National Battery Strategy

Engineers Australia submission to the Department of Industry, Science and Resources

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ENGINEERS
AUSTRALIA

National Battery Strategy: Engineers Australia's Submission to the Department of Industry, Science and Resources

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Introduction

Engineers Australia pleased to have the opportunity to make a submission on the National Battery Strategy. The impacts of Covid and recent geopolitical events have brought the need for strong supply chains and manufacturing sovereign capability into stark relief. Batteries are vital to the energy transition. They will be used to power electric vehicles (EVs), residential and community energy storage, and grid scale storage. Australia can move up the value chain from mining raw materials to refining chemicals, production of precursors and active materials, cell manufacturing, battery pack assembly, service and maintenance, re-use and recycling. Some of the activities will be more achievable and the formation of a national strategy is critical in identifying which opportunities to prioritise. Australia can leverage its strengths in mining, research and development and engineering innovation to support the transition to net zero emissions and grow the economy at the same time. Engineers Australia strongly supports the development of a vision for a sustainable and thriving battery manufacturing ecosystem.

This submission provides feedback from to the questions posed in the consultation paper. If you wish to discuss any points raised further, please contact Grant Watt, Senior Policy Advisor at policy@engineersaustralia.org.au.

About Engineers Australia

Engineers Australia is the peak body for the engineering profession in Australia. We are a professional association with over 115,000 individual members, constituted by Royal Charter to advance the science and practice of engineering for the benefit of the community. Our members represent every discipline of engineering and work across all sectors of the economy, impacting the lives of Australians every day.

Summary of key points

The development of a battery industry in Australia is an exciting opportunity to develop better batteries and systems for a sustainable future.

1. Australia can move up the value chain, starting in mineral processing, and focussing on all processes and precursors prior to mass manufacturing.
2. Competing with gigafactories producing at immense scale will be difficult, so we should focus on assembly in niche applications, including those designed and built for Australia's climate, remote communities and defence needs.
3. Concentrating on safety standards and ESG credentials can be leveraged as a competitive advantage.
4. Australia needs strong leadership at a federal level, including a national body to bring all the initiatives together under a long-term strategic plan.
5. Australia has a proven history of innovation, but a poor track record of turning that into commercial products and services. Australia needs to support the innovation ecosystem, including the engineers who take ideas from concepts to products and solutions.
6. Government has a critical role in promoting collaboration between industry and universities.
7. Australia can play an important role on the international stage in developing R&D and practice in battery fire safety.
8. Tax reform can make or break a developing industry.
9. Australia needs joint government and industry commitment and investment to establish an industry.
10. Government and industry need to work together to utilise our engineering workforce and improve the uptake of STEM education and engineering qualifications in Australia.
11. Programs that support students to combine study and on-the-job training are likely to have a significant impact on the quality and 'job readiness' of graduates.
12. We need to develop standards for all parts of the battery industry to ensure public safety, interoperability and competitive advantage.
13. Circular economy means much more than recycling, including reducing demand through energy efficiency.

Australia has an opportunity to develop an industry that incorporates circular economy, fire safety and ESG priorities in tandem.

Response to consultation questions

Theme 1: Moving up the value chain.

Q1.1: WHAT ARE AUSTRALIA'S EXISTING ADVANTAGES? HOW CAN AUSTRALIA CAPITALISE ON ITS EXISTING ADVANTAGES? AND HOW CAN AUSTRALIA EXPAND THESE ADVANTAGES?

The energy transition requires a diverse range of battery technologies. Australia can contribute across the value chain in various battery chemistries, lithium-ion, sodium-ion vanadium flow, and more. Australia has vast reserves of the raw materials needed for batteries and is the dominant player in mining battery materials. We produce 60 per cent of the world's lithium but import 100 per cent of our lithium-ion batteries, which highlights both the lack of secondary manufacturing of new technologies and the significant opportunity in Australia.

