



Rebuilding Vehicle Manufacturing in Australia:

*Industrial Opportunities in an
Electrified Future*

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- industrial relations;
- social policy;
- manufacturing and industry policy;
- vocational education; and
- international labour solidarity.

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Summary

Global automotive manufacturing is rapidly transitioning to the production of Electric Vehicles (EVs) in line with technological advancements and the global community's commitment to addressing climate change. This transition presents an enormous opportunity for Australia to rebuild its vehicle manufacturing industry, taking advantage of our competitive strengths in renewable energy, extractive industries, manufacturing capabilities, and skilled workers.

Australia possesses many of the crucial elements for an EV manufacturing industry: rich mineral reserves, an advanced industrial base, a highly skilled workforce, and consumer interest. But what it lacks is an overarching, coordinating and strategic national industry policy. Global experience shows that this is central to EV-oriented industrial transformation. Australia can play an important role in global EV manufacturing industries but developing a strategy to realise this will require active government policy responses to both the challenges and opportunities at hand.

Australia's natural resource endowments and industrial capabilities make EV industry development a viable economic and social strategy. Our moral obligations to create a sustainable future make it essential public policy. This report illustrates how Australia can rebuild a vehicle manufacturing industry, on a sustainable ecological foundation, and meet our international environmental obligations. The report covers several important related dimensions of the issue:

- How an EV manufacturing strategy can add value to Australia's existing exports of primary resources – connecting them to innovative, sustainable manufacturing industries;
- Developing supply and value chain linkages to the global EV industry by increasing the capability for innovation and advanced manufacturing amongst small and medium-sized enterprises;
- The central role of Australia's education systems in delivering sustainable industry-focused training and skills development, to provide workers with career pathways shaped by lifelong access to education and learning;
- How active government intervention can coordinate economic sectors in an innovative and strategically oriented industry policy driving sustainable economic and technological transformation; and
- Understanding the importance of automotive manufacturing to our industrial future, its role in redesigning transport systems, investing in new technology

and gearing production systems to meet social and environmental requirements.

To make the case for a national EV manufacturing policy, this paper reviews existing literature and presents relevant data to show that an EV industry in Australia is not just desirable – but it can also lead the sustainable transformation of Australia’s economy.

The paper is arranged as follows. The next section provides an overview of the Australian national EV policy landscape and the international context, to identify trends and opportunities in EV manufacturing.

The bulk of the paper is then dedicated to reviewing four key ‘Building Blocks’ of an industry policy: the resources sector, skilled labour, supply chain capabilities and capital assets, and the capacity of government to develop a policy response that assembles these key elements as the foundation for rebuilding Australian manufacturing with EVs at the centre.

In mapping this foundation of an EV manufacturing policy, the subsequent section cautions that an EV industry is not a panacea for addressing the broader climate crisis and creating a sustainable economy. It argues, however, that a sustainable EV industry should be considered as a major driver of industrial transformation alongside other positive cultural and environmental changes within Australian society.

The conclusion summarises the paper’s overarching theme that Australia can build a strong EV manufacturing industry with the right policy settings and government actions. It makes several specific recommendations to get the ball rolling on developing these settings – including recommendations touching on industry planning, energy requirements, consumer demand, resource use, supply chain developments, skills and training, and government support.

Australia's EV Policy Landscape

Vehicles with Internal Combustion Engines (ICE) currently dominate global automotive manufacturing. Dozens of countries can produce ICE vehicles or components. They and many other countries (including Australia) participate in international supply chains that produce millions of cars, trucks, buses, and other vehicles each year.

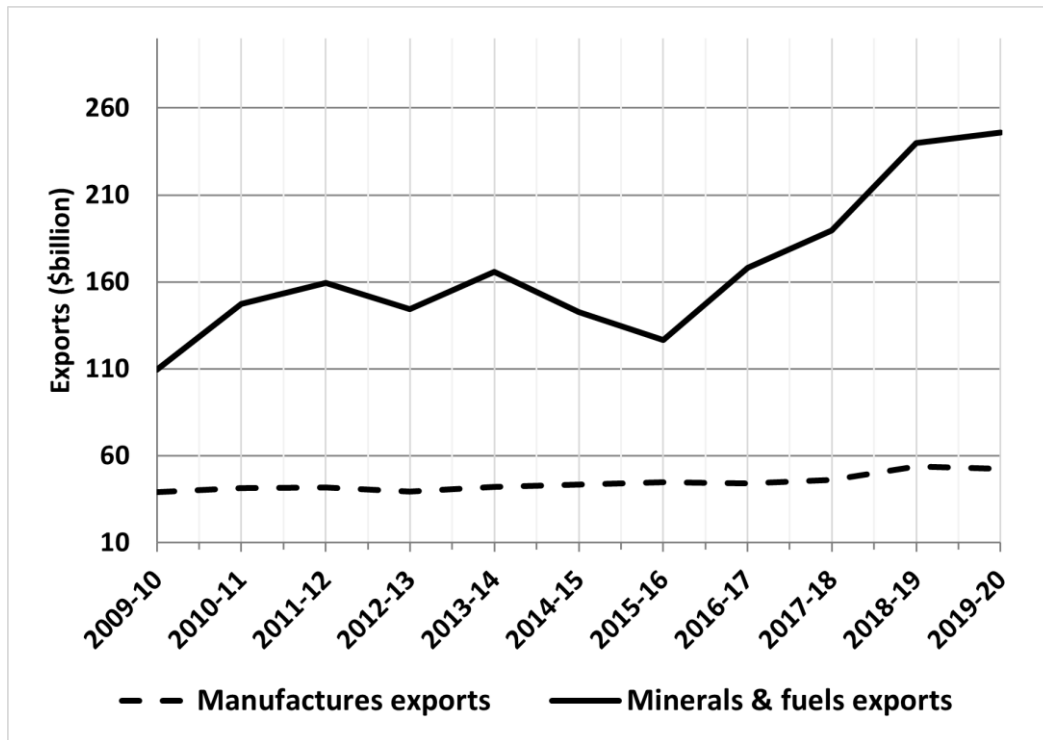
Australia was counted as a nation that mass produced passenger vehicles until 2017, when the last remaining automotive manufacturing firm (General Motors-Holden) closed its assembly operations (following on the heels of earlier assembly closures by Ford and Toyota). Ever since, a range of stakeholders has sought to identify opportunities for Australian manufacturing transformation. Production of Electric Vehicles (EVs) is an emerging global manufacturing industry that presents significant opportunities for rebuilding Australian manufacturing.

A country that 'makes things' is a country that succeeds economically – and, most often, socially as well. Given Australia's industrial history, a transformation of automotive industries in step with the requirements of environmental sustainability and changing global tastes makes both economic and social sense. But Australia faces major questions about the shape of its industrial future.

Australia's Industrial Advantages: Compare or Compete?

Over the past several decades, Australian governments have gradually abandoned efforts to make strategic and forward-focused policy choices to sustain and promote manufacturing. In place of deliberate, strategic industry policy (coordinating public and private sector actions to promote the qualitative development of Australia's economy), federal governments have focused instead on resource-based commodities. An economic growth strategy based so narrowly on extraction and export of unprocessed, non-renewable resources arguably does not develop our economy, jobs, skills, or communities (see Fernandes 2021). The consequences of this are evident in Figure 1 below, which compares Australia's resource commodity exports to our manufacturing exports.

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



Source: DFAT (2021).

Australia ranks poorly in terms of economic complexity – a measure of how well a nation can mobilise knowledge and technology to produce high-value, innovative products for export. This is because Australian governments for decades have explicitly or implicitly embraced an economic strategy of ‘comparative advantage.’ In this theory, those industries which reflect some ‘natural endowment’, or attribute are favoured by policy, and hence lead the nation’s economic development and export orientation. By this simplistic view, Australia’s comparative advantage is clearly in resource extraction. Unfortunately, despite occasional periods of high prices in global commodities markets, the resulting reliance on extraction and export of non-renewable resources does not support long-term economic growth, stability, or, as Australia’s global standing demonstrates, economic complexity.

This failure is evident in a global ranking of economic complexity, carried out by The Growth Lab at Harvard University (2022). This ranking places Australia at 86th out of 133 countries surveyed: a surprisingly weak position for an advanced industrial economy.¹ Other major industrial nations (to which Australian politicians often compare our own economy) rank mostly within the top 20 for economic complexity. In

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.

contrast to Australia, these more complex and competitive nations all pursue policies of ‘competitive advantage’, not comparative advantage. A strategy based on competitive advantage pro-actively favours industries that support greater and increasing economic returns in the long term. This includes manufacturing. 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 promotes innovation and networking through diverse sectors of the economy. Hence, a nation achieves not just economic growth, but also economic *development*. This explains why seizing sustainable industry opportunities in manufacturing represents Australia’s best hope for a prosperous future.

Looking Forward by Learning from Our Past

Australia’s manufacturing sector (including a strong automotive manufacturing base) was the driving force of Australia’s economy for most of the 20th century. The production of ICE vehicles, and ICE vehicle components manufactured by local Australian enterprises for overseas carmakers, supported skilled jobs for thousands of Australians. That ended when the last completed Holden rolled off the production line in 2017 at General Motors-Holden (GMH) in Elizabeth, South Australia. A report by the Allen Consulting Group (2013) showed that the automotive industry, supported with \$500 million in government funding each year, increased the size of the Australian economy by \$21.5 billion annually.

Because Australia stopped mass production of cars in 2017 and did not implement a coordinated response to a post-closure industrial transformation, we do not enter the global race for EV success from the strongest industrial position. Moreover, the COVID-19 pandemic further exposed the gaps in our supply chain, and highlighted a concerning dependence on imported manufactured equipment (needed to fight this unprecedented global health crisis).

Industrial path dependence as a strength

With the right policy settings and investment, automotive manufacturing can, once again, be restored at the centre of Australia’s economy. This would produce major benefits, even more so considering a key lesson of Australia’s industrial history: Australia’s manufacturing sector demonstrates a significant degree of ‘path dependence’. Generally, this means that *history matters*: past decisions about industrial development determine what a country, industry or business can practically invest in, now and into the future.

Investment flows down the path of least resistance: for example, if an OEM (Original Equipment Manufacturer) is assembling cars, many auto parts manufacturers will locate nearby to take advantage of logistical savings and other advantages. Assembly

and components manufacturers rely on each other for business, all benefiting from an integrated supply chain co-located in an expanding cluster of business activity. Industry policy that supports the healthy growth of such networks holds the potential to generate economic and social benefits that extend far beyond the industry itself.

The automotive supply chain is a key originator of technology, skills, and productivity. Innovation drives investments at multiple stages of car making; tax incentives further influence the pursuit of quality and efficiency. It is for such reasons that the closure of a whole industry can be so detrimental to a country's ability to make things: what flows through the economy can quickly disappear when key investments stop being made.

When a country no longer makes high-value goods, relatively well-paid jobs, investment, and skills all disappear. In many cases, jobs disappear permanently as skilled workers drop out of the workforce (via retirement, underemployment, or unemployment).² Sometimes, investors remove capital from deindustrialising regions in search of new, more profitable geographical locations (see Bluestone and Harrison 1982).

