DEVELOPING INDUSTRIAL POLICY FOR MANUFACTURING ELECTRICAL VEHICLES

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Global automotive manufacturing is dominated by the production of vehicles with internal combustion engines (ICEs). Dozens of countries produce ICE vehicles or components, participating in international supply chains that make millions of cars, trucks, buses, and other vehicles annually. In adapting to climate change, however, global automotive manufacturing is rapidly transitioning to the production of electric vehicles (EVs).

Australia mass-produced passenger vehicles until 2017, when General Motors-Holden, the last remaining automotive manufacturing firm, closed its assembly operations, following previous closures by Ford and Toyota. Since then, in a context of geopolitical and energy shifts that are driving a race for critical mineral resources to power renewable technologies, it is pertinent to explore the possibilities for Australian manufacturing. Could this be a new dawn for vehicle manufacturing in Australia?

Manufacturing is critical to a nation's social and economic development and an industrial strategy for manufacturing can present transformative economic opportunities. A sustainable electric vehicle (EV) industry – one that is powered by renewable energy – could be a major driver of industrial transformation in the context of positive cultural and environmental changes to Australian society. But how can this be achieved, what capabilities does Australia possess, and what industry policy mechanisms are required to make it happen? This article, based on a report written by the author when working at the Centre for Future Work (Dean 2021), seeks to explore the possibilities.

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From extractivism to manufacturing

Over the past several decades, Australian governments have favoured an 'extractivist' approach to industry policy, focussing on mineral resource-based industries. While income-generating in the short-term, an economic growth strategy based so narrowly on the extraction and export of unprocessed, non-renewable resources does develop an economy, jobs, skills, or communities in a sustainable way (see Fernandes 2021). The consequences of governments giving priority to extractive industries and abandoning strategic and forward-focused policies to sustain and promote manufacturing are shown in Figure 1, which compares Australia's resource commodity exports to its manufacturing exports.

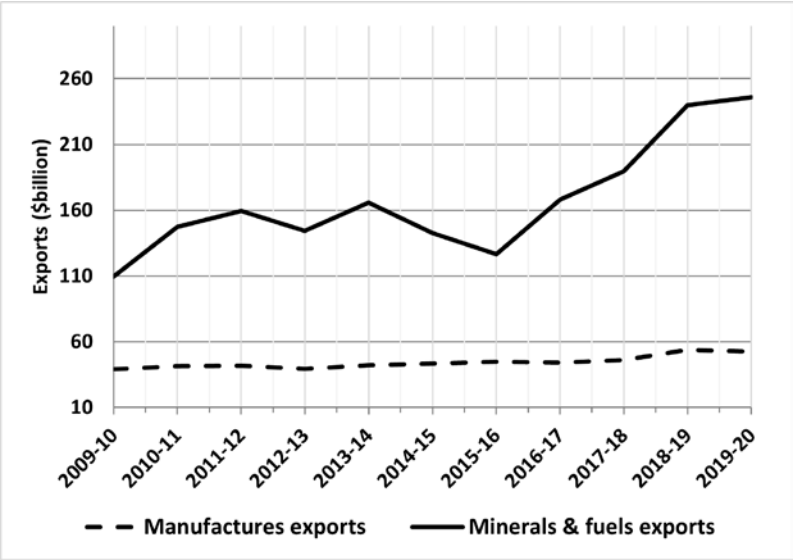
A significant result of this extractivist orientation is Australia's poor ranking in terms of *economic complexity* – a measure of how well a nation mobilises knowledge and technology to produce high-value, innovative products for export. The Growth Lab at Harvard University (2022) ranked Australia 86th out of the 133 countries surveyed: a remarkably weak position for an advanced industrial economy.[1] Other major industrial nations rank mostly within the top 20 for economic complexity because, in contrast to Australia, they take a dynamic approach to competitive advantage in their industrial policies. In practice, this means favouring manufacturing industries where 'learning by doing' and achieving economies of scale tend to be fundamentally important.

Manufacturing has underpinned innovation and transformation in advanced industrial nations throughout history, as shown in numerous studies (*e.g.* Kaldor 1967; McCausland and Theodossiou 2012; Porter 1990; Wang 2009). According to Stanford (2020), manufacturing carries strategic importance as the most innovation-intensive sector; anchors hundreds of thousands of other jobs throughout the economy in complex supply chains; commonly offers high-quality, full-time jobs and above-average incomes; and accounts for most of international trade, which means that an undersized manufacturing sector is often associated with trade deficits and balance of payments problems. Despite the growth of

[1] This was Australia's ranking in Harvard's 2019 data, the most recent release of economic complexity world rankings. According to Harvard's Economic Complexity Index, Australia's highest recorded position was 55th in 1995, still far behind most advanced industrial nations.

services sector employment relative to manufacturing employment over the past several decades, an OECD study (Sorbe *et al.* 2018) showed that productivity in services is still weaker than manufacturing productivity, the latter making a far greater contribution to global GDP growth.