Australia can move up the value chain in mineral processing, so that we produce Li2CO3 not just crushed spodumene, nickel sulphate instead of nickel ore (same for manganese and cobalt), high-purity alumina instead of standard alumina, and so on. In fact, Australia could start by focussing on all processes and precursors prior to mass manufacture and start with assembly in niche applications, including defence, microgrids and grid stabilisation. Supporting these companies to increase the onshore processing is the area where Australian can achieve early gains. In addition, much of the work is being developed in parallel with installing green energy to process the concentrates and battery feed stocks. At the back end of the cycle, Australia could focus on refurbishment, reuse, and recycling. Also, provenance and certification for ESG considerations, in which Australia has an edge that can impact the global battery supply chain.

Australia's research and development (R&D) capacity is comprehensive, distributed across the country and well positioned to support this growing area. Australia is currently doing excellent research into silicon (for anodes), high nickel and high manganese NMC cathodes, as well as high purity aluminium (HPA) for precursor doping and for displacement of cobalt. Australian R&D and the commercialisation of innovation could focus on these and include other emerging technologies such as sulphur, sodium, graphite and other technologies such as flow or solid batteries. Australian researchers at the University of Wollongong have been working with 'Edge Functionalised Graphene,' which they say could unlock cheaper and better performing lithium-ion batteries. The lithium salt currently used in lithium-ion batteries is lithium hexafluorophosphate, which poses a safety risk. Researchers are developing the use of fluoroborate salts, which are showing promise for being much safer. Researchers in Japan have produced lithium-air batteries, which they claim have some of the highest energy densities and best life cycle performance. While our natural resources are the obvious advantage, they are located low in the "value add" chain, which necessitates higher order thinking regarding value advantages. Government can facilitate co-ordinated research in partnership with universities and industry, as well as funding.

Research should be focused on safer technologies as the thermal runaway and toxicity properties of lithium-ion is concerning. Developing new products with improved performance and safety, such as lithium sulphur and lithium silicon-sulphur, would create new business opportunities and a competitive advantage.

Australia will struggle to be competitive in an open market against gigafactories at immense scale. Downstream processing of the mined ores is a more attractive option with manufacturing more a niche prospect, particularly for stationary batteries in regional areas (designed and built for the local conditions). Potential specialisations include safer batteries for countries with hot climates, off-grid applications for Australia's remote communities and the requirements of our sovereign defence capability.

Australia has world-leading electrical innovations and product development in infrastructure and components such as capacitors. This small-scale manufacturing and product development expertise can be leveraged. Universities within Australia are working much closer with industry on research and development of products and leveraging that research with strong manufacturing cooperation would allow Australia to develop world-leading products that could create huge local and export opportunities.

Furthermore, Australia has extensive expertise in the fast charger market with products manufactured locally for EVs both within Australia and across the world. Leveraging these companies to integrate batteries could rapidly progress a package solution for EV charging and distributed battery storage.

Q1.2: WHAT AREAS OF THE GLOBAL BATTERY SUPPLY CHAIN SHOULD AUSTRALIA FOCUS ON, AND WHERE ARE THE POTENTIAL BARRIERS AND VULNERABILITIES FOR AUSTRALIAN INDUSTRIES IN THE GLOBAL SUPPLY CHAIN?

Barriers

The following supply chain barriers will impact local manufacturers and companies for the foreseeable future:

- constrained global supply chains leading to significantly higher component prices
- scarcity of specialist materials and devices
- emerging technologies and materials required for battery optimisation have limited global production capacity.

Vulnerabilities

Potential causes of vulnerabilities include:

- a lack of sovereign capability in the manufacturing of batteries coupled with competition from China, the US, the EU and Japan, countries that have more developed industries and established strategies
- access to the right engineering and manufacturing skills
- bulk purchase of limited components by other parties
- the lack of semiconductor manufacturing can cause significant disruption to the supply of electrical components
- geo-political tensions in regions with high industry concentrations, for example, Neon gas production in Ukraine for semiconductor manufacturing or the growing tensions in Taiwan
- a lack of recycling facilities within Australia capable of handling the volume and types of batteries, including components, we are importing could create ballooning disposal costs at the end of the asset life cycle.

