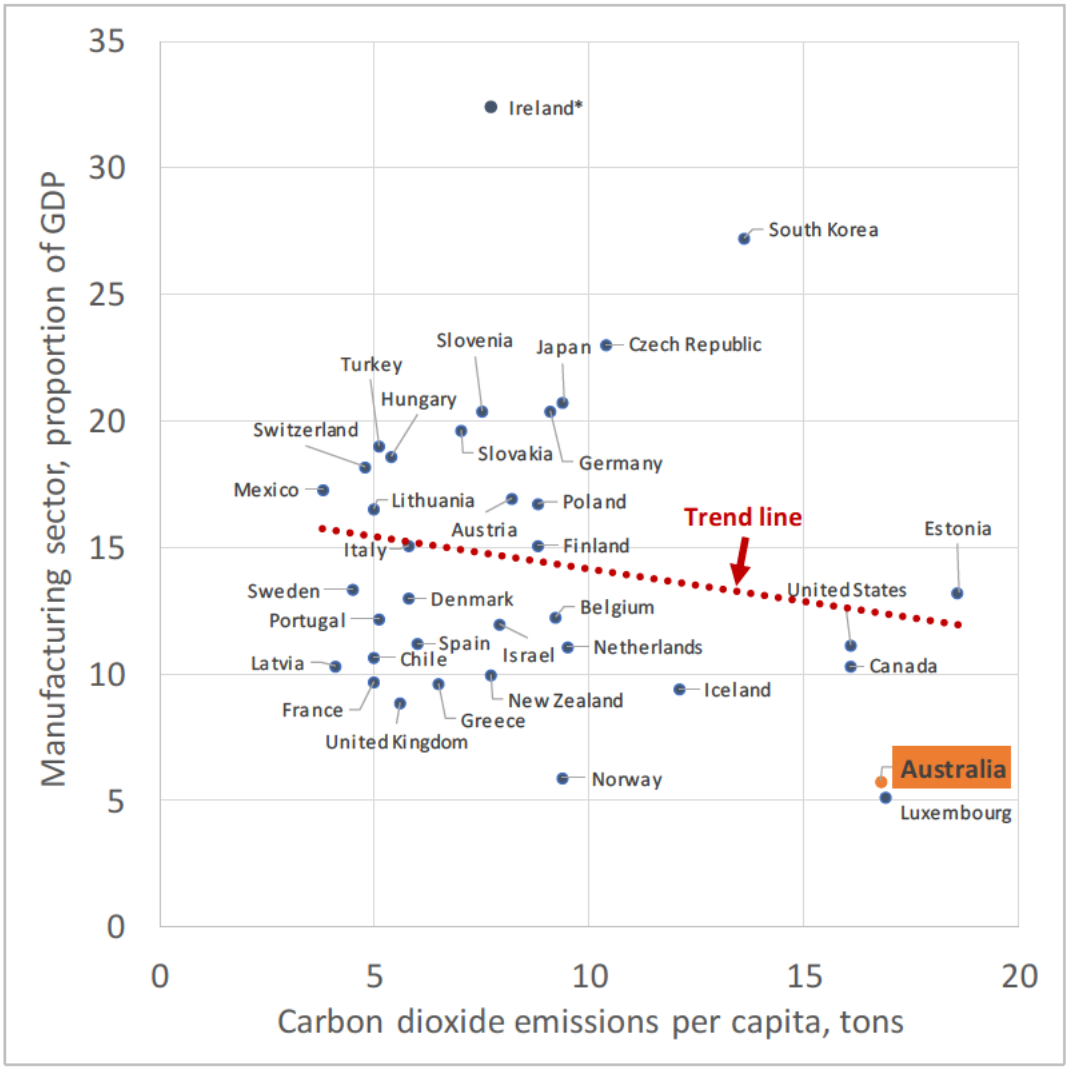
These results present a broad estimate consistent with an extensive economic literature, including work generated by the CSIRO and Commonwealth Treasury, showing that a shift to renewables is affordable and beneficial. While the results of individual models vary, depending on the methods assumptions made, claims that ambitious transitions would be 'economy wrecking' are not credible.

[18] Other storage technologies may be somewhat more or less expensive, but the order of magnitude of the cost advantage of renewables is nonetheless robust. Some analysts, such as Diesendorf and Elliston (2018), argue that, based on international experience, the emphasis on storage is excessive. Noting that reliability is a property of the whole grid, not of individual generation sources, some individual intermittent renewable sources can be offline while others are producing – as long as the supply of energy for any given consumer at any given time is sufficient to meet demand.
[19] Expressed in 2017-18 dollars.