Figure 1: Exports by industry: Australia, 2009-10 to 2019-20



Source: DFAT (2021).

Investments in manufacturing maximise the quality and value added to processes and products for export to global markets. In turn, these broaden the scope of economic complexity, which is driven by supply chain integration that links diverse sectors of the economy and promotes innovation. This is how a nation achieves not just economic growth, but also economic *development*. It explains why seizing sustainable industry opportunities in manufacturing represents Australia's best hope for a prosperous future.

Industrial policy: A political choice

The export of raw materials may yield high returns during periods of strong commodity prices but, as a long-term economic strategy, extraction hollows out higher-value manufacturing industrial capabilities. High commodity prices drive up the value of a nation's currency, making other sectors competing on price less competitive in global trade terms. This was the reality that faced Australia at the peak of the mid-2000s mining boom, when the remaining automotive OEMs in Australia, Ford and GM-Holden, began planning their exits from Australian industry.

The 'default' economic and industry policy adopted by successive Australian governments since the 1990s – and in earnest since 2013 – has favoured resource extraction as Australia's national comparative strength, reflecting the priority to support the capital interests of global firms in resources and finance sectors. A clear example was the former Morrison Coalition government's plan for a 'gas-fired recovery' as part of its fossil-fuel intensive energy policy. This was proposed despite the loss of 3,800 jobs in the gas industry between May 2020 and February 2021, even as employment across the economy grew by 863,000 jobs (Saunders and Denniss 2021).

In an essay for *Independent Australia*, Tim Thornton (2020) critically described the gas-fired recovery as 'industry policy in reverse'. Channelling JK Galbraith's concept of the 'predator state' to characterise governments shaped by wealthy and powerful interests (in this case, the fossil fuel industries), Thornton argues that the Morrison government conformed to this template. He warned, however, that in the context of the potential ecological collapse that humanity now faces:

> the situation is also inherently fragile, given that in a democracy there is always the means to produce outcomes that reflect the general interest, though, of course, the majority needs to be aware and engaged enough for this means of change to work (Thornton 2020: n.p.).

Industry policy reflects political capacity; and the subsequent political decision-making reflects the political will to deliver on strategic aims.[2]

[2] As a contrast to policy for a gas-fired recovery, had, for example, the $2.9 billion allocated to new gas and oil refinery support measures in the 2021-22 budget been spent on health and education instead, a net 19,000 additional jobs would have been created. Other non-market-driven measures in the budget included $2.3 billion in subsidies to Australian petroleum refineries, supposedly to ensure domestic fuel security.

Seen in this way, political decisions made by the former Abbott Government to accept – and even endorse – the end of automotive manufacturing in Australia were short-sighted. They bucked the trend of strategic, long-term industry policy and planning adopted by the world's leading economies – including the United States, Germany, Switzerland, Singapore, Japan and China.

A neoliberal orthodoxy has long dominated Australia's political economy, having first pollinated our political and economic institutions in the 1970s and thereafter co-opting both labour and capital into the neoliberal institutional order (Humphrys 2019). Whereas other advanced industrial nations maintain a similar rhetorical commitment to free trade, free markets and minimal government intervention, their industrial policies in practice have been more interventionist. Thus, even if these nations celebrate the virtue of 'free markets' in political rhetoric, they continue to intervene regularly and powerfully to create, shape, and direct the development of markets and industries (see Mazzucato 2015, 2019). In Australia though, the historical arc that neoliberalism has taken means that the primary government macroeconomic institutions maintain a *laissez-faire* status quo wherever possible. A primary example is the Productivity Commission's recent recommendation that no decisions should be made by government on economic strategy for EV uptake and industrialisation before the next decade (Kurmelovs 2023).

Recognising that industry policy can play an active role in developing a more complex and innovative economy, the governments of many other industrial nations have planned an EV-centred industrial future as a priority, with their domestic automotive industries responding to affirm interventions ranging from fuel efficiency and emissions standards to industrial sustainability initiatives and even public equity in new ventures. There is typically a strategic rationale for these initiatives, implicitly targeting global value chain niches or sovereign industrial strengths that can be developed from a nation's existing base for competitive advantages in a globally distributed EV industry.

These interventions prove that industry policy must be political – meaning making strategic choices for industrial directions, premised on the nation's economic and social capacity to deliver. Setting directions is something governments should do on behalf of a nation's citizens and for objectives that benefit society. Policy leadership from government is essential, as is the demonstrated political will to make bold and future-focused choices.

Seen in this context, a strategic Australian EV industry policy could build positively on existing industrial capabilities, contribute to innovation in burgeoning renewable energy ventures, and better utilise and further develop a highly skilled workforce for a sustainable future of work.