These barriers and vulnerabilities can be countered by:

- leveraging our expertise in mining and mining equipment
- focusing on niche products
- development of battery management systems
- concentrating on safety standards and our ESG credentials
- developing a sustainable industry that take batteries from cradle to grave
- leveraging synergies with existing manufactured products.

Q1.3: HOW SHOULD GOVERNMENT, INDUSTRY, AND RESEARCHERS SUPPORT AUSTRALIA'S BATTERY INDUSTRIES TO GROW AND COMPETE?

A clear commitment from government, industry and research institutions to value-add to the battery industry is required. Moving Australia up the battery value chain will have to be a public and private enterprise because Australia needs the scale and market at this stage.

Entrepreneurship will be the key driver for Australia's battery industries to grow and compete. The incentive of being able to derive material benefits from an endeavour drives entrepreneurs in research and development to take risks to invest in developing new products and services.

The government's role is to:

- establish a national body for the co-ordination of research and to bring the various state initiatives together under an overall long-term strategic plan

- set the strategic framework, and create the legislative and regulatory settings that will drive innovation
- fund research and development, and the commercialisation of innovation
- support business to improve productivity through greater use of advance manufacturing and industry 4.0 technologies
- support the development of technical skills, especially university and training programs, which will develop engineers and other occupations to support the industry
- tax reform for companies focused on research and development as well as local manufacturing
- reform procurement practices to prioritise locally manufactured products, and provide financial incentives to work with local companies
- incentivise the installation and adoption of battery technologies at the distribution network level, including community batteries, DNSP systems, and households
- provide more grants to regional councils for MW-scale battery installations to protect their local grid and take advantage of local solar production, especially in remote areas
- provide more long-term financing for 'grid owners' and major power plant owners for grid-scale battery investments
- make it easier for energy supply licenses to be acquired for larger installations
- provide incentives for storage related energy research; both for start-ups and established businesses
- establish a national programme to bring the production, R&D and assembly operations of major international players into the local market
- establish a national register of energy manufacturers and component suppliers
- work with industry, local government and the public on ways of disposal by recycling of batteries components, thereby creating new and sustainable industries.

Universities and other research organisations can assist by:

- establishing specialised research centres for battery technology that work with industry
- bringing leading international researchers into the country to contribute to foundational research and provide the necessary skills to local engineers, researchers and scientists.

Industry – Energy Storage Companies / Manufacturers

- work to vertically integrate supply chains within Australia where practical, and where it is not practical (cost/labour supply), work with the government and key industry bodies to remove barriers to local production
- improve business processes to increase international competitiveness through mechanisms such as advanced manufacturing and industry 4.0
- take more graduate engineers to build local competencies in the sciences, engineering, and technology
- work with the government to remove barriers to grid-scale implementations and mass adoption at the retail level
- create more sustainable types of batteries that can be recycled or repurposed easily and reduce the waste, and reliance on overseas waste facilities.

Industry – Energy Producers

- work with the government and other organisations to establish the necessary energy storage assets on the grid and source the solutions locally.

Industry – Minerals and Materials

- encourage extraction businesses to work with local organisations on mineral processing and material manufacturing/production. Especially in areas where the materials are scarce today

- encourage development of these new processing and manufacturing industries in rural areas nearer the source of minerals thereby growing the employment and skills opportunities within rural Australia.

Industry – Buy Side

- local industry should buy from local manufacturers first. This can be accelerated via rebates/offsets and so forth
- once the Australian local industry starts developing, encourage the importation of products that do not have batteries already fitted to ensure the local industry has a growing market.

Theme 2: Turning our innovative ideas into opportunity.

Q2.1: HOW SHOULD AUSTRALIA BUILD ON ITS STRENGTHS IN R&D AND INNOVATION TO COMMERCIALISE MORE BATTERY RELATED RESEARCH?