Path Dependence in Australia's Automotive Industry

What began in Australia as the final assembly of imported 'kits' from Europe and North America in the 1930s, later developed into a fully-fledged industry comprised of (at peak in the 1970s and 1980s) several global OEMs – including General Motors, Ford, Mitsubishi (Chrysler from 1964-1980), BMC (until 1976) and Toyota. All these assemblers depended on a critical supply chain of small and medium-sized enterprises (SMEs) producing components that fed into the automotive industry (which in turn depended on the OEMs for business). This comprised an Australian automotive manufacturing 'ecosystem,' and set the whole national manufacturing sector on a successful, automotive-inspired trajectory after the Second World War.

Beyond this, car making had a huge employment and social presence in many Australian communities – creating not only industrial path dependence, but a significant degree of social and cultural interdependence (see Peel 1995). Hence, the shuttering of automotive manufacturing resulted in the loss of many of Australia's manufacturing capabilities and the devastation of many communities dependent on the high-skill, high-wage jobs they provided. Some jobs and capabilities have been retained; but these are often niche elements that lack integration with other domestic industries. What remains of the automotive manufacturing sector must now be

² For a long-term study of the negative employment and social consequences of auto closures, see Beer and Thomas (2008).

strengthened and expanded so that the broader economy can respond to the growing global demand for electric vehicles.

Towards an EV-Manufacturing Future

This paper discusses the opportunities for visionary leadership in Australia to capture via an electric vehicle (EV) manufacturing policy. Such a policy would leverage the possibilities of renewable energy technologies in step with opportunities in traditional automotive manufacturing. We show that Australia could capture a valuable share of global EV manufacturing by planning and developing a domestic EV industry.

An EV industry policy that encourages a rapid shift from automotive manufacturing from ICEs to EVs should form a major pillar of an economy-wide strategy to rebuild Australia's industrial transformation around sustainable transport systems as part of our national response to climate change. In this sense, 'EVs' can refer to all vehicles that are powered by electric batteries or connected to power networks that include batteries in their energy mix – all of which are ultimately powered by renewable sources of energy. This report focuses on the fundamental role of automotive industries in rebuilding manufacturing in Australia while progressing towards these sustainability goals.

Transforming manufacturing production and transport systems in step with renewable energy presents a massive opportunity for innovation and industrial transformation. It can help to meet Australia's obligations to global climate change adaptation. An EV-driven transformation of manufacturing is essential for environmentally friendly industrial innovation. Without it, we risk becoming a dumping ground for the world's sub-standard ICE vehicles – and a country overlooked by companies seeking to market new EV technologies. An EV-led transformation would also link manufacturing to our innovative renewable energy industries. To bring these elements together, Australia requires a long-term plan for social and economic development. This can be delivered with a robust manufacturing industry policy.

Why Manufacturing Industry Policy Matters

As Treasurer during the 1980s, Paul Keating lamented that “in the 1970s ... [Australia] became a third world economy selling raw materials and food³ and we let the sophisticated industrial side fall apart.” Keating warned at the time that if the country did not deal with these fundamental problems, it was destined to become a ‘banana republic’ (Mizen 2020). Nevertheless, since the 1990s – and in earnest since 2013 – the

³ We can assume that by ‘food’, Keating was referring to raw agricultural exports; today, in contrast, Australia's manufactured food exports are a successful exception to the general trend of manufacturing contraction that has been experienced in other manufacturing sectors.

‘default’ economic and industry policy setting of government has favoured resource extraction as our national strength.

For several decades, Australia has relied disproportionately on mining resources, and positioned its extractive industries as the focus of economic policymaking. This strategy works against advanced manufacturing industries that generate higher export value and are more competitive and resilient over the longer term. Political decisions 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, Japan, and China. Renewed global interest in active industry policy demonstrates an understanding that manufacturing carries a unique strategic importance to economic growth and development.

Manufacturing underpins innovation and transformation in all advanced industrial nations. It is a knowledge- and technology-intensive activity central to the process of economic development; its activities form the foundations of more economically complex and competitive economies. This is evidenced throughout modern history and is detailed in studies that highlight the central role of manufacturing in all stages of the development of industrial nations (see Kaldor 1967; McCausland & Theodossiou 2012; Porter 1990; Wang 2009). According to Stanford (2020a), manufacturing is not just another sector; rather, it carries strategic importance:

- Manufacturing is the most innovation-intensive sector in the economy.
- Manufacturing anchors hundreds of thousands of other jobs throughout the economy, through its long and complex supply chains.
- Manufacturing offers relatively high-quality jobs and is more likely to provide full-time hours and above-average incomes.
- Manufactured goods account for most of international trade, and hence an undersized manufacturing sector will contribute to trade deficits and balance of payments problems.

The export of raw materials may yield high returns over temporary periods of strong commodity prices, but as a long-term economic strategy, extraction hollows out higher-value manufacturing industrial capabilities and places us on a pathway to eventual economic stagnation. Ultimately a successful nation must export complex, elaborately transformed manufactured goods to develop and retain high standards of living, skilled workforces, and productive economies.

Australia’s growing export orientation on raw commodities has been a boon for vested mining interests. But mining has contributed little to value-adding in other areas of the economy. Meanwhile, manufacturing has also suffered at times from an overvalued

Australian dollar, pushed up by the value of Australian mineral exports. This had deeply adverse effects for automotive manufacturing.⁴ The loss of complex manufacturing capabilities poses major challenges to the broader economy. The painful lessons of Australia's recent industrial history must be understood, and our knowledge of the strategic importance of manufacturing applied constructively in forward-looking policy.

EV Industry Policy as Global Climate Change Action

Automotive manufacturing faces opportunities to incorporate climate change responses into renewable energy-based industrial strategies. Furthermore, manufacturing can help to bolster efforts to not just rebuild, but transform, economies in the wake of the COVID-19 pandemic. Many nations are already pursuing these transformations, and auto manufacturing is at the forefront (given the accelerating global transition from ICEs to EVs).

In 2021, the global community recommitted to strong efforts to address carbon emissions reduction, including via the renewables-driven transformation of industry. At COP26 in Glasgow in November, world leaders signed a global agreement to make EVs a 'new normal' by 2030, as part of its 'Breakthrough Agenda' to accelerate the uptake of clean technologies and limit global temperature rise to 1.5°C (Climate Champions 2021). This agreement was preceded by earlier efforts in many countries to develop EV industry policy in partnership with global OEMs. In May 2021, the Biden Administration agreed with US automakers to a US\$174 billion plan to build EVs in the United States.

Industrial shifts to EV production are supported by broad public awareness of the necessity of sustainable transportation technologies in the fight against climate change. The public understands that a shift to renewable energy sources for vehicles is a significant part of addressing climate change concerns, and global consumer support for an EV-driven industrial transformation is strong. A 2019 survey conducted by the Union of Concerned Scientists and Consumer Reports (2019) found that 63% of Americans are interested in EVs, and 31% would consider an EV as their next car purchase. The survey found that interest in buying an EV was not limited to wealthy consumers, with nearly one-third of people having an annual income of \$50,000 or less also considering an EV purchase. A total of 75% of prospective EV buyers believed incentives and tax rebates should be available to EV consumers, and more than 60% of

⁴ Previous automotive assemblers closed their Australian operations when the Australian dollar was inflated (by sky-high global commodity prices) as much as 75% above its purchasing power parity.

survey respondents wanted state-based policies to support investment in EV charging infrastructure as well as electrifying various forms of public transit.

In Europe, the United Kingdom has overtaken France as the region's second-largest EV market after Germany. In part, this is due to new emissions rules that make auto manufacturers responsible for carbon reductions (Jolly 2021). Germany is a world-leading producer of EVs. For example, the German company Volkswagen (VW), the world's second largest automotive OEM, has announced a full phase-out of ICE vehicle production by 2040.

The International Energy Agency's *Global Electric Vehicle Outlook* (IEA 2021a) found that the COVID-19 pandemic did not interrupt the world's growing embrace of EVs. At the end of 2020, there were 10 million EVs on the road; EV registrations increased by 41% that year, despite a pandemic-induced decrease in overall car sales of 16%. In 2020, three million EVs were sold, and the IEA expects further rapid increases in the sale and registration of EVs in the years to come. This growth is reinforced by supportive policies from most governments – including regulatory frameworks and incentives that support an expanding range of EV models, and ongoing reductions in battery costs (IEA 2021b, p. 6). But the IEA further recommended policies to leverage this momentum to accelerate EV-driven transformation, and not only of passenger vehicles. It also proposed incentives to accelerate the use of EVs for medium- and heavy-duty use as well, and that EV policies deepen the focus on transformation as a climate change mitigation strategy. These moves will all contribute to further reductions in costs associated with the production and purchase of EVs.

Nations in Europe, North America, Asia, and Oceania are already capitalising on the contribution of EVs to achieving emissions reductions targets. Many of these nations are also developing strategies for their automotive industries to benefit from growing consumer interest in EVs. Announcements from 18 of 20 of the largest OEMs regarding plans to increase the availability of models and boost production for the EV-driven future of automotive manufacturing (IEA 2021, p. 26) signal vast transformations to production are on the horizon. These transformations contain opportunities for Australia to play a major role – but only if our economic and industrial policies move quickly to seize them.

The Australian Perspective

Many nations with growing shares of EV ownership are also nations with strong automotive industries that are transforming toward EV production, responding to both environmental pressures and consumer demand. A significant commitment to meeting Australia's climate change obligations can be achieved with a strategy for the development of an Australian EV industry, which would help to rebuild Australian

manufacturing and nurture domestic EV consumption. But what do we know about the Australian context?

Consumer sentiment

Evidence indicates that Australians (like consumers in other countries) expect a rapid shift to EVs and believe that our manufacturing industries should reflect this transition. A survey conducted in 2019 by The Australia Institute confirmed these sentiments:

- three in five Australians support a national program to switch to an electrically charged transport system;
- the geographically largest states (Western Australia, Queensland) had amongst the highest support; and
- just a small minority (16%) of respondents opposed a national program to switch to an electrically charged transport system.

Furthermore, there is growing support in Australia for EV sales. The same poll found half of Australians supported shifting *all* sales of new vehicles to EVs by 2025 (The Australia Institute 2019). Support for EV networks and sales also crosses political lines, with more Coalition and One Nation voters supporting EVs than opposing them.

In 2020, the Electric Vehicles Council (2020) reported findings of a survey of nearly 3,000 Australians, with 56% indicating they would consider purchasing an EV as their next car. Among reasons why, participants cited environmental concerns, running costs and relative performance as reasons for considering buying an EV. Respondents were concerned about charging equipment accessibility and driving range uncertainty, but 80% underestimated the range of EVs and the availability of charging access. Additionally, respondents' concerns do not necessarily match the degree to which EV charging infrastructure has developed around Australia, nor the plans of several business ventures in renewable energy industries to invest in the expansion of charging infrastructure across both urban and regional settings. An example is Chargefox's plan to expand its EV charging network to 5,000 plug-in chargers across Australia by 2025.

'Electrify Everything'

Late in 2021, the Australia Institute's annual *Climate of the Nation* report (Quicke 2021c) explored attitudes of Australians to EVs and EV policies. The results were unequivocal: Australians believe the country should 'electrify everything'. The report found that more than two-thirds of Australians (68%) think the federal government should be doing more to increase EV uptake in Australia. Support is found across the political spectrum. Nearly three-quarters of Australians believe that reducing CO₂

emissions from vehicles is an effective way to address climate change – including switching from passenger ICE vehicles to EVs and electrifying public transport.