Whether and how Australia participates in the rapidly expanding global EV industry depends, first and foremost, on the choice between three broad options:

- importing EVs and training workers to maintain and repair them;
- assembling imported EV 'kits' and training workers to maintain and repair them; or
- manufacturing and assembling EVs and EV components (including batteries), maintaining and repairing them, and exporting them to global markets after related value-adding production processes are undertaken in Australian industries.

It is the contention of this article that the third option is optimal. Not only would the local manufacture and assembly of EVs and EV components promote direct job creation, but it would also create a base for spin-off manufacturing and service industries, technological innovation processes, extensive export opportunities and a deepened knowledge and skills base in the Australian labour market. Making it happen would require a strategic industrial policy for manufacturing that breaks with the market-focused character of Australia's recent industry policy prescriptions.

Four building blocks of EV manufacturing industry policy

The Australian economy already has the key economic, social, institutional and industrial elements that a strategic industrial policy requires. These can be understood in terms of four key building blocks - critical minerals, a highly skilled workforce, capital and supply chains, and capable governments and institutions. Each reflects a resource Australia already possesses either in abundance or at levels that are sufficient to start developing EVs. It is the more proactive and coordinated development of these features that holds the opportunities for Australian labour, industry and the community to apply its collective knowledge, skills and expertise to maximise ecologically-driven productivity. Each of these four building blocks can now be considered.

Value-adding to Australia's critical minerals resources

A strategic approach to Australia's EV manufacturing future would begin with transforming the current export regime. This entails a shift away from its current domination by exports of processed raw commodities (especially minerals) toward more elaborately transformed manufactured goods that have undergone value-adding processes higher up the critical minerals value-chain. Australian exports of commodities such as lithium, cobalt, bauxite and rare earth elements (*i.e.* vanadium) have significant relevance to EV industries. Lithium is particularly important: Australia is the world's biggest exporter of spodumene[3] and holds the largest reserves of all lithium mining and export nations. Cobalt is a by-product of copper and nickel ore processing and has also been identified as a critical mineral, given its application for batteries – for which a 'substitution is unlikely to emerge over the medium term' (DIIS 2019: 12). Currently, Australia lags far behind the world's largest cobalt exporter, the Democratic Republic of Congo (DRC), despite holding the second largest proven reserves of cobalt (after the DRC) and the DRC's 'artisanal' industry being practically synonymous with modern slavery (see Clean Energy Council 2022: 8). For these key mineral inputs, and a range of rare earth metals, Australia has an opportunity to become a world leader in high-value EV component industries.

The report on *Australia's Identified Mineral Resources 2020* (Geoscience Australia 2020) highlighted the significant difference in export value between raw minerals and processed mineral commodities, the latter having far greater value because of downstream processes (including refining and smelting). In *Superpower*, Ross Garnaut (2019) argues that, where Australia possesses unrivalled access to natural resources in terms of sun (solar), wind, and waves among other resources, an industrial focus on processing and transforming minerals for EV batteries would be globally competitive, given the cost advantages of renewable sources of energy to power refining, smelting and even manufacturing activities. Downstream processes add significant value to mineral exports. The refining opportunities for all minerals are significant, but especially so in the case of spodumene processing. Although Australia's production of spodumene yielded $1.1 billion in 2017, the Future Battery Industries

[3] Spodumene is the primary ore comprising lithium carbonate, the precursor necessary for lithium-ion batteries.

Cooperative Research Centre (FBICRC) reported that 'the major value-adding steps, including precursor production that was worth $22.1 billion', was carried out overseas instead of in Australia's downstream processing industries (FBICRC 2020: 7). Whilst the export value of spodumene grew in 2021-22 to $4.9 billion, with export figures at 335,000 tonnes, it was projected to increase to 399,000 tonnes in 2022-23 ($16.1 billion of export revenue) and 470,000 tonnes in 2023-24 ($17 billion in export revenue) (DISER 2022). These figures will continue to yield revenues far short of the expected returns from downstream value-adding, especially as demand for inputs to manufacturing of batteries for EVs increases exponentially.

Rather than remaining as the world's leading exporter of lithium ore, Australia has significant opportunity to add value to this commodity by manufacturing EV batteries and components. The Global Battery Alliance (2019) has shown there are potential large gains that could be made with a strategy to participate in the higher value-adding phases of battery and component production. More value-adding and employment opportunities can be gained from stages beyond extraction, particularly in production phases focused on refining battery materials like lithium, developing battery cells and packs, and eventually processing these materials for reuse and recycling. Aiming for such higher levels of participation in global EV industries could see more GDP and more jobs in value-adding in Australia if policy is made to position our economy to capture these opportunities. Battery manufacturing could very well become the key driver of EV industrialisation because harnessing the significant value-adding potential to domestically refined critical minerals would secure an Australian share of global EV value chains and create the impetus for further EV industrialisation – including metal fabrication, components and final assembly – where capital identifies the sophisticated industrial base that has existed in Australia for many generations.