In fact, these potential savings are being borne out by manufacturing firms' real-life investment decisions, as more and more of them develop renewable power supplies for their own operations and sell what they do not use back to the grid. This strongly suggests that fossil electricity generators are 'padding out' their prices.

Many manufacturers operating in Australia are already taking advantage of the opportunities offered by renewable energy, notwithstanding the dearth of Commonwealth government support. This includes heavy manufacturers such as metals producers. There is empirical evidence that businesses such as Bluescope Steel and Carlton & United Breweries (CUB) are already locking in savings of up to 50 per cent by entering into renewable power purchase agreements (PPAs), contractual arrangements between a generator and a consumer, typically to allow new generation investment to be undertaken. However, tangible support from the Commonwealth Government could see a broad expansion of renewably-powered heavy and advanced manufacturing capacity. The Renewable Energy Zones under development in NSW, Victoria, and Queensland begin to indicate the scope of the solutions on offer.

Figure 3. Manufacturing Success and Carbon Intensity, OECD Nations, 2018



*Source: 'Manufacturing, value added (% of GDP)' and 'CO2 emissions (metric tons per capita)', World Bank (2019a, 2019b). Note: In a small number of cases, the latest manufacturing sector (vertical axis) data are from 2017, 2016 and in the case of Canada, 2015. CO_2 emissions exclude land use. * Irish GDP data must be interpreted with caution (due to issues of international tax shifting); however, removal of Ireland does not affect the general correlation.*

There is abundant evidence of success in deliberate policy approaches favouring renewables and manufacturing in overseas contexts: across the OECD, most other industrial countries are outperforming Australia on both reducing emissions and supporting domestic manufacturing. There is no positive statistical relationship between manufacturing in OECD countries (as a proportion of GDP or exports) and carbon emissions. In fact, there is a weak negative correlation between manufacturing success and carbon pollution: in general, countries which emit less tend to manufacture more. Australia is currently in the worst of both worlds: it is an extremely high emitter per capita, with a hollowed-out manufacturing sector. This is particularly alarming and unnecessary considering Australia's spectacular advantage in renewable energy resources.

As illustrated in Figure 3, which shows the relationship between manufacturing intensity and CO_2-equivalent emissions, most other industrial countries are outperforming Australia on both reducing emissions and supporting domestic manufacturing. Across the OECD, only tiny tax haven Luxembourg has more emissions and less manufacturing than Australia, on a proportional basis. The claim that continued fossil fuel consumption is essential to the future of manufacturing is decisively refuted by this international evidence.

In contrast to the current unhappy situation, Australia can succeed in adding value and complexity to our economic mix, and cutting emissions, if a renewably-powered manufacturing program has the support of government. Australia is especially well positioned to make policy choices in favour of a rejuvenation of our manufacturing industry based on renewable energy. Government policy should aim to 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.

In this context, the introduction of a carbon price in some configuration would immediately rebalance Australia's industrial incentive structure in favour of cleaner manufacturing. Economy-wide, this could be revenue-neutral (with revenues recycled into other fiscal measures or projects), while reshaping our overall industrial profile and changing the way firms do business. A carbon price would incentivise manufacturers to seek efficiencies in their energy usage, and it would also reinforce incentives to develop sustainable sources of energy to power their own operations (and to supply their surplus energy to the grid).

Carbon border adjustments being introduced internationally mean that, in practice, Australian exporters will increasingly be affected by the carbon prices of other countries, regardless of whether we implement one ourselves or not. The revenue raised from such adjustments will support the renewable transitions of our trading counterparts—not our own.

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

- direct financial assistance, including fiscal support for the production and use of renewable energy, through, for example, the continuation and expansion of the Clean Energy Finance Corporation (CEFC) and the Australian Renewable Energy Agency

- 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 very much tied up in the success of these workers and businesses)

- leveraging of 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 supply 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
- EV manufacturing
- manufacturing public transit equipment
- producing wind and solar generation equipment.

A national, independent statutory authority should be established to design plans for economically and socially rewarding transitions into the high-value industries that will play a leading role in the low-carbon economy of the future. This authority should design these plans in conjunction with affected businesses, workers, unions, educational institutions (such as TAFEs) and other stakeholders. Its tasks would include managing adjustments and transitions for workers in affected fossil fuel industries (including coal-fired electricity generation and thermal coal mining), as well as mobilising and training the workers who are required in a growing, sustainable manufacturing sector.