Climate of the Nation also found enormous support for specific policy solutions to drive EV uptake that have been proven overseas. The greatest support was for Australia to increase domestic manufacturing of EVs and EV components, with 75% indicating they would support such a policy. Beyond fostering domestic EV manufacturing, a fast-charging network for recharging EVs also attracted broad support (74%), as did the full electrification of state bus fleets by 2030 (74%).

In sum, Australians strongly support policy to kickstart a domestic EV manufacturing industry, as well as the infrastructure that will help consumers integrate EVs into their lifestyles. When asked if they would buy an EV as their next vehicle purchase, more than two-thirds (69%) responded that they would – including 27% who would purchase outright, and 42% who would do so with financial incentives.

Market conditions

The encouraging enthusiasm among Australians for an EV-driven transition in transport and manufacturing is not yet reflected in the availability of EVs in the Australian market. Only 16 EV models are currently available.⁵ And with the price of the cheapest model – the MG ZS EV – starting at approximately \$44,000, most remain out of reach for many Australians. The limited availability of EVs in the Australian market is further highlighted by comparison with the US market (where 56 different EV models are available), and the European market (which is set to offer 214 different models by the end of 2021; Transport & Environment 2019). There are hints that more EV models will arrive in Australia in 2022, including more affordable offerings. However, most expected market entrants remain positioned in the higher end of the market (see White 2021).

There are some attempts underway to improve market competition for EVs in Australia. For example, the Australian renewable technology investment company, TrueGreen, has declared its intention to bring three EV models priced below \$35,000 to the Australian market from the second half of 2021. TrueGreen has called on global OEMs to meet frustrated consumer demand by supplying low-cost models, instead of waiting for more favourable government incentives (Vorrath 2021a). But a market-oriented approach to levelling the EV consumer playing field in Australia represents only a partial, supply-side response to a far more systemic problem: namely, the lack of industrial EV structure in Australia to support domestic investments in employment,

⁵ Of the 16 EV models available in the Australian market, six are priced at over \$100,000 and one costs over \$200,000. The other ten models range between \$44,000 and \$85,500.

technology, and knowledge development through demand-driven policies. Market-based responses are no substitute for an EV industry policy committed to a transformative approach to Australia's manufacturing industries, given the flow-on benefits this represents to the economy, society, and the environment.

Australia's Policy Challenges

Despite growing support for a larger role for Australia in EV manufacturing, and increasing consumer demand for EVs, the further development of the industry is held back by an Australian policy context lacking federal leadership and consistency. Prior to the 2019 federal election, there was bipartisan support for a rapid transition to EVs. Federal Treasurer Josh Frydenberg even cited the advanced EV policy responses of Norway – the world leader in EV uptake – as demonstrating how government policy could achieve a transformation of our transport system. However, the Coalition's EV policy outlook quickly pivoted in the lead-up to the 2019 election, with its now infamous (and laughable) claims that EVs would 'destroy the weekend'.⁶

The federal government's laggard EV policy is consistent with the weakness in its broader climate change position. At COP26 in Glasgow, the Australian government's climate commitments were the weakest of any advanced industrial country (Dewan, Westcott & Whiteman 2021). Even the Australian government's ratification of the Breakthrough Agenda on EVs was largely symbolic. The \$250 million EV strategy it released to coincide with the summit offered no new tax incentives for EV uptake amongst consumers, no new emissions standards for ICEs, and only minimum funding support to expand charging stations. There is a growing distance between Australia's lagging response to climate change, and that of most other nations powering ahead.

Coalition claims that EVs are not well-suited to Australian applications have been discredited by continuing improvements in their capacity and range. For example, the global automotive industry's embrace of EVs of all sorts includes electric utes, which are even more powerful than ICE utes – with the first potentially reaching Australian markets in 2023 (Schmidt 2021). Not only that, production of Australia's most popular ute – the Ford F-150 – has doubled from a target of 40,000 units in 2022 to 80,000, given extraordinary demand for the electric version. Annual production of a second-generation EV F-150 in 2025 is estimated at 160,000 units (Hill 2021a). Similarly, mining and agricultural industries are amongst the first industrial adopters of EVs (see Hill 2021b; Schmidt 2020).

Other parties have proposed more ambitious measures to expand EV use in Australia. Labor has proposed cutting the import tariff on EVs worth below \$77,765, as well as

⁶ See Remeikis (2019) and Quicke (2021b).

exempting them from fringe benefits tax (Murphy 2021). It supports an electric vehicles discount to make EVs cheaper for families, and to reduce emissions. Labor also seeks to stimulate government and private EV fleet growth through tax rebates, with regulatory reforms targeted at coordinating national and state EV infrastructure planning (Labor 2021).

The Greens have called for a 100% phase-in of EVs by 2030 and have outlined steps toward developing an EV industry in Australia. The Greens also propose strict emissions reduction targets, to stimulate use of more fuel-efficient and lower-emission ICE vehicles. This would help incentivise manufacturers to deliver their highest standard ICE vehicles to Australian markets, as well as competitively priced EVs. The Greens have also proposed withholding federal funding to states that introduce disincentives to the use of EVs (such as road-user charges) (The Greens 2019).

There is thus a diversity of approaches to EV policy currently enunciated by Australian political parties. The accelerating global transition to EVs, however, and growing consumer acceptance and excitement about the potential of these vehicles, will increase the pressure on all parties to adopt more favourable and ambitious plans: both to stimulate greater use of EVs by Australian consumers, and to nurture the development of EV manufacturing here, as well.

Picking Losers

The 2021-22 federal budget (Commonwealth of Australia 2021) contained no support for EV industry development in Australia. Instead, the Coalition government announced a plan for a ‘gas-fired recovery’, recommitting to a fossil-fuel intensive energy policy. This positions Australia poorly as the world adapts to a renewable future. Research by the Australia Institute showed a 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). Had 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. A gas-fired recovery makes little sense from an economic and employment perspective, even before considering its potentially damaging ecological implications (Swann 2020). Other measures in the budget included \$2.3 billion in subsidies to Australian petroleum refineries, supposedly to ensure domestic fuel security. But promoting EVs would be a far more effective approach to improving energy security than more subsidies for fossil fuel industries, and would aid the transition to clean, renewable sources of energy (see Saddler 2021).

The result of lagging fuel quality standards in Australia is that the “dirty, cheap fuel” manufactured here ranks among the worst produced anywhere in the OECD

(Kurmelovs, 2019). This makes Australia ineligible to receive and use many newer and more fuel-efficient ICE models, which cannot run on low-quality Australian petrol. It further makes us vulnerable to the ‘dumping’ of lower-standard vehicles from other countries, where overseas markets with stricter emissions regulations ban their sale (Kurmelovs, 2019). A similar problem arises from Australia’s refusal to implement fuel efficiency standards for ICE vehicles. As Quicke notes, “Fuel efficiency standards are key policy levers for driving EV uptake and increasing EV model availability” (Quicke, 2021a, p.9).

In Europe, in contrast, stronger emissions standards on ICE vehicles have contributed to the EV market share more than tripling in 12 months from 2019 to 2020 (Quicke, 2021a). The largest decrease in CO₂ emissions from new vehicles (since data has been available) also occurred over this period. At the federal level, the implementation of strong fuel efficiency standards must be amongst the first elements of a strategy to phase out ICEs, as domestic use (and hopefully production) of EVs expands. Without strict minimum fuel efficiency and emissions standards, Australians will be stuck buying lower quality ICE vehicles, further discouraging the marketing of newer model EVs.

The Senate Select Committee on Electric Vehicles (Commonwealth of Australia 2019) recommended a national EV strategy to facilitate and accelerate EV uptake. It indicated this required effective national-level standards and regulatory measures. The Select Committee recommended a 10-year EV manufacturing roadmap, along with a range of other initiatives. Within a long-term strategy, these initiatives would coordinate national and state government collaboration, infrastructure planning with industry stakeholders, and support for developing apprenticeships and traineeships for EV industry workers.

The Committee’s recommendations further emphasised the need to develop Australia’s position in the global value chain of EV manufacturing. Australia needs to shift upwards from the export of raw materials that are used in manufacturing of EV components (such as lithium for batteries) to value-adding processes within Australia that produce, use, and export complex EV components. Ultimately, we should also strive to rebuild a final EV assembly capacity. Building higher-value vehicle supply chains in Australia will also require industry assistance programs to stimulate EV components production, a broader industrial transformation plan to redeploy remaining automotive manufacturing assets and develop new ones, and workforce training to ensure Australians have the skills needed to build EVs and EV components.

The Committee stated, scathingly, that it “received no evidence of a clear, coherent and comprehensive federal government policy position supporting the development of

an EV industry.” It further claimed that it was not clear whether any of the automotive transitional funds introduced in the wake of the OEM shutdowns – including the Automotive Transition Scheme (ATS), Growth Fund (for Victoria and South Australia), and the Advanced Manufacturing Growth Fund – contained any strategic coordinating elements that would resemble an industry plan.

Australian state-level policy developments

Amidst setbacks at the federal level, the EV policy landscape at the local and state levels in Australia is fragmented, often *ad hoc*, and uncoordinated. Some state policies are oriented towards nurturing a local EV consumer market, and target potential opportunities to create local industries,⁷ new markets, and respond to climate change demands. But other states have been less cooperative, due in part to a lack of consistent policy signals from the federal government. Without federal industry policy leadership, investment in an EV-driven future presents risks to businesses and consumers alike, and the states cannot fill that policy void on their own.

Actions taken by state governments prove that policy support can nurture EV industries and markets in Australia. But they also show that, absent a federal industry policy vision for EV development, a state-level policy patchwork will lack coordination and consistency. This situation risks creating conflict and confusion between states still attempting to develop EV policies. It also has flow-on effects for consumer sentiment and business confidence.

The implications of this patchwork, in the context of a federal policy vacuum, are already becoming clear. Some states have EV policies to leverage consumer demand and encourage uptake of renewable technologies more broadly (including public transport and purchases of EVs for fleets). States developing EV policies to offset expected losses in petrol tax revenue from the shift to EVs risk discouraging consumer uptake before EV consumption reaches a threshold that triggers economies of scale in charging networks and other service infrastructure. A lack of federal-level regulation permits a spectrum of EV policy responses at the state level that do not create a stable, predictable ground for a consolidated market and broadened scope for industrial developments.

Industry Policy: A Political Choice

The key takeaway from this overview of the Australian EV policy landscape is that industry policy is ultimately a political choice. Other jurisdictions including the United States, Japan and the European Union use active industry policy to develop a more

⁷ In some Australian states, particularly Victoria, EV manufacturing of commercial vehicles including buses and other commercial vehicles exists, thanks largely to efforts to tie these activities to subsidies and public procurement policies.

complex and innovative economy. Their recent announcements to embrace an EV industry future make clear that it is feasible to plan economic trajectories. Even if these nations celebrate the virtue of ‘free markets’ in political rhetoric, they intervene regularly and powerfully to create, shape, and direct the development of markets and industries (see Mazzucato, 2015, 2019).

In fact, industry policy *must* be political. Strategic support for a particular industry or sector is indicative of the industrial path-dependence options that shape a nation’s future. Setting directions is something governments should do on behalf of a nation’s citizens, and for objectives that benefit society. The EV policy responses of most other advanced industrial nations highlight a political commitment to addressing the threats climate change poses to economies and societies, as well as determination to seize the industrial opportunities opened by those changes. They subsequently resolve to harness industrial advantages while progressing goals of social and economic sustainability.