Industrial strategy for critical minerals and EVs in the European Union will also impact Australia's global export opportunities. Using strict local content production rules, from 2027, the EU will implement Rules of Origin for proportions of battery products that must be created in the UK or EU to be classed as an EU-originating product. It will mean that, from 2027, battery packs in imported EVs must contain either 65 percent UK/EU content for the battery cell or 70 percent for the total battery pack. The EU Rules of Origin for batteries are a technical trade barrier that will significantly limit overseas competition in the market for batteries installed in EU-made EVs.

With overseas jurisdictions pursuing such regulatory changes to develop and strengthen their position in critical minerals value chains, industrial policy development requires that Australia quickly pursue similar approaches to supply chain challenges. Indeed, there are signs that the Australian Government is beginning to take seriously these pressures. In contrast with the former Morrison Government's ill-conceived 'gas-fired recovery' – an industrial policy dismissed by former conservative Prime Minister Malcolm Turnbull as 'piffle' – the Albanese Labor Government has already begun the process of developing a *Critical Minerals Strategy*, engaging in consultation with industry and other stakeholders to develop a policy response to creating opportunities within the sector. This could be taken to represent the new government's awareness that a sustainable social and economic future means breaking ties with what Guy Pearse termed 'quarry vision' (2009), a political philosophy that has long defined Australia's economic trajectory and limited its capacity to innovate and develop advanced industrial capabilities.

Despite efforts in policy and practice to develop Australia's economy towards more downstream value-adding to critical minerals exports, however, a basic tension must also be noted. This is that viewing domestic downstream processing opportunities for lithium represents what Collins (2022: 8) frames as a 'resource curse/blessing' paradox, whereby both are 'derivative forms of extractivism'. By such a measure, the potential economic and social benefits to be gained from the redistribution of revenue captured in domestic critical minerals manufacturing industries does not overcome the ecological threat of climate change to which mining industries are inextricably linked. In *The Rare Metals War*, Guillame Pitron (2020) writes of the global shift to an ecological growth model, which, he contends, 'has resulted in intensified mining of the Earth's crust to extract the core ingredient – rare metals – with an environmental impact that could prove far more severe than that of oil extraction'. Whilst it is unlikely that the renewable transition and its dependence on critical minerals will be stopped or scaled down, a strategic industrial policy in Australia for an EV-led economic transformation must ensure that any disruption to the environment and local communities (particularly First Nations' communities) through the intensification of extractive industries is minimised, along with the regulation of forms of profligate and wasteful energy consumption - such as cryptocurrency mining, which is a growing contributor to carbon pollution (Sparkes 2022). This must be a central

feature of industrial transformation, making the ongoing extraction of the resources a key part of the transition rather than a countervailing force.

Training and skills for high-value industries

Australia will require far greater coordination and development of its already highly skilled labour to grow and develop sophisticated EV industry supply chains. This presents significant challenges, but a concerted effort to achieve this goal can yield great returns. Australia already has an industrial workforce of skilled and experienced workers, capable of meeting the foundational industrial base of a growing EV industry, supported by ongoing retraining and upskilling.

As Table 1 shows, vehicle components manufacturing has retained a significant footprint in Australia despite the shutdown of ICE assembly plants and loss of jobs. In recent years, it has even shown indications of expansion. Thousands of workers continue to build automotive parts, supplying Australian products to heavy vehicle (*i.e.* bus, truck and trailer) manufacturing firms throughout the country and to global automotive manufacturing industries. Expanding EV components production and final assembly work can occur if supported by active industrial planning but, to support this, Australia must also invest urgently in relevant skills to underpin greater domestic involvement in global EV supply chains.

Table 1: Motor vehicle and motor vehicle part manufacturing, Australia, 2019-21

Indicator	2019-20	2020-21
Employment (number of persons, at end June)	34,258	33,494
Wages and salaries ($m)	2,274	2,285
Sales and service income ($m)	14,753	15,069
Industry value-added ($m)	3,956	4,500

Source: ABS (2021, 2022 – manufacturing sub-sector 231).

Because of current skills limitations to expanding EV production in Australia, delivering new training packages for apprentices and trainees will be essential to preparing skilled labour for future EV manufacturing. The VET system will require whole new units of competency. In 2020, the Industry Reference Committee (IRC) representing the automotive industry, along with the Australian Industry and Skills Committee (AISC), proposed changes to the 'Automotive Retail, Service and Repair' Training Package to create new qualifications and units of competency that support skills for the EV industry (PwC and DESE 2020). But the proposed changes, being the implementation of non-trade Certificate II and Certificate III qualifications, do not support the creation of pathways for workers into higher-paid and higher-skilled jobs. EV industries can be expected to be characterised by higher-level jobs requiring at least Cert III qualifications. At present, EV manufacturing production is not even incorporated into Certificate II- or Certificate III-level qualifications for the automotive industry. Furthermore, the proposed changes consist of updates to existing units, or new qualifications that are equivalent to Training Packages associated with traditional ICE vehicles.