Engineering is often the foundational aspect of new product development and starts with R&D and design. Engineers have demonstrated the ability to innovate, problem-solve and to take ideas from concepts to products and solutions. Australia has a proven history of innovation but, with some notable exceptions, does not translate that well into commercial products. Australia's STEM start-up ecosystem is consistently ranked one of the worst in the developed world. Engineers Australia welcomes the development of this strategy because without a long-term vision and plan, no amount of funding and incentives will deliver the results that the highly technical and complex nature of STEM start-ups will require. Three broad policy issues need to be addressed:

- improving models of collaboration and ecosystem development
- reforming grants processes and tendering requirements
- reducing regulation and incentivising investment.

Figure 1: Innovation ecosystem[1]

[1] International Development Innovation Alliance, Typical Actors in an Innovation Ecosystem, IDIA website, n.d., available at https://www.idiainnovation.org/ecosystem-actors, accessed 16th September 2021.

To promote collaboration:

- explore and develop partnerships in Australia and overseas with like-minded organisations to leverage expertise and learn from best practice
- put start-ups at the centre of STEM innovation
- recognise the vital role that government plays by providing grants to bring stakeholders together.

Universities need to connect more directly with local commercial entities. The product lifecycle of a critical battery product is likely to stretch over years, and there needs to be a synchronisation between university research and commercial product development. In other words, "the research needs to make it onto the roadmap."

There are two streams of energy storage:

1. Large >100MWh up to 1GWh (salt solutions)
2. Medium <100MWh down to 1kWh (conventional lithium-based (unsafe), other lithium-based (Li-S, Li-Air), solid-state salt batteries, other)

Battery research needs to focus on the following specifications:

Functionality	Large	Medium
Safe (no thermal runaway)	Yes	Yes
High Energy Density (=>1kWh/kg)	No	Yes
Large storage (>100MWh)	Yes	No
Medium storage (<100MWh-1kWh)	No	Yes
Quick charge (<30min)	No	Yes
High charge-discharge rate	Not necessarily	Yes
Charge cycles (>2000)	Yes	Yes
Charge Retention (> 3 weeks)	Yes	Yes
Utilise 100% of the charge	Not necessarily	Yes
Low cost (<$500/kWh)	No, not necessarily	Yes
Australian material availability	Yes	Yes
Recyclability of raw materials	Yes	Yes
Re-use of battery	Not necessarily	Yes

Q2.2: HOW COULD AUSTRALIA BEST PROMOTE ITS STRENGTHS IN R&D TO GROW DOMESTIC BATTERY INDUSTRIES?

The fire safety aspect of batteries will increasingly become an issue for society. Extinguishing battery fire is hazardous and difficult. There are no Australian standards or building regulations for the use of new battery technologies in buildings. Australia should work at an international level in this rapidly growing industry, leveraging Australian R&D on battery fire safety. This will give a significant advantage over other manufacturers/countries. Engineers Australia members are contributing to this work and the development of standards.

A specific funding commitment of the order of $5 to $10 billion by both public and private organisations for battery research is needed, including:

- identifying areas of battery specialisation in academic institutions and industry
- setting up 'Battery Clusters'
- facilitating forums and other strategies to bring these communities together.

Technology development and innovation

There is an underlying assumption that Lithium batteries provide the greatest opportunity for 'vertical production'. There are battery technologies that are non-lithium and for which it may be easier to capture global market share, such as flow batteries and others. Lithium polymer batteries have many faults besides the safety issue, for example, they do not hold a charge well, and this presents an opportunity to develop new products that address these issues.

Energy density – different needs

The residential, commercial, and industrial sectors have different needs to transport, which requires greater energy density. Laptops and scooters have very different needs compared with mine sites and big batteries that need to hold storages: different needs, different scale, different types of chemistries.

We need to look at least one kWh per kilogram and eventually move to 10-kilowatt hours per kilogram for transportation batteries. We are still determining if that is possible, but that should be the target for R&D. This is the type of R&D needed to innovate and then commercialise these technologies. The large range of use cases detailed indicate the diversity of opportunities for R&D and manufacture that provide competitive advantage.