The Australian government likewise understands the political nature of industry policy, but it is expressed in different forms, and in pursuit of different goals. Its policies such as support for a gas-fired recovery, subsidies for fuel refineries, and continuing fiscal supports for fossil fuel extraction and export all reflect a willingness to engage in active industrial policy – but not in a direction that is consistent with the global energy transformation. The Coalition government often claims that governments cannot ‘pick winners’. But in its political decision to subsidise industries that contribute to climate change, the government is in fact ‘picking losers’: motivated by immediate political aims, but at the expense of a sustainable social, economic and ecological future. Analysing PM Morrison’s pitch to the world at COP26 on Australia’s climate commitments, Grattan (2021) aptly summarised the willingness of the government to adopt interventions to favour certain sectors over others, despite its purported faith in market forces to make these decisions:

While expounding “can do capitalism”, the government is in fact pursuing an interventionist approach by putting all its eggs in the technology-support basket and not enough in the market-creation one (Grattan 2021).

Industry policy that commits an economy to positive climate-sensitive innovations represents an opportunity for a nation to signal its openness to new investment and its willingness to drive market-creation. Hence, it can also demonstrate a nation’s willingness to embrace change and opportunities arising from the emerging global EV industry. As argued above, what is most essential is policy leadership from government, and the political will to make bold and future-focused choices. Australia

can do this by identifying, as a major strength, its unique position as a nation that, despite not currently mass-producing cars, still possesses much of the infrastructure, capital and knowledge required to do so. With political choices that deliver strategic industry policy responses, Australia can participate in global supply and value chains in ways that revitalise the world-class capabilities of our manufacturing sector.

Transforming Australia's EV Manufacturing Policy Landscape

A strategic Australian EV industry policy would build positively on existing industrial capabilities, contribute to innovation in burgeoning renewable energy ventures, and prepare our skilled workforce for a sustainable future of work. Australia can choose to pursue a renewed industrial future via an EV industry. This has environmentally and socially transformative potential. Australia's participation in the rapidly expanding global EV industry depends on a spectrum of policy choices. This spectrum includes strategies that are limited, and those that are potentially expansive in character, including:

- 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 in Australia, maintaining and repairing them, and exporting them to global markets after value-adding production processes in domestic Australian industries.

The third option is optimal. Not only would the manufacture and assembly of EVs and EV components in Australia maximise job creation, but it would also create the broadest base for spin-off manufacturing and services industries, technological innovation processes, extensive export opportunities and a deepened knowledge and skills base in the Australian labour market. But to make it happen, the federal government must commit to an EV industry policy that is both active and interventionist. This in turn requires a break with the supposedly market-focused orientation of Australia's recent industry policy prescriptions.⁸ Hence, the remainder of this report elaborates on four major Building Blocks that must characterise an EV industry policy that can achieve this breakthrough in Australia. They include:

⁸ In practice, as discussed above, many federal economic policies are not market-driven at all, but clearly mobilise public resources and regulatory influence in favour of specific selected sectors (including fossil fuel producers).

- Building Block #1: the sustainable transformation of Australia's natural and primary resource industries, by enhancing their linkages to domestic manufacturing industries;
- Building Block #2: the development of supply chains and deployment of capital assets that enhance manufacturing firms' capacities and capabilities;
- Building Block #3: the development of skilled labour through our vocational education and training system, to support jobs growth in EV and other renewable industries; and
- Building Block #4: the strategic mobilisation of government's policymaking capacity to coordinate, incentivise and create the conditions for a thriving EV manufacturing industry; and the role of other key social and democratic institutions in shaping EV and other sustainable industry growth.

The Building Blocks of an Australian EV Manufacturing Industry Policy

This section catalogues four critical ‘Building Blocks’ for a future Australian EV manufacturing industry. Together, they create a promising foundation for an EV-led industrial transformation that would contribute significantly to a socially inclusive and environmentally mindful future for Australia.

BUILDING BLOCK #1: TRANSFORMING AUSTRALIA’S RESOURCE INDUSTRIES

A strategic approach to Australia’s EV manufacturing future begins with transforming our 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 – which embody these same resource commodities after undergoing value-adding processes.

For decades, Australia’s manufacturing sector played a primary role in driving the nation’s high standard of living. But more recently, the export of unprocessed or barely processed resource commodities has overshadowed manufacturing. Data compiled by the Department of Foreign Affairs and Trade (DFAT 2021) and summarised in Table 1 below shows that Australia’s major exports in 2019-20 consisted mostly of minerals and fuels exports, with services placing second. Manufactured goods and rural exports (mostly food) lagged far behind.

Table 1 Australian Total Exports by Sector¹ 2019-20 (\$b)	
Sector	Value (\$bn)
Minerals & fuels	245.8
Services	92.3
Manufactures	52.3
Rural	46.7
<i>¹on a balance of payments basis Source: DFAT (2021)</i>	

No manufactured product features among Australia’s top 20 exported products. Instead, a range of minerals & fuels exports and some services comprise this mix (see DFAT 2021). Australia needs to reconsider its over-reliance on commodities exports and develop a strategic plan to shift towards value-adding industries that will help to restore the nation’s economic complexity. This will entail driving the share of manufactured goods to a higher (and hopefully the highest) position on the export table. Achieving a much larger share of manufactured goods among Australia’s top exports will also support the success of high-value services industries in this mix. Services frequently accompany manufacturing industries, and the ‘servitisation’⁹ of Australian manufacturing will increase Australia’s GDP and economic complexity overall.

Mineral opportunities for EV industries

Australian exports of commodities including lithium, cobalt and rare earth elements have been identified by the Department of Industry, Science, Energy and Resources in its Critical Minerals Strategy (DIISER 2019) as having significant relevance to EV industries. Lithium is a critical mineral for use in rechargeable batteries. Australia exported 217,000 tonnes of spodumene (crushed raw lithium) in 2020-21 for an export revenue value of \$1.1 billion (DIISER 2021). 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” (DIISER 2019, p. 12). Currently, Australia lags far behind the world’s largest cobalt exporter, the Democratic Republic of the Congo (DRC), despite holding the second

⁹ Servitisation refers to the packaging of services with manufactured products in a joint offering to the consumer. Examples include scheduled maintenance, customer support and feedback, leasing arrangements and other forms of supplier-consumer interactions that deepen business ‘relationships’ before, during and after initial sales.

largest proven reserves of cobalt (after the DRC). The *Australia's Identified Mineral Resources 2020* publication (Geoscience Australia 2020) highlighted the significant difference in export value between raw minerals and concentrates and processed mineral commodities, the latter attracting far greater value thanks to downstream processes (including refining and smelting).

The export value differences between the ore/concentrate and refined export forms of these critical minerals are summarised in Table 2 below. Downstream processes add significant value to mineral exports. The refining opportunities for all minerals are significant, but especially clear in the case of spodumene refining. Spodumene can be refined in various ways: lithium hydroxide is the more valuable refined product. Although Australia's production of spodumene yielded \$1.1 billion in 2017, the Future Battery Industries 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, p. 7). This missed value-adding opportunity is illustrated in Table 2 below, where Australia's export volume of lithium hydroxide in 2020-21 was miniscule compared to its export of lithium ore – yet the small quantities which were exported generated revenue per kiloton (kt) more than 200 times higher than exports of unrefined spodumene. In copper and nickel, as well, unit revenues received for refined products are many times higher than for unprocessed ores and concentrates.

Table 2 Australian Export Volumes and Values of Select Critical Mineral Commodities (2020-21)		
Mineral/Metal	Export Volume (kt)	Value (\$bn)
Spodumene (lithium ore)	217	1.1
Lithium hydroxide (refined lithium)	0.07	0.084
Copper Ore & Concentrates	1,895	6.26
Copper Refined	407	3.83
Nickel Ore & Concentrates	258	0.44
Nickel Refined	241	3.67
<i>Source: DIISER (2021); Geoscience Australia (2020); World Bank (2021)</i>		

Maximising the value of critical minerals exports

Australian minerals could make a far greater contribution to the economy through the development of an EV manufacturing industry, rather than being exported raw or even

in processed forms. Not only more refining, but additional transformation into elaborately manufactured products, could be undertaken through downstream value-adding processes. Further value-added processing and transformation of raw materials in Australia would not just increase the value of our exports by an order of magnitude, but it could also anchor further transformations of raw commodity exports into strategic manufactured components.

Among commodities exports, aluminium ores & concentrates (garnering \$8.8 billion worth of exports in 2019-20) and precious metal ores & concentrates (\$1.8 billion in 2019-20) (DFAT 2021) hold significant potential for application to EV industries (i.e., the production of green aluminium for EV bodies).¹⁰ If Australia took advantage of its abundant renewable energy reserves, it could leverage existing mining projects into the domestic manufacture of a host of products relating to EV industries.

Lithium-Ion Battery Opportunities

Australia is the world's largest producer of lithium by a significant margin (United States Geological Survey 2020). In 2019, Australia produced 42,000 tons, compared to second-placed Chile with 18,000 tonnes. As shown in Table 2 above, these exports presently undergo limited domestic value-adding; our exports consist mostly of unrefined spodumene.

Yet Australia possesses significant capability to add value to our lithium production, including via manufacturing of 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. There are far greater value-adding and employment opportunities to 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 Gross Domestic Product (GDP) and more jobs in value-adding in Australia if policy is made to position our economy to capture these opportunities.

¹⁰ See Stanford (2016) for a detailed analysis of the potential to add value to aluminium through more smelting and secondary manufacturing in Australia.

Many high-skilled manufacturing jobs can be created through the development of secondary processes in the EV value chain that would add considerable complexity to Australia's economy. Building Block #3 below examines opportunities for skilled workers in further detail. Where Australia presently exports its lithium as a largely unprocessed commodity, this will not lead to long-term economic development and manufacturing growth, nor to the higher-paid, higher-skilled jobs and advanced industrial base founded on sustainable energy transformations. Taking the value-adding approach ultimately builds potential for Australia to become an exporter of EV batteries to the major EV auto manufacturers of the world.

Challenges and Limitations

There are currently major challenges to policy movement on downstream value-adding to resource extraction in Australia. A lack of government support for linking mining operations with supply chain processes stymies interest in domestic manufacturing of batteries and related technologies. This encourages circumstances where, during periods of mining downturn that inevitably follow boom periods, many mining interests sell their leases to overseas investors, but without ensuring that locally established secondary processes are developed in Australia. Political leadership must address this negative feedback loop if Australia is to become a lithium-ion battery exporter. Only by strengthening and regulating the link between activities in the extraction of commodities and adding value to them through manufacturing can Australia capture a more lucrative share of global EV industries.

Industry policy will need to incentivise mining companies and interests to increase their R&D expenditure in ways that commit them to domestic value-adding processes. Beyond any direct incentives, this can be achieved with developed Australian supply chain capabilities. This will maximise the flow of raw inputs to domestic industrial production instead of to overseas buyers that will produce the batteries that we don't. Mining companies will continue to simply export their raw commodities if Australia does not develop manufacturing activities that demand refined, processed lithium.

Economic growth, or economic development?