The proposed changes to the Automotive Accessory Fitting qualification (AUR22021) incorporate EV skills and training at the Certificate II level. This results in a backwards step to the base-level trade qualification (which previously was a non-trade Cert III). Such a qualification standard leads the industry in the wrong direction. The broader Automotive Manufacturing Training Package still refers only to 'hybrid' vehicles, with no mentions of fully electric vehicles. The proposal of one of the largest consulting firms in Australia, together with the bureaucratic apparatus of the former Coalition Government, has contributed to the further deskilling of Australian automotive trades, rather than augmenting workers' role in the labour process for an emerging advanced manufacturing industry.

These weaknesses confirm that VET policymakers have a big task ahead to fully prepare for the impact of EV manufacturing (and servicing/ maintenance) on Australia's skills system. Present shortcomings in EV industry skills and training pathways partly reflect the time lags encountered in developing new training units, packages, and qualifications to be approved and endorsed by the relevant IRCs. These processes involve a wide range of industry stakeholders and are challenged to keep up with more rapid advances in EV technology.

The EV manufacturing transition is more complex than a straightforward transfer of ICE automotive manufacturing work to EV automotive manufacturing work. The development of a highly skilled workforce for EV industries will require meticulous attention to training structures and frameworks. This requires root-and-branch analysis of the skills, job functions and occupational structures required for EV manufacturing. Indeed, this deep analysis of the skills requirements of the EV industry must be at the heart of industrial transformation. A full account of what is needed to ensure that Australian manufacturing workers are involved in component manufacture and final assembly of EVs is an essential precursor to building these capabilities. This means involving all industry stakeholders, including trade unions as essential partners in performing occupational profiling, engaging directly with workers and feeding into the development of training resources.

Union involvement is crucial where, even as increased digitalisation and automation shapes manufacturing, the role of workers remains pivotal to highly skilled and complex manufacturing processes. EV industry policy must be developed in a way that recognises both workers' skills informed by experience as well as their qualifications. Studies of some of the world's most sophisticated automotive supply chains have determined that, even in highly automated workplaces, the *experiential* knowledge and skills of workers is an essential ingredient in highly advanced, digitalised, and automated industrial systems (see Pfeiffer and Suphan 2015). Human skills become critical inputs in firms that acknowledge workers' first-hand knowledge of production processes is more than just 'routine', and therefore is not easily replaced by labour-saving technologies. The ramifications of this recognition of the value of workers' all-around knowledge for transforming VET-based skills provision are enormous. An approach to industry policy that places skills at its centre ensures competent workers are active in shaping advanced manufacturing workplaces, such as are necessary for an EV industry.

Lessons can also be learned from other countries about how new forms of worker intervention in production can contribute powerfully to highly skilled workforces and increased productivity. Miller (2021) reports how the management of Volkswagen (VW) learned that a positive-sum strategy for productivity outcomes that meet union and worker aims can produce long-term benefits for both firms and workers. When the unions representing the German automotive firm's workforces were initially shut out of decision-making, VW quickly understood that an adversarial

approach to strategising firm growth would create more problems than a cooperative approach that embraced union industrial democracy. Hence, more recently, union representatives have collaborated with VW management to develop a 'shared vision' for EV productivity and growth driven by high-quality job-creation instead of cost-cutting measures that typically result in job losses. Focusing on greater worker input to planning and productivity enhancements therefore represents a growth strategy that can benefit both EV manufacturing firms and EV manufacturing workers.

Increasing the space for workers to provide input on EV industry development can also maximise the knowledge-informing innovation in EV supply chains - from mining and refining to manufacturing. Where experienced and knowledgeable workers transfer skills and expertise from traditional automotive manufacturing to new EV manufacturing, they provide key inputs to innovation processes. Workers and their unions must therefore be given scope for involvement in industry policy development, identifying the necessary skills formation and industrial knowledge required. These insights should then inform the development of curriculum in state-based TAFE institutes, with nationally recognised training delivered and regulated within a federally-coordinated framework that aids both labour mobility and career progressions, allowing workers to pursue a range of qualification pathways.

EV industry policy can also benefit from government procurement strategies. Stanford (2018) has shown that, when targeting its spending power to improved labour market outcomes, government can better link its expenditure programs to the pursuit of better jobs and stronger wages growth. This support for both economic and social objectives can occur in various ways – through direct government investment in the EV industry, such as purchasing EVs for government fleets; through funding of service-producers, such as the delivery of VET education and training of EV workforces by TAFE and other VET providers; and through purchasing goods and services from private sector firms.

Government assistance is also beneficial when it extends to investment in R&D. International examples of advanced procurement industry policy confirm that an active government role in innovation processes leverages more training efforts from partnering firms, which ultimately become like a 'technical university' (Eliasson 2011). In this manner, workers – already holding formal qualifications from the VET system – can advance their experience and skills further through on-the-job learning.