Given that institutional investors are acutely aware that Australia's energy arrangements are in flux, they should consider the medium- and especially long-term payoff of weighting their energy investment mix towards renewables in line with CSIRO's cost estimates. This could be expected to have positive effects for renewables investments and usage throughout the value chain (for example, economies of scale and large-scale supply agreements signed between producers of electricity and retailers/consumers).

This stance would be especially advantageous in an investment environment where the clients of institutional investors are more actively interested than ever in how their savings are invested. Large investors should also exert pressure on governments to adopt more farsighted policy settings, including the reintroduction of a price on carbon.

Hydrogen is likely to be a major output from, and input into, manufacturing processes in years to come—both in Australia and internationally. We are at a crucial juncture in terms of getting the industry settings right. Proposals to develop a hydrocarbon-based hydrogen industry (even using so-far unpromising carbon capture and storage 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 should expect policy clarity and targeted government co-investments in a green hydrogen strategy, with priority placed on maximising the potential manufacturing spin-offs through both

greater use of hydrogen in domestic manufacturing processes and maximisation of the domestic manufacturing content in hydrogen projects.

Australia's superabundance of renewable energy resources makes supplying renewable electricity both cost-competitive and reliable. Renewable electricity can be substituted for fossil fuels in almost all industrial contexts—and research and development presently underway will quickly close the remaining gaps (such as replacing coking coal in steel making with non-carbon processes).

Conclusion and Recommendations

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.[20]

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.

The general principles of modern sector development policies can all be invoked in a multi-dimensional strategy to ensure Australia's manufacturing sector grows and thrives in decades to come. A growing consensus among economists acknowledges the value and necessity of pro-active government policy interventions, aimed at reinforcing the viability of domestic manufacturing and capturing a larger share of the external benefits that flow from innovation-intensive, export-oriented production. These interventions include the following major strategies:

Sector Strategies

Government needs to identify manufacturing sub-sectors with the right criteria and best chances for success, and then co-ordinate interventions with other sector stakeholders for maximum impact on investment and growth.

Domestic Content in Public Procurement

Australian governments are massive purchasers of manufactured goods. An obvious way to support domestic manufacturing is to direct those expenditures to domestic production with strong Buy Australia policies.

[20] 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).

Networks, Eco-Systems, and Clusters

Successful modern industrial policy relies centrally on connections and collaboration among different firms, agencies, and stakeholders. Spillovers and knowledge-sharing among diverse sector participants are crucial to achieving a 'critical mass' in any high-tech industry.

Innovation

No sector is more directly connected to the practical innovation process than manufacturing. We need better systems for linking public innovation activity with commercial applications, and more effective fiscal supports for industrial innovation efforts that reward Australian research and commercialisation.

Targeted Fiscal Supports for Investment

No-strings-attached company income tax cuts do not stimulate new investment, innovation, or employment. Rather, fiscal incentives are more effective when they are linked directly to investment: like accelerated depreciation measures and investment tax credits.

Industrial Infrastructure

Government investments in public capital assets of all kinds can foster manufacturing growth. Infrastructure investments can help to offset the sustained weakness of private investment, and to repair weak macroeconomic conditions.

Mobilising Capital

Medium-sized companies in Australia's manufacturing sector have suffered the biggest decline over the past decade; their constrained access to sources of long-term, 'patient' capital is a key factor in their inability to survive and grow. Public finance vehicles (like national investment funds) can be used to support manufacturing investment; industry super funds could play a larger role, too.

Leveraging Energy

Manufacturing facilities have always been located to take advantage of accessible energy sources. What has changed is the source and geography of energy. Thanks to Australia's superabundance of renewable resources, and rapid declines in cost, renewable energy will be a powerful lever for attracting manufacturing investment.

Skills and Training

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. 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.

Trade that Goes Both Ways

International trade is essential to manufacturing, due to the importance of economies of scale in production and the specialised nature of both products and markets. But we need trade arrangements that make access to Australian markets conditional on comparable purchases of Australian-made output, and other measures to stimulate Australian exports of manufactured products.

These broad policy levers will all need to be activated as part of 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.

To this end, we make the following specific policy recommendations to strengthen Australia's manufacturing base as the national and global economies continue to rebuild after the COVID-19 pandemic and recession:

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 training.

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.

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