Continuing to export raw minerals benefits mining interests through predictable short-term bursts of revenue. But it achieves little for Australia's long-term industrial planning and transformation. Australia's mining industry currently generates enormous revenues and has contributed to recent growth in Australia's GDP. Yet the amount of that GDP ultimately received by Australian workers and communities is undermined by the capital intensity and high profit share of mining industries, the high degree of foreign ownership of the industry, and recent reductions in compensation for mining workers. A better outcome for Australians can be obtained from developing value-added lithium manufacturing. Australia can create supply chain links between

primary and manufacturing sectors, which will not only make a larger contribution to GDP but will also encourage capabilities that underpin future economic development. An ambitious, integrated, and powerful EV industry policy can help to forge these links. This is critical to ensuring Australia becomes a major hub for processing, manufacturing, and trading complex EV components for the global EV market.

Leveraging our extractive industries as a key pillar of a future EV industry means safeguarding our future economic development from vested interests in the resource sector. In some cases, public ownership of the extractive industries essential to building an EV manufacturing industry in Australia can also be considered (the potential role of public ownership is discussed later in this paper).

Sustainable value chains

Transforming extractive industries means also ensuring the environmentally and socially sustainable sourcing and extraction of lithium required for EV battery manufacture. A reduction of the actual content of critical metals in batteries – including less lithium content – and the efficient reuse of batteries at their end-of-life stage, must be embedded in integrated policy responses. Presently, the lower costs of mining relative to recycling and refurbishing encourages more extraction over recycling; however, innovative R&D initiatives are seeking to overcome these challenges (Castelvecchi 2021).

The current state of EV battery manufacture and reuse indicates the growing potential for embedding ‘circular economy’ principles in the EV battery supply chain. The traditional economic model is linear: taking raw inputs and transforming them into manufactured products with a set shelf-life, which end in disposal as waste. In contrast, a circular economy seeks to keep products, equipment, and infrastructure in use for the longest possible time. This improves productivity and ultimately transitions materials to better alternatives than waste disposal – like reuse, repair, remanufacturing and recycling (Invernizzi et al. 2020).

A circular economy can advance goals of sustainability and resource security. These principles are already beginning to influence policy developments in renewable energy, including EVs. The European Union (EU) has recognised the unsustainable production principles underpinning the extraction of most of the mineral inputs used in the production of renewable technologies. To address this issue, it has introduced new plans to increase the EU’s resilience in critical minerals, such as by improving transparency in supply chains, identifying options for reuse and recycling, and increasing efficiency, together with aims to source more minerals from within its own borders.

The EU approach to building sustainability and security into its supply chains is designed to work in step with other goals of its 'European Green New Deal' and 'Just Transition Fund' policies (Thorpe 2020). Altogether, the EU aims to integrate sourcing and recycling of critical minerals for EV batteries with policies to promote European manufacturing of EVs, batteries, and other renewable energy equipment. European industries are being assisted to shift into sustainable industrial innovations, whilst ensuring that workers and their communities benefit from industry adjustments geared towards decarbonisation. Australia could advance its own EV industrial aims with ambitious circular economy principles that contribute to our renewable and zero-emissions targets.

The circular economy and resource security

Australia's government should consider a strategy to encourage domestic EV industry development framed by sustainability and resource security objectives. The CSIRO's *Australian National Outlook* (2019) recommended the government's establishment of a long-term plan for local battery recycling, and this goal will need to be built into an EV industry policy. Several Australian companies are already exploring commercial battery lifecycle opportunities. For example, as *The Driven reports* (Vorrath 2021b) Envirostream, a commercial battery recycling venture, has since 2018 diverted 240,000 kilograms of battery materials that would have gone to landfill or shipped to China for processing. Lithium Australia is attempting to develop technology to repurpose end-of-life EV batteries for storage purposes (Vorrath 2021b).

These examples demonstrate the opportunities for manufacturing supply chains to branch into a range of circular value chain opportunities. EV battery manufacturing can put Australian-mined minerals into Australian-made batteries. These batteries can then be recycled at end-of-life – broken down for reconstitution into batteries or repurposed as storage for home solar energy or commercial energy storage applications. In these and other ways, the EV industry could become the centrepiece of a complex web of supply and value chains, spurring collaborative R&D initiatives, diverse market demand and reduced costs to consumers.

These and other developments can promote new and innovative ways to address Australia's climate change obligations. ClimateWorks Australia's report, *Decarbonisation Futures* (2020), modelled a transport scenario that would see 7.6 million petrol and diesel cars reach end-of-life as the market share of EVs grows to 2030. But, echoing a concerning theme, it showed that Australia remains the only developed nation without a policy for the disposal of ICEs in an environmentally and sustainable way (Stock 2021).

Building a recycling supply chain on ethical principles and circular economy practices remains a major hurdle in the scaling up of battery recycling in Australia. A wide-ranging federal industry policy is needed to incentivise investment and infrastructure in these developments. Policy must coordinate the actions of extraction industries and manufacturing industries in an integrated and sustainable EV-driven future economy.

BUILDING BLOCK #2: MOBILISING CAPITAL AND DEVELOPING SUPPLY CHAINS

Major capital investments are required to achieve an EV-driven transformation of manufacturing in Australia. 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 policy responses encouraging EV uptake by consumers, and growth in the manufacture of EVs (Dunstan et al. 2011). The policies analysed generally focused on mandates for the manufacture and consumption of EVs, adopting targets for safety and technical innovation, emissions reduction regulations that encourage more efficient, less-polluting EVs,¹¹ and incentivising manufacturers, including OEMs, to invest in EV technology R&D.

Mobilising Capital

Capital released from fossil fuel industries can be redirected to investments in renewable technologies and industries that accelerate the Australian economy's decarbonisation. Other nations are taking rapid action to shift their economies to renewable-powered sources and Australia must do the same. In the *Australian Financial Review*, Chair of the Australian Renewable Energy Agency (ARENA), Martijn Wilder has argued that Australia must "think differently":

Australian companies, investors and our superannuation funds should invest in the development of ideas that can lead to long-term nation building or breakthroughs in the transition to net zero emissions (Wilder 2021).

To build investor confidence, the federal government must lead a sustained decarbonisation push, identifying opportunities like EV industry developments linked to renewable energy. Public ownership of assets, infrastructure, and public oversight

¹¹ 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 investment decisions to build a decarbonised economy are critical to establishing the public’s stake in transformation. Potential private investments can be incentivised by government. By partnering with business, companies, and investment groups, government can coordinate the establishment of industries and secure supply chain developments.

SMEs and Supply Chain Development

Stronger innovative capability must be nurtured amongst the Small and Medium-sized Enterprises (SMEs) that make up the bulk of Australia’s manufacturing sector. For decades, these firms utilised the skilled and knowledgeable labour that served the operation of manufacturing in Australia. Key large or ‘anchor’ firms provided the initial spur to production and employment growth through their domestic investments; this was especially clear when major global automotive OEMs were operating in Australia. More recently, however, many of the core capabilities of vehicle manufacturing have departed Australia. That leaves the broader manufacturing sector even more dependent on SMEs for its continued activity. As Stanford (2020a, p. 57) has shown, although 86,000 businesses were registered as operating in the manufacturing sector as of June 2019, most of these businesses were very small. Furthermore, only 500 companies in total had over 200 employees (see Table 3 below). The number of manufacturing SMEs was also modest and had declined over the previous dozen years. The OECD (2021) has also highlighted the ‘missing middle’ of medium-sized enterprises in Australia’s economy. This translates to a lack of resilience in both Australia’s intra-national and international business linkages. It renders the economy more deeply exposed to global supply chain disruptions, as experienced throughout the COVID-19 pandemic.

Table 3					
Count of Manufacturing Businesses by Size					
No. employees	0	1-19	20-199	200+	Total firms
2019	38,430	40,998	6,513	487	86,428
Share Total	44.5%	47.4%	7.5%	0.6%	100.0%
2007	41,182	44,177	10,191	756	96,306
Change, 2007-2019	-6.7%	-7.2%	-36.1%	-35.6%	-10.3%

Source: Stanford (2020a).

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 of industrial scale required to support robust innovation and supply chain expansion. It can also be inferred from the above

data that in recent decades, collaborative projects that once connected SMEs in supply chains became fragmented. Historically, such firms would ‘cluster’ together geographically, benefiting from the economies of scale and knowledge-sharing achieved by proximity to each other, as well as 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 located 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 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, as Table 4 below indicates. The obvious and expected decline in employment, wages and salaries and sales and service income between 2015-16 and 2019-20 tells only part of the industry’s story. Following automotive industry closure, industry value-added declined only modestly, and in fact stabilised at a higher level than immediately prior to the last industry closures.

Table 4					
Motor Vehicle and Motor Vehicle Part Manufacturing Australia 2015-16 – 2019-20 (\$millions)					
Indicator	2015-16	2016-17	2017-18	2018-19	2019-20
Employment (at end June)	39,721	39,037	37,537	36,080	34,258
Wages and salaries	2,528	2,811	2,754	2,264	2,274
Sales and service income	18,031	17,462	16,067	15,363	14,753
Industry value-added	3,765	3,684	4,029	3,897	3,956
<i>Source: DIIS (2020). Manufacturing sub-sector (231)</i>					

These data indicate that the oft-declared death of automotive manufacturing in Australia after 2017 was premature. The automotive manufacturing industry still maintains an important level of activity in Australia, including contributions to innovation, productivity, and exports. A future EV manufacturing industry could build on the enormous potential that remains in 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 domestic EV bus, truck, and other heavy vehicle manufacturers). On the strength of this surprisingly resilient automotive manufacturing supply chain, Australia possesses a strong industrial foundation on which to integrate manufacturing with EV and renewable technology industries.

Recent reports from the Centre for Future Work have elaborated on Australia's opportunities to benefit from the combination of renewable energy and manufacturing transformations. Firstly, in *Powering Onwards*, Dan Nahum (2020, p. 51) has argued that Australia needs clarity and stability in energy policy. This, Nahum explains, is essential to coordinating a national response, underwriting state-level policies, and partnering with renewable energy firms and manufacturers. Secondly, Jim Stanford (2020b, pp. 54-55) has shown how the Australian renewable energy industry continues to expand despite uncertainty and inconsistency in energy policy. Moreover, conventional statistics on renewable energy job-creation opportunities in Australia typically understate the total employment in renewables: most projections do not count indirect renewables jobs across the economy, such as in electricity supply, construction, and of course, manufacturing.

The Geography of Sustainable Supply Chain Developments

Following the closure of Australia's automotive assembly operations, within years much of the associated major industrial infrastructure was shut down. But a surprising range of capital assets remained in place. For example, in a tour of the General Motors-Holden factory at Elizabeth, South Australia, journalist Royce Kurmelovs described the situation:

Across the complex, steel towers rise into the air, still able to lift a car body into the ceiling for transport elsewhere. Spare parts sit on old conveyer belts. An entire crane system is in perfect working order (Kurmelovs 2021).

Much capital infrastructure remains intact in the regions where it was initially utilised in vehicle assembly and parts manufacturing. Several regions – Elizabeth (Playford) and Salisbury in Adelaide's north; Lonsdale in Adelaide's south; Fisherman's Bend in Port Melbourne; Geelong to Melbourne's south; among others – are also regions of great potential for re-investment in new forms of manufacturing, including EV industries.