Mobilising capital to develop supply chains

Evidence from international experience confirms that active, interventionist EV policies must mobilise private and public capital to drive the transition of industries and markets. In 2011, the CSIRO commissioned a report that took stock of international policies encouraging EV uptake by consumers and growth in the manufacture of EVs (Dunstan *et al*. 2011). These policies include mandates for the manufacture and consumption of EVs, adopting targets for safety and technical innovation, regulation emissions reduction to encourage more efficient and less-polluting EVs,[4] and incentivising manufacturers, including OEMs, to invest in EV technology R&D.

Nurturing stronger innovative capability is increasingly important amongst the Small and Medium-sized Enterprises (SMEs) that make up the bulk of Australia's manufacturing sector and, for decades, utilised the skilled and knowledgeable labour in manufacturing industries. Historically, key large or 'anchor' firms provided an initial spur to production and employment growth through their domestic investments – a process that was especially clear when major global automotive OEMs were operating in Australia. More recently, however, their departure has left the manufacturing sector more dependent on SMEs for its continued activity. As Stanford (2020: 57) shows, although 86,000 businesses were registered as operating in the manufacturing sector as of June 2019, most of these businesses were very small: only about 500 firms had over 200 employees. The number of medium-sized manufacturing businesses is also modest and had been declining over the previous dozen years. The OECD (2021) has highlighted the 'missing middle' (or *Mittelstand*) of medium-sized enterprises in Australia's economy, leading to a lack of resilience in the nation's intra-national and international business linkages and rendering the economy more deeply exposed to global supply chain disruptions, as experienced during the COVID-19 pandemic.

Although major firms still dominate R&D spending and innovation activity in Australia, their performance falls below international standards. The lack of investment from business can be understood in part by the loss

[4] EVs may not emit carbon pollution like ICEs, but they do contribute to pollution in other common ways, *i.e.* tyres which gradually wear down, creating microplastics that end up in oceans and rivers; and braking systems that generate toxic dust including mercury, lead, cadmium, and chromium (see Welch 2021).

of economies of agglomeration that support robust innovation and supply chain expansion. Historically, firms linked closely in supply chains would 'cluster' together geographically, benefiting from knowledge-sharing facilitated by their proximity, as well as from the presence of larger primary firms (*i.e.* Holden, Ford, Toyota or their 'Tier 1' suppliers). It was common for employees to shift from one employer to another nearby in an existing cluster of business, taking knowledge with them and using it to contribute to innovation processes in their new role (Porter 1998).

In the wake of the closure of automotive manufacturing in Australia, there remain fewer larger manufacturing firms with which SMEs can coordinate their production efforts. This would suggest that, in the absence of industry clusters, there is little, if any, reason for firms to share knowledge due to higher opportunity costs. The result, it would seem, has been an erosion of the networked knowledge-sharing and commercial collaborations that previously sustained vibrant manufacturing. However, within the existing Australian automotive parts supply chain, despite the end of large-scale automotive assembly, significant manufacturing activity remains (see Table 1 above). Following the automotive industry closure, industry value-added declined only modestly, and actually stabilised at a higher level than immediately prior to the last of the industry closures.

Thus, the oft-declared death of automotive manufacturing in Australia after 2017 is simply at odds with reality. The automotive manufacturing industry still maintains an important level of activity in Australia, contributing to innovation, productivity, and exports. A future EV manufacturing industry could build on the automotive supply chains that still employ thousands of Australian workers and contribute high-quality manufactured goods to both global markets and domestic assembly operations (including the bus, truck, and other heavy vehicle manufacturers that still directly employ hundreds of workers and contribute to tens of thousands of supply chain jobs).

Where activity in the automotive supply chain has continued beyond the ICE automotive industry's closure, the ongoing importance of industry clusters in Australia's former automotive manufacturing regions provides a useful base for the development of new EV manufacturing. Numerous submissions to the Senate Select Committee on Electric Vehicles (Commonwealth of Australia 2019) referred to Australia's 'residual engineering capacity' and highlighted the potential for revival of existing industrial infrastructure through the development of an EV industry.

Because a significant quantity of physical manufacturing capital currently sits idle in unused industrial sites – mothballed robots not already sold off to other manufacturers, operational gantry cranes, and with many sites having geographical proximity to existing logistics networks – assembling the capital stock required to build an Australian EV manufacturing capability could have a significant head start.