Elizabeth in South Australia and Geelong in Victoria are two of the most important of these regions. Newer clusters of vehicle production have also emerged in recent years, including in Dandenong, Victoria – where SEA Electric produces electric trucks. At

Edinburgh Parks, South Australia (adjacent to the former Holden factory), Precision Buses has begun testing electric buses for use in the local, national, and international markets.

Since 2010, the Tonsley Innovation Precinct in Adelaide's inner-southern suburbs has developed on the former Mitsubishi vehicle assembly plant. Its goal has been to link the remaining manufacturing strengths of the region with advanced technology SMEs in collaboration with new manufacturing and innovation ventures. Tonsley is a particularly pertinent example of how government support can nurture innovative clusters. This long-term policy support has helped steer the site to renewed growth. Similarly, policy can help build EV industry clusters around these former sites of automotive manufacturing, capturing long-developed regional knowledge, capabilities, and capital assets that all contribute to and sustain long-term development.

Given the potential of this remaining capital stock, offers were made by various industry consortia to take over automotive operations. One company has planned to develop a business park on the Elizabeth site of the former Holden assembly factory, for a range of manufacturing, construction, engineering, automotive and commercial uses (Dornin 2017). Later, Sanjeev Gupta (executive chair of British-based GFG Alliance) identified potential for the site for building EVs (Davies 2018). However, as of 2021, Elizabeth remained largely undeveloped for manufacturing purposes, demonstrating the pace with which industrial activity quickly diminishes after the closure of a major industrial player. It also illustrates the difficulties that characterise private sector-led attempts to market de-industrialised sites as investment opportunities without strategic government intervention and fiscal support.

All this makes clear the importance of developing industrial 'clusters' of economic activity. More than two decades ago, Michael Porter wrote in *Harvard Business Review* (1998) that "the enduring competitive advantages in a global economy lie increasingly in local things—knowledge, relationships, motivation—that distant rivals cannot match." More recently, evidence from around the world has shown that a region's competitive advantage emerges not just from co-locating firms in a specific cluster and expecting that market forces will deliver positive results. Instead, planning and strategising the interaction of various firms is necessary to coordinate multiple 'moving parts', including people, firms, industries and institutions (Asheim et al. 2011; Cooke & Leydesdorff 2006).

The local knowledge, skills and capabilities that developed in Australia's historic regions of car manufacturing likewise emerged from strategic policymaking that coordinated people, firms, industries, and institutions in vehicle manufacturing production activities. Despite the closure of ICE manufacture, these regions still

demonstrate the benefits derived from the dense networking of businesses, institutions, supply chain infrastructure, training providers and communities of high-skilled workers. The economic activities of individual firms and workers within them continue to contribute to ‘positive externalities’ – the ‘spillover’ of knowledge, innovation and productivity gains that tend to deliver benefits to multiple actors within the cluster and result in more competitive firms and regions.

Where activity in the automotive supply chain has continued beyond the ICE automotive industry’s closure, the ongoing benefit of industrial clustering becomes clear. Spin-off industries in after-sales services, maintenance, and repair of EVs, EV batteries and components therefore hold great potential for a home-grown Australian industry embodying global expertise. Increased digitalisation and automation of production processes could in the short-term result in some disruptions and transitions in employment patterns. However, Australia can develop related manufacturing and services occupations that transition workers into higher-skilled, higher-income roles critical to supporting EV manufacturing. These possibilities indicate enormous R&D opportunities and other ways of enhancing Australia’s competitive advantages.

EV industries and automotive clusters

The ongoing importance of industry clusters in Australia’s former automotive manufacturing regions provides a useful base for the development of EV manufacturing. Numerous submissions to the Senate Select Committee on Electric Vehicles (Commonwealth of Australia 2019) referred to Australia’s ‘residual engineering capacity’, highlighting the potential of existing industrial infrastructure to be revived through an EV industry. Given that a significant quantity of physical manufacturing capital currently sits idle in unused industrial sites, assembling the capital stock required to build an Australian EV manufacturing capability could have a significant head start.

Further supporting this case, Australia’s manufacturing history 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 research and development (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, finding in its analysis of post-auto industry closure that:

Companies benefit tremendously from holistic assistance that includes: consideration of a company’s vision and goals; skills and retraining;

resources (guidance as well as financial resources) and planning tools (DIIS 2020).

Hence, it will be important 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.

BUILDING BLOCK #3: EDUCATION AND SKILLS FOR HIGH-VALUE INDUSTRIES

Australia will require skilled labour to grow and develop sophisticated EV industry supply chains. This presents significant challenges, but a concerted effort to achieve this goal will yield great returns. Australia already possesses an industrial workforce of skilled and experienced workers, capable of meeting the needs of a growing EV industry, supported by ongoing retraining and upskilling. However, there are obstacles to kickstarting these processes.

The Australian Council of Trade Unions (ACTU) argued in its submission to the Senate Select Committee on Electric Vehicles that Australia should take advantage of underutilised skilled workers to build capacity in areas where skilled automotive workers and associated businesses are located. Building Block #3 follows from the above discussion about automotive clusters and the benefits that can be derived from retraining and reskilling former automotive workers and other skilled manufacturing specialists in new EV-related industries, which will require whole new strategies for training and skills development. The active participation of the Vocational Education and Training (VET) system is thus pivotal to the success of future EV manufacturing.

Rebuilding Skilled Manufacturing Labour

Many workers lost employment in the automotive industry and broader manufacturing sector since the OEM closures over the last decade. As previous studies have documented, in the wake of those closures, many displaced workers left the manufacturing industry permanently (Beer & Thomas 2009).

Laid-off manufacturing workers often face limited opportunities. They commonly find employment in industries characterised by lower pay, less hours, chronic insecurity, and poorer conditions. 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. For example, when manufacturing workers seek employment in retail industries, they compete directly with younger people with more experience in retail environments.

A common experience of former manufacturing workers leaving the sector is negative health consequences and barriers to social participation. This reflects the preceding problems, but also 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 capturing the skills and capabilities that are retained by workers in SMEs that still operate in the post-automotive manufacturing sector.

Skills for Final Assembly of EVs

As discussed above, vehicle components manufacturing has retained a significant footprint in Australia despite the shutdown of ICE assembly plants and a significant loss of jobs. Australia already produces a range of specialised EVs (such as buses) and EV components, supplying both domestic and global markets. Expanding EV components production and final assembly work is both desirable and feasible, if supported by active industry planning. But to support this, Australia must also invest urgently in relevant skills to underpin greater domestic involvement in global EV supply chains.

Mobilising VET for a Skilled EV Workforce

Delivery of new training packages for EV industry apprentices and trainees will be essential to preparing skilled labour for future EV manufacturing. The VET system will require whole new units of competency.

Current training and skills limitations

In 2020, the Industry Reference Committee (IRC) representing the automotive industry, along with the Australian Industry and Skills Committee (AISC), have proposed changes to the 'Automotive Retail, Service and Repair' Training Package to create new qualifications and units of competency to support skills for the EV industry (PwC & DESE 2020). However, these changes are to non-trade Certificate II and Certificate III qualifications, and thus do not support the creation of pathways for workers into higher-paid and higher-skilled jobs. EV industries will be characterised by higher-level jobs requiring at least Cert III qualifications, and these proposed changes demonstrate the current narrow scope of skills reform for EV industries.

These changes also are focused on after-market areas of qualification and occupation, and hence would not facilitate the development of skills suited for EV components manufacture or vehicle assembly. At present, EV manufacturing production is not even incorporated into Cert II- or Cert 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 qualifications and units of competency proposed by the IRCs and the AISC are outlined in Table 5.

Table 5
Automotive Retail, Service and Repair (AUR) Training
Package: Proposed Changes

Project: Accessory Fitting
Qualifications
AUR22021 Certificate II in Automotive Accessory Fitting ¹
Units of Competency
AURETR049 Install and modify in-car entertainment and convenience systems ¹
AURLTD008 Replace and refit vehicle steering and suspension components ¹
AURVTN043 Install protection equipment to vehicles ¹
AURLTD101 Select and install performance enhanced suspension system products ²
AURVTN112 Install vehicle sunroofs ²
AURVTT119 Fabricate and install automotive and marine frames, canopies and side curtains ²
Project: Battery Electric Vehicle
Qualifications
AUR37321 Certificate III in Automotive Electric Vehicle Technology ¹
Units of Competency
<i>AURETH015 Diagnose and repair heavy electric vehicle rechargeable energy storage systems¹</i>
<i>AURETH016 Diagnose and repair complex faults in battery electric vehicle powertrains¹</i>
Project: Heavy Vehicle Telematics
<i>AURETR051 Diagnose, repair and replace precision agriculture systems¹</i>
<i>AURETR052 Diagnose and repair commercial road transport electronic management systems*</i>
<i>AURETR053 Diagnose and repair mobile plant electronic management systems¹</i>
<i>AURETR121 Diagnose, repair and replace electronic management, monitoring and tracking systems²</i>
¹ <i>Refers to entirely new Qualifications or Units of Competency that do not replace older versions</i>
² <i>Refers to updated Qualifications or Units of Competency that replace older versions (relating to ICE vehicles).</i>
<i>Source: adapted from PwC & DESE (2020).</i>

The proposed changes to the Automotive Accessory Fitting qualification (AUR22021) incorporate EV skills and training at the Certificate II level. This actually results in a backwards step to the base-level trade qualification (which previously was a non-trade Cert III). This reduction in qualification standards leads the industry in the wrong direction. The broader Automotive Manufacturing Training Package still refers only to 'hybrid' vehicles, with no mentions made to fully electric vehicles. These weaknesses confirm that VET policymakers have much remaining work ahead to fully prepare for the impact of EV use and manufacturing on Australia's skills system.

Addressing shortcomings in current training and skills

Shortcomings in EV industry skills and training pathways at present 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 development of a highly skilled workforce for EV industries will require meticulous attention to training structures and frameworks. The EV manufacturing transition is more complex than a straightforward transfer of ICE automotive manufacturing work to EV automotive manufacturing work. A root-and-branch analysis of skills, job functions and occupational structures required for EV manufacturing will be required. Deep analyses 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.

Unions will be essential partners in developing training resources, skills formation, and industrial knowledge of what is needed. Union involvement is critical where, even as increased digitalisation and automation shapes manufacturing, the role of workers remains pivotal to highly skilled and complex manufacturing processes.

Workers are Pivotal to Industry Policy Success

EV industry policy must be developed in a way that recognises workers possess not only qualifications, but skills informed by experience. 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 & 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. Industry policy that places skills at its centre will manage the transition to an EV industry by ensuring competent workers are active in shaping advanced manufacturing workplaces.

Government's direct investment in the EV industry, such as the purchase of EVs for government fleets; funding of service-producing organisations, such as the delivery of VET education and training of EV workforces through TAFE and other VET providers; and purchasing of goods and services from private sector firms are all ways that the full potential of government spending power can be mobilised in support of both economic and social objectives.

This role of government 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 – advance their experience and skills further through on-the-job learning.

BUILDING BLOCK #4: THE ROLE OF GOVERNMENT AND OTHER KEY INSTITUTIONS IN EV INDUSTRY DEVELOPMENT

In responding more fulsomely to the climate change challenge, 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.¹² Tesla is now one of the world's most innovative manufacturing companies, providing commercial and retail products in the EV and renewable energy sectors. The success of global manufacturing giants like Tesla can only be understood with reference to the industry policy context that enabled them.