Further supporting this case, the history of Australian manufacturing reveals a sector intrinsically shaped by an automotive industrial base, which set in motion a pattern of capital investment, business activity and skills development that continues to this day – years after the OEMs departed. Automotive manufacturing has been a key driver of demand in other industries and sectors for complex products; and a leading stimulator of R&D which still ripples throughout the economy. The Department of Industry, Innovation and Science (DIIS) has highlighted the importance of government policy support to transition existing auto industry clusters to new manufacturing opportunities (DIIS 2020). A just transition, coordinated by a federal body – such as the Energy Transition Authority proposed by the labour movement (ACTU 2022) - will be essential to capturing benefits of new industry for the workers transitioning from legacy industries to the broad range of opportunities related to renewables. Hence the importance for an EV industry policy to acknowledge automotive manufacturing's ongoing role in economic development by preserving existing regional industry clusters and strengthening them through an EV industry strategy.

There is a further *social* dimension to reviving industry clusters in an EV-led reindustrialisation of the economy. Many workers lost employment in the automotive industry and broader manufacturing sector since the OEM closures over the last two decades. As previous studies have documented, in the wake of those closures, many displaced workers left the manufacturing industry sector permanently (Beer and Thomas 2009). These laid-off manufacturing workers have faced limited opportunities, often moving to jobs in industries characterised by lower pay, less hours, chronic insecurity, and poorer conditions - characteristics that now commonly combine with 'gig economy' labour market dynamics to thrust skilled tradespeople into precarious working conditions (Beale 2022). It is also common that the skills or experience of these workers are a poor match for work in these industries and disadvantage them relative to other workers. The former manufacturing workers commonly suffer from negative health consequences and barriers to social participation, partly

reflecting the loss of community that workers commonly experience after losing long-term, well-paid, and unionised manufacturing positions.

An EV industry policy could reverse these negative trends by reinvigorating the positive benefits of regional industry clusters and building upon the skills and capabilities that are retained by workers in SMEs that still operate in the post-automotive manufacturing sector.

A role for government and other key institutions in EV industry development

In responding more fulsomely to the challenge of climate change, the Australian government could put an EV industry at the centre of its economic and environmental strategies. This represents a strategy that goes far beyond industry policy as an exercise in 'picking winners'. Instead, it is about seeding a range of viable innovative industrial pathways. As a case in point, Mariana Mazzucato (2015) has highlighted the Obama Administration's backing of two renewable energy technology ventures, Solyndra and Tesla, to show that the failure of Solyndra (at a cost of more than $US500 million) was more than offset by the multi-billion-dollar success of Tesla.[5] Tesla is now one of the world's most innovative manufacturing companies, providing commercial and retail products in the EV and renewable energy sectors.

Yet the success of global manufacturing giants like Tesla can only be understood with reference to the industry policy context that enabled them. Industry policy must also ensure that its successes help to enable social and environmental goals. In more recent work, Mazzucato (2019) argues that Tesla 'privatised' the profits of its extraordinary success, while 'socialising' the costs of funding innovation.[6] Future public investment in firms with significant growth potential should result in the state not only shouldering much of the risk, but sharing in the reward when a highly innovative firm grows. Where initial public investment is the catalyst for such growth, the public is deserving of a share in the success through a

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5 According to Mazzucato, the Obama Administration provided guaranteed loans of US$535 million to Solyndra, and US$465 million to Tesla.

6 While the failure of Solyndra was more than offset by the enormous success of Tesla, Mazzucato (2015: 12) explains that 'Taxpayers footed the bill for Solyndra's losses – yet got hardly any of Tesla's profits.'

social dividend. Thus, Australian governments need to avoid the situation in the US, where, as reported by Hirsh (2015), Tesla had benefited by 2015 from nearly US$5 billion in US federal and state subsidies to develop and expand multiple ventures (including EVs, tunnel boring, renewable energies, and even space exploration), and yet initial public investment was never paid back by the company, nor any equity in Tesla obtained by state or federal governments. Tesla CEO Elon Musk's willingness to exploit workers and actively prevent unions from organising Tesla plants has also been widely reported (see Sainato 2018). His subsequent business ventures – including takeover of Twitter and other vanity projects like his Boring Company's anti-public transport tunnelling projects – indicate a fuller picture of this entrepreneur's relationship to state industrial strategy, presenting a negative model that a more progressive industry policy should actively seek to overcome.

Active participation by the Australian government in various aspects of EV industry development could involve a coordinating, as well as a regulatory, role. This includes the development of secondary processes downstream from extractive industries, regulating skills development, supporting supply chain enhancement, and incentivising the use of EVs by consumers (such as sales incentives and charging infrastructure). ARENA (2018) has reviewed EV policies in other countries and shown that they commonly feature purchasing incentives, procurement targets, import regulations, fuel efficiency and consumption regulation and even the phasing in of ICE vehicle bans. ClimateWorks (2018) has argued that campaigns to raise awareness amongst the public, by demonstrating and deploying EVs and EV charging infrastructure, are necessary to accelerate public engagement in the EV transition.