¹² According to Mazzucato (2015) the Obama Administration provided guaranteed loans of US\$535 million to Solyndra, and US\$465 million to Tesla.

Industry policy must also ensure that its successes further 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.¹³ Hirsh (2015) reported that by 2015, Tesla had already benefited from nearly US\$5 billion in U.S. federal and state subsidies to develop and expand multiple ventures (including EVs, tunnel boring, renewable energies, and even space exploration). There are also widely reported cases of Tesla CEO Elon Musk’s willingness to exploit workers and prevent unions from organising workers at Tesla plants (see Sainato 2018).

This experience confirms that the federal government should actively participate in various aspects of EV industry development. 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 outright 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 must hold 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 prospects. 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. The *Australian Financial Review* reports (Greber 2021) that Tesla has estimated its annual demand for Australian-produced lithium, nickel, and other critical and rare earths to exceed \$1 billion beyond 2021. The clear lessons for Australia are that due diligence must be taken by governments to plan industry policy that builds competitive advantage in EV industries and guarantees a proportionate share in the benefits flows to workers, communities, and the public. EV manufacturing firms seeking to benefit from Australian incentives and supports should be pressed to maximise domestic investments and distribute the proceeds broadly throughout society.

¹³ While the failure of Solyndra was more than offset by the enormous success of Tesla, Mazzucato (2015, p. 12) explains that “Taxpayers footed the bill for Solyndra’s losses – yet got hardly any of Tesla’s profits.”

Industry Policy as Industrial Democracy

New forms of worker intervention in production – for example, greater input into the design of EV manufacturing processes and companies making room for workers and representative unions to provide feedback on increasing its efficiency – can contribute powerfully to highly skilled workforces and increased productivity in Australia. Miller (2021) reported 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 embraces 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 will benefit both EV manufacturing firms and EV manufacturing workers.

Increasing the space for workers to provide input on EV industry development can maximise the knowledge informing innovation in EV supply and value chains, from mining and refining, to manufacturing. Workers and their unions must possess scope to intervene in industry policy development, identifying the necessary skills formation and industrial knowledge required to shape EV manufacturing developments. Where experienced and knowledgeable workers will transfer skills and expertise from traditional automotive manufacturing to new EV manufacturing, they are amongst the most critical inputs to innovation processes.

Community participation in an inclusive EV future

Beyond worker interventions, communities must be active stakeholders in developing and implementing sustainable social and environmental thinking and practices. This can 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, private EV ownership would be supplemented by an abundance of well-funded and innovative sustainable public transport planning, all supported by a vibrant and innovative manufacturing sector. This basis for developing renewable futures would complement environmentally sustainable innovations in Australia’s energy systems, and rapidly drive an environmentally friendly renewal of our economic system.

Electric Vehicles as Part of a Broader Climate Policy

The previous section outlined four ‘Building Blocks’ present to varying degrees in Australia, that will be critical in establishing an EV industry policy in Australia that can meet the goals of economic development and sustainability. These Building Blocks do not constitute an exhaustive list of the components of a successful EV industry. However, they will be essential to any EV industry policy response that acknowledges manufacturing as a key strength for the sustainable rebuilding of Australia’s economy. And together they constitute just one pillar of a broader and transformative policy response required to lead our energy systems, transport infrastructure, and societal norms toward a more sustainable future.

Beyond ‘Magic Bullet’ solutions

Building an EV industry in Australia is not a magic bullet for ending our social, political, and environmental woes. An Australian EV strategy based simply on a 1:1 replacement of ICEs with EVs would ‘lock in’ systems of production and transportation, and an over-reliance on private vehicles, that are 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). Therefore, an Australian EV manufacturing industry should be seen as one major component of a nation-wide approach to addressing climate change and creating a sustainable future.

Australia is thus in an enviable position of being able to rethink what an EV industry could look like. For example, by utilising our existing industrial base and mobilising it for a renewable future, linking it to a democratic industrial transformation – in manufacturing workplaces and in broader climate-conscious social institutions – Australia can develop its industrial capabilities around a competitive advantage in what would broadly be ‘applied renewable energy solutions’. The Australian EV manufacturing industry would then not just produce cars for private use and for government and private business fleets, but also Australian-made electric-powered trains, trams, buses, ferries, motorcycles, bicycles, scooters and more. The refining of lithium would supply industries that develop batteries for these forms of transport, as well as for our energy infrastructure networks. As Australia’s energy system increasingly draws on renewable sources, the capacity to utilise our uniquely abundant

renewable energy resource to support high-value product and service exports will grow as well.

Governments can mobilise and advertise this global competitive advantage and its related products and services as a nation-building strategy, and as a global export opportunity. The goal should be to provide sustainable solutions to problems that emerge from dependence on ICEs and other carbon-intensive forms of transport, and ways of living and doing business. This would focus Australian technological innovations on decarbonising transport systems and demonstrating to the world our economy-wide renewable energy knowledge, skills, and capabilities. Ultimately, an EV industry policy presents a major active government opportunity for gearing our economy and society towards meeting the mutually reinforcing goals of environmental sustainability, economic prosperity, and democratic participation.

Conclusion and Recommendations

Australia possesses many of the key elements for an EV industry: rich mineral reserves, an advanced industrial base, a highly skilled workforce, and consumer interest. But what it lacks is an overarching, coordinating and strategic national industry policy. Global experience shows that industry policy is central to EV industrial success.

This paper has argued that Australia's obligation to reducing global carbon emissions requires a nation-building response centred on an EV industry that restores automotive manufacturing in Australia, but kickstarts innovative transformations across the whole economy. Such a response must understand that an EV industry represents a strategic industrial approach to a much broader industrial, social, and environmental transformation. Ultimately, EV automotive manufacturing would anchor a far broader social, economic, and environmental transformation that embeds principles of renewability and sustainability in social, cultural, and economic norms.

The benefits of an EV manufacturing industry would be significant for our economy, society, and environment, and include:

- Tens of thousands of good-quality manufacturing jobs.
- Stimulus for further development of a high-technology supply chain.
- Opportunity to utilise Australian mineral resources (including lithium and other rare earths) in value-added industries, thus expanding their value many times over.
- Diversifying Australia's export profile and reducing our dependence on raw resource extraction and export.
- Complementing and reinforcing our accelerating transition toward non-polluting energy sources and systems.
- Spurring enhanced innovation, research, and engineering activity in Australia – still recovering from the closure of mass vehicle manufacturing in the mid-2010s.

Hence the challenge facing Australia's decisions about its industrial future is ultimately one of moral values and political will. Australia can choose to pursue a renewed industrial future via an EV industry and its environmentally and socially transformative potential. This would both address our climate change responsibilities and revive our strong industrial history, by making us a leading renewable energy and industrial innovator.

An EV industry supported by government will create the context for a revival of domestic EV manufacturing in Australia far beyond automotive manufacturing. The

array of industries that contribute to its growth will be internationally competitive, considering our abundance of critical minerals and renewable energy. It will employ skilled workers with high incomes because Australia still has an industrialised economy. But to make all of this happen, the federal government must commit to industry policy that is both active and interventionist – taking measures to identify and coordinate these and other moving parts. This approach requires a break with the traditional business-driven, ‘comparative advantage’ approach to the future development of Australia’s economy.

Even numerous figures from industry – both within Australia, and amongst international and global investors seeking renewable energy opportunities here – have lamented the lack of policy direction at the federal level (Black 2021). Without an overarching federal industry policy, some believe we could create for the EV industry the ‘railway gauge’ issue¹⁴ (Fernyough, 2021). This would damage Australia’s reputation in the growing global EV industry, with states ‘going it alone’ in the context of a federal Australian policy vacuum (Mazengarb, 2021).

Within this context, Australia must change track and take a more positive approach to industry policy. Our history of highly complex manufacturing activities must be recognised as a potential competitive strength, and prompt strategic imperatives to prioritise our most innovative manufacturing capabilities. This is something an EV-driven manufacturing revival can achieve. An EV industry policy will integrate mining, manufacturing, and services, placing advanced manufacturing at the centre of our sustainable future.

Thus, Australia faces political choices on its road to sustainable economic transformation. Australia can make a valuable contribution to the rapidly growing EV manufacturing industry by strengthening our role in global supply and value chains for public and private focused EV transport solutions. Governments and policymakers must make better political choices by accepting the strategic nature of industry policy for Australia to meet its moral obligations to society, a fair economy, the environment, and future generations.

Recommendations for Rebuilding Vehicle Manufacture in Australia

Writing about the implications of technological change, Laurie Carmichael interpreted a ‘crossroads’ in political and economic history:

¹⁴ Prior to Federation in 1901, different rail sizes between states restricted Australia’s internal trade in the absence of a national coordinating policy

The choices that current history is putting before us lies between allowing the corporations to create a society where fewer and fewer are able to work and earn an income whilst paying more and more taxes to keep more and more totally unemployed... alternatively the people, workers and the unions in particular, interven[e] in opposition to the corporations ... asserting the right of all people to equitably participate in socially necessary labour and to have an adequate means of sharing the social product (Carmichael 1980, p. 22).

More than forty years later, Carmichael's interpretation is relevant to a critique of the current Australian federal government's narrow and unsustainable industry policy response to EV opportunities. The following recommendations are put forward as major steps towards developing an industry policy that can focus on EV-related manufacturing as a driver of Australia's sustainable manufacturing-led transformation.

Recommendation #1: An EV Manufacturing Industry Commission

The federal government should create an EV Manufacturing Industry Commission, with a board comprising major stakeholders from government, unions, business, and the community, and chaired by an EV industry expert. The Commission would be initially tasked with holding a broad consultation and inquiry into Australia's EV industrial prospects, with terms of reference that relate to:

- the role of an EV industry in Australia's economic, social, and environmental future;
- its potential benefits for employment and business sustainability;
- the opportunities and challenges of developing an EV industry;
- issues relating to federal, state, and local government policy coordination;
- policy measures to incentivise EV industry supply and value chain developments;
- the potential of adopting a whole-of-economy framework for EV industrial transformation;
- energy transformation requirements to power EV industries with renewable sources of energy; and
- other related matters.

The Commission would be mandated to deliver its findings within 18 months, in the form of recommendations for specific policies that would constitute a well-rounded plan for EV-driven industrial transformation – maximising its potential for leading sustainable social, economic, and environmental change.

Recommendation #2: An EV Industry Powered by Sustainable Energy

The federal government's industry policy should recognise that EVs in Australia, and a domestic EV manufacturing industry, must both be powered by sustainable energy sources. This is required to support the production of 'clean' EVs – vehicles that are not just zero-emission in nature, but also produced in a sustainable way via a value-adding process that is consistent with decarbonisation of the economy. Access to renewable sources of energy is also a strategic advantage in attempts to attract global EV industry capital investment to Australia (see Recommendation #8, below).

Nahum (2020) argues that Australia's competitive advantage in the production of renewable energy can be utilised to power the value-added processing of raw minerals extracted from Australian mines. Carbon-neutral hydrogen production, hydrogen-based steel, and aluminium processing using renewable energy are key examples of technologies deployed in other parts of the world that could reinforce Australia's energy and industrial transformations. By identifying the renewables-driven development of manufacturing as a competitive advantage, Australia can market itself globally as an attractive investment location. This would also maximise the manufacturing sector's participation in global EV supply chains.

An EV industry policy must therefore be linked integrally to a broader sustainable energy strategy. It must aim to rebuild manufacturing on the strength of renewable resources, creating potentially thousands of jobs from a suite of policies that directly address climate change and attract global EV industry investment.

Recommendation #3: Encourage Consumer Demand

The federal government should prioritise the growth of a domestic 'home' EV market to reinforce high levels of Australian consumer demand for EVs (including, in the future, Australian-made EVs). The faster development of the local consumer market for EVs can be accelerated through key policy instruments including sales incentives, emissions regulations, carbon pricing and the rapidly expanded rollout of EV charging infrastructure.

EV purchasing incentives, such as rebates, waiving stamp duty on the purchase of EVs (but not luxury cars), providing interest-free loans for the purchase of EVs, and even packaging loans for EV purchase together with incentives for home renewable energy system installation, can leverage consumer concerns about climate change. These policies have been applied at the state level with positive effect.

These incentives can be combined with policy that targets a particular level of new car sales by a given date (for example, targets of 50% of new sales by 2030 have been

implemented in many nations). Pricing policies that favour EVs have been shown in international jurisdictions to reduce ICE unit sales. Exempting EVs from fringe benefits tax can also help stimulate consumer demand amongst businesses, including amongst sole traders considering purchasing an EV for their business needs.

By implementing strict emissions reduction and fuel efficiency standards for ICEs imported to Australia, the federal government can also incentivise overseas OEMs to take advantage of favourable policies towards EV uptake and deliver the cleanest, most innovative EVs to Australian markets. Increasing production of EVs can benefit consumers with lower purchasing costs as unit production costs decrease when EV manufacturing reaches economies of scale.

Some Australian state-level governments have discouraged EV sales by implementing new taxes before there is enough public interest in the EV market to sustain its growth. The federal government can address the uncoordinated implementation of state-level EV tax policies with a nationally coordinating taxation and incentives policy. This will drive further investment and consumption of EVs and EV-related services.

Recommendation #4: Add Value to Australian Resources

The federal government should address barriers to downstream value-adding processes that deepen the linkages between primary resource extraction industries and high value-adding manufacturing processes. Specifically, the export of lithium and rare earth metals without any secondary processing in domestic manufacturing supply chains, must be reversed to support value-adding processes. Government policy should incentivise closer integration of critical minerals extraction with battery manufacture and other value-adding opportunities. This is also a resources security issue, as identified by Tesla (see Greber 2021), so global firms demanding Australia's critical minerals for EV production should be required to invest in major elements of value-adding production processes on Australian shores.

The federal government should therefore create regulation that sees private mining interests and large-scale purchasers of Australian lithium commodities commit to doing most of the value-adding to resources used for EV battery and component manufacturing in Australia's supply chains. Value-added tax measures could be applied to resource firms that export commodities without first attempting to enhance Australian value-added; firms that invest in local supply chains would be exempt. A resources rent fee could be applied to firms that produce and export volumes above domestic requirements and targeted towards the development of downstream value-adding industries via subsidies on capital investments. Subsequent domestic refining, processing and EV battery/component manufacture activities will stimulate significant export revenues, create skilled jobs, and increase Australia's economic complexity with

accompanying positive social and economic benefits. The federal government thus also has an important role to play in communicating to mining interests and the public that maximising the value-added potential of our resources is essential to Australia's economic development, requiring regulatory measures so that their extraction meets long-term industrial objectives.

Recommendation #5: Develop EV Supply Chains

The federal government should identify necessary investments in Australian supply chains to strengthen capabilities for EV industry participation. Using investment tax credits could help more closely link extraction industries to manufacturing capabilities, incentivising firms that typically export raw resources to instead invest in, or connect to downstream production, to supply emerging Australian EV battery and EV battery components industries. This in turn can build further capacity for EV manufacturing and competitive EV industry export strengths. Firms that presently export lithium ore could be specifically targeted to invest in refining to attract downstream processing capabilities so that this supply chain results in the production of refined lithium products for use in domestic battery manufacture and other uses.

A thorough mapping of manufacturing supply chain assets must be undertaken to identify capital infrastructure and industrial capacity before government agencies liaise with prospective business ventures identified as potential investors in downstream refining and processing activities. Once investment priorities and business partners are identified, EV industry policy can mobilise investment through public equity co-investments in EV supply chain activities, EV supply chain development grants and financing, co-investment in resource industries, and by creating other incentives for business investments in supply chain growth. These and other determined objectives for the growth of value chain opportunities can be identified via a battery industry strategy that sets the direction of growth in supply chain development initiatives.

Recommendation #6: Invest in Essential Skills

The federal government should identify the key role of VET in rebuilding Australian manufacturing and take responsibility for reforming and rebuilding the VET sector.¹⁵ Immediate actions by the federal government will be required to ensure the effectiveness of this approach and the efficiency of funding provision in a longer-term strategy for VET and TAFE.

The government should establish an EV industry reference committee comprising representatives from unions, government, manufacturing, and renewable energy

¹⁵ See Carney and Stanford (2018) for a thorough review of the failures of past market-oriented VET policies in Australian manufacturing.

industries to expedite a new specialised Training Package for EV manufacturing industries. This new Training Package would establish, as an absolute minimum, trade-based Certificate III-level qualifications that create apprenticeship opportunities in EV industries, establishing career pathways in EV-related industries, and linking these pathways to Diploma, Advanced Diploma and Bachelor levels of qualification.

As outlined in this paper, traineeship packages in the EV manufacturing industry are in the process of being endorsed. As these relate only to non-trade automotive retail, service and repair, and electric vehicle technology pathways, provision of education and training should be expanded to include EV components manufacturing, EV assembly, engineering, and design apprenticeship pathways as well.

With the highest-quality VET education provided by TAFEs, the Australian Skills Quality Authority (ASQA) should be authorised to develop standards for education and training provision using well-funded TAFE-based delivery of EV-related education and training as the benchmark. TAFEs must constitute the central channel for development of new EV-related qualifications and skills pathways. This will ensure that EV education and training is regulated to meet standards set in industry policy responses to skills and knowledge requirements.

The federal government should also coordinate the state-based rollout of new TAFE provision of EV education, training, and skills so that serious attention is given to the needs of regions transitioning from declining industrial bases to emerging renewable opportunities. This will be essential to avoid a repeat of the fragmented response to the automotive industry's closure; it could also support a 'Just Transition'¹⁶ for regions that can benefit from a rapid shift to renewable energy and advanced manufacturing industries.

The provision of TAFE-based education and training to support EV manufacturing jobs should be provided free of charge. This will help to address the potential job losses from the coming decline in fossil fuel industries, and sustainably transition workers and their communities to high-quality jobs in advanced, sustainable industries (like EV manufacturing).

Delivering a high-quality and effective VET system to meet EV industry growth demands and provision of free education and training would require that TAFE

¹⁶ A Just Transition is a framework developed by the union movement to ensure that workers and their communities benefit in the climate change adaptation-based transition from carbon-intensive to sustainable economies (see ACTU 2020).

receives a minimum of 70% of VET funding in future budget allocations to the sector.¹⁷ This is essential to ensure that the public provider of education and training is restored as the major driver of the skills and qualifications required to sustain an Australian EV manufacturing industry and the high levels of qualification, skills and knowledge within the labour market.

Recommendation #7: Public Procurement

The federal government should announce its commitment to public procurement of EVs with high Australian content (ultimately including final assembly) for the rapid electrification of government vehicle fleets. This would signal state and local levels of government to undertake similar procurement policy responses and encourage private sector business investment in their own fleets. A target of 50% of government fleets made up of EVs by 2025 is a reasonable medium-term target to aim for at the federal level, with federal assistance being provided to state- and local-level counterparts for meeting similar aims. EVs making up 100% of fleets at all levels of government by 2030 should be the goal of long-term procurement measures, working in step with other economic policy responses that aim to decarbonise Australia's transport stock and infrastructure.

If the federal government is to take seriously its role in building a world-class EV industry, it will require an active public procurement plan to meet these aims and thereby incentivise the private sector to take similar measures. A 'catalogue' of all public fleets at all levels of government would provide the basis for prioritising the decommissioning of ICE vehicle stock and assessing options for gradual replacement with a range of EVs provided by Australian EV industries for cars, buses, trucks, trains, and trams.

A foundational element of this policy response would be an advanced public procurement strategy to meet government EV demand with Australian-made EVs. Local suppliers would be prioritised to tender for projects that manufacture EVs to specifications (i.e., specialised vehicles like garbage collection trucks for local governments; specialised agency vehicles for state and federal governments; etc.). This would also see R&D initiatives established to develop local manufacturing capabilities in partnership with industry and importantly, co-investment from global OEMs (see Recommendation #8). Minimum local content requirements for government fleets could help to drive investment activity throughout Australian EV supply chains and anchor the commitment of Australian governments to a home-grown industry that

¹⁷ See Pennington (2020) for a full analysis of TAFE's contribution to the Australian economy and the minimum levels of funding required to ensure its central role in rebuilding Australia's economy after the COVID-19 pandemic.

supplies most public and private EV fleets. This is common practice in European, Asian, and North American nations.

Using government procurement as an active tool can thus support industry growth, R&D, and skills policy. All are required to create high-quality labour markets, demand from firms for highly educated and trained workers, and dynamic public sector workforce capabilities to deliver on these aims.

Recommendation #8: Attract One or More EV OEMs

A major goal of a federal EV industry policy should be the federal government's active attempt to attract EV automotive OEMs to locate in Australia, once again establishing Australia as a country that mass-produces cars. As outlined in this report, Australia possesses the resources, skills, capital infrastructure and government capacity to undertake the manufacture and final assembly of vehicles in Australia; and as EVs are the future of the global automotive industry, Australia should become a nation that builds them. The federal government should aim to attract an OEM to Australia by 2025 to build EVs, with the first EV production processes to begin 2-3 years later (after extensive planning, supply chain and skills mapping is undertaken by government in collaboration with unions and industry).

The federal government should assemble and offer an investment package to globally operating OEMs that features attractive incentives, including:

- Commonwealth and state government fiscal incentives, such as tax credits, capital asset write-offs, access to low-cost renewable energy, payroll tax concessions, and other subsidies;
- An additional and optional suite of incentives to encourage EV firms to invest all or part of their new Australian venture in regions undergoing industrial and employment transition from traditional industries to new opportunities in clean manufacturing and renewable energy;
- Labour market programs that streamline pathways for workers educated and trained in the TAFE system to careers in EV manufacturing and services industries;
- Access to infrastructure, including power (renewable energy), roads, rail and additional measures required to integrate geographically disperse supply chains;
- Potential public capital participation, such as through a joint-capital ownership arrangement (perhaps 51% privately held and 49% publicly owned), demonstrating government's significant backing of industrial development;

- Public procurement programs that guarantee government becomes the first EV customer directly following the OEM's agreement to invest in the Australian industry;
- Export promotion resources and support from AusTrade, including export financing and export development grants for EV product and service developments that strengthen export opportunities for firms in Australian supply chains, and other financing support for collaborative initiatives between EV OEMs and Australian SMEs to develop products and services for procurement purposes.

* * * * *

These recommendations should form the core of an EV industry policy response that maximises the potential of the Building Blocks highlighted in this paper. They would ensure that the federal government, which has significant capacity to coordinate national industrial development, can do so with the right political choices in mind for Australia's future society and economy, and the planet's climate.

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