In terms of *industrial relations* policy development, unions and other civil organisations need to play an active role to enhance the resulting benefits of EV industry growth for workers, the public and future generations. These investments are guided by the twin goals of decarbonising the Australian economy and enhancing our technological and industrial sovereignty. The urgency of government measures to maximise societal benefit are illustrated once again with Tesla's plans for prospective ventures in Australian rare earth mining. Tesla's estimated annual demand for Australian-produced lithium, nickel, and other critical and rare earths has been reported to exceed $1 billion beyond 2021 (Greber 2021).

In 2022, the Biden Administration's *Inflation Reduction Act* has also acted as both magnet for new technology ventures and foreign policy posturing against the global market dominance of China. This legislation has attracted numerous high-tech Australian firms to establish US manufacturing operations, many of which initially sought to anchor their enterprises in Australia but were discouraged by the lack of industrial strategy under the former Coalition government, its recalcitrance to action on climate change and its subsequent ambivalence towards renewables industries.

The clear lessons are that due diligence must be taken by governments to plan industry policy that builds competitive advantages that lift the nation's position in global value chains (i.e. developing industry beyond simply digging up commodities and exporting them overseas where the value is added), thereby ensuring a proportionate share of benefits from the renewable future flows to workers, communities, and the public. Considering the US government's supply chain review (White House 2021) and the subsequent *Inflation Reduction Act*, the Albanese Labor government has undertaken public consultation to begin the process of developing a critical minerals strategy for Australia, as well as a battery manufacturing industry strategy. Within its coordinating industry policy role for whatever mechanisms emerge, it needs to ensure that EV manufacturing firms seeking to benefit from Australian incentives to maximise domestic investments and distribute the proceeds broadly throughout society.

What next?

With the key industrial building blocks already in place or capable of being developed, what is required to mobilise Australia's policy landscape and institutional settings to produce an EV-led reindustrialisation of Australia's economy? An Australian EV manufacturing industry should be seen as one major component of a nationwide approach to addressing climate change and creating a sustainable future. Hence, there is a far more pivotal role to be played by democratic institutions in planning, shaping and delivering a sustainable industrial future that benefits the environment and society.

In August 2022, the National Secretary of the Australian Manufacturing Workers' Union (AMWU), Steve Murphy, called on the new federal Labor government to boost domestic manufacturing by beginning with the

establishment of a tripartite National Innovation Council that would be tasked with developing and coordinating a long-term plan for EV manufacturing in Australia – one that would focus on industry policy, jobs, skills and training, and active governance (AMWU 2022). Since this initial political ask, the AMWU has worked with a growing list of cooperative industry partners in energy and manufacturing sectors, as well as think tanks and research organisations, to elevate a policy proposal that would establish a collaborative and representative industry innovation council. This Council, when established, could represent the coordinated industrial response to the opportunities detailed in this article. It could be the means to deliver major worker-centred interventions through cooperation with industry to identify the occupations and skills required to create scale throughout EV industries and related supply chains.

Beyond worker interventions, communities must be active stakeholders in developing and implementing sustainable social and environmental thinking and practices. This would reinforce a cultural shift to deeper ecological and community-minded social participation. A significant commitment to meeting Australia's climate change obligations in such terms can make great strides towards the transformation of cultural norms. Ultimately, in a sustainable social, political and industrial future, private EV ownership would be supplemented – even supplanted – by an abundance of well-funded and innovative sustainable public transport planning, supported by a vibrant, diversified and innovative manufacturing sector. This basis for developing renewable futures in Australia would complement environmentally sustainable innovations in energy systems and drive an environmentally friendly renewal of our economic system.

Conclusion

A country that can manufacture goods is more likely to be a country that succeeds economically and socially. Given Australia's industrial history and demonstrated capacities, a rebirth of an automotive industry makes sense for several reasons. It is in step with the imperative to undertake a global energy transition to stabilise the climate and it is both economically and socially beneficial. For this strategy, Australia will need an EV industry policy that encourages a rapid shift in automotive manufacturing away from ICEs but within an economy-wide strategy to rebuild

Australia's industrial transformation around sustainable transport systems as part of a national response to climate change. An Australian EV strategy based simply on a one-for-one replacement of ICEs with EVs would 'lock in' systems of production and transportation with an over-reliance on private vehicles baked into them, and this is ecologically unsustainable. We must also rethink our relationship to cars and consider more socially and environmentally sustainable modes of transport (*i.e.* public transport, cycling, walking) to meaningfully address climate change (Mattioli et al. 2020; Morgan 2020).

Building an EV industry in Australia is therefore not a panacea for dealing with multi-layered social, political, and environmental challenges. However, as this article has argued, anchoring Australia's industrial transition in an EV industry policy represents a significant opportunity to rebuild an advanced manufacturing industry – one that helps the nation meet its international environmental obligations and contributes to a just transition for Australian workers and communities. It would substantially augment efforts to decarbonise Australia's economy. To make it a success would require an industrial strategy to achieve the labour and environmental aims of an EV-driven industrial transformation.

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