Q2.3: WHAT STEPS SHOULD GOVERNMENTS, OR A GROWTH CENTRE-LIKE ENTITY, TAKE TO SUPPORT GROWTH OF DOMESTIC BATTERY INDUSTRIES?

Australia needs strong leadership at a federal level to ensure collaboration under a national co-ordinated strategy. Also, focus on advancing technology through to pilot installations in the network, in industries and within the suburbs, coordinating the relevant authorities, industry bodies and community groups.

Approaches to collaboration include:

- collaboration between innovative companies, governments and universities
- co-location, vertical integration and shared infrastructure.

In Australian government tenders, there is generally no advantage/weighting placed on locally manufactured products or services. This change would improve the local manufacturing industry's ability to compete with well-established foreign suppliers who can use bulk discounting to flood local markets with cheaper products. There can also be a reduction in the importation of goods that have specific types of batteries already fitted in a finished product. The batteries could be sourced in Australia and fitted here thereby increasing our market share and introducing new jobs for fitting components.

A focus could be placed on critical infrastructure projects and supply chains. The government would be well placed to commit to utilising local products in areas such as the Renewable Energy Zones (REZs).

Systemic inefficiencies continue to inhibit the commercialisation of innovation, including:

- challenges finding appropriate grants
  - a central repository of grants would alleviate this
- the administrative burden of applying for grants
  - simplify and streamline the application process
- the length of time between applying, being awarded a grant and receiving the funds can be difficult for smaller start-ups

- Reduce the timeframe.

Larger players often have the resources to dedicate significant time and money to the grant process compared to smaller organisations, who would often receive more benefit from the grant.

A growth centre approach would be well placed to bring together locally established and emerging industries related to electrical infrastructure and battery technologies to coordinate the "pieces" of the manufacture and supply chain required to create a market. This same entity could leverage technologies such as fast EV charging stations to integrate batteries throughout the distribution network. Distributed Network Service Providers (DNSPs) would also be well placed to trial these types of local infrastructure and could be a testing area for emerging technology. Encouraging collaboration between industries, R&D, and implementation can enable faster developments to be rigorously tested within actual service conditions.

Other approaches that may assist with the commercialisation of innovation:

- require larger organisations that win government contracts to partner with smaller domestic start-ups
- implement a secondary stream of government tendering specifically for STEM start-ups
- tax incentives for businesses that invest specifically in these new technologies.

While the government has an important role to play, it is the market that will pick eventual winners.

Theme 3: Encouraging investment to grow our battery industries.

Q3.1: WHAT ARE THE BARRIERS TO INVESTING IN AUSTRALIA'S BATTERY INDUSTRIES, AND HOW CAN THEY BE MITIGATED? HOW CAN GOVERNMENTS ENCOURAGE MORE INVESTMENT?

There needs to be a clear commitment and confidence that Australia can develop a viable and complex battery value chain from raw material to finished product.

Tax reform can make or break a developing industry. Currently, start-up companies associated with battery technology (and other areas) are disadvantaged locally due to taxation arrangements. Similarly, low-cost offshore products are already well established in items such as EVs.

The government should investigate tax:

- credits
- exemptions, particularly where profits are being reinvested
- offsets to support investment in R&D.

Local battery manufacturers that have been going for many decades but have a strong focus on lead-acid for the car industry have limited opportunities to expand into other technologies without significant changes in manufacturing processes and tooling.

Challenges and solutions include:

- overweighted investment required in vertically integrated industries with a lack of capacity in key areas of the supply chain
- need joint government and industry investment strategies focusing on relevant components of the supply chain
- limited domestic market with barriers to export into other major markets (brand awareness, existing market presence), which leads to lower return on investment and higher investment risk
- Queensland's mitigations for government co-invested share buybacks in early-stage entities
- setting aside specially dedicated industrial parks and areas near processing plants to assist new industries to get established and thrive

- create minimum volumes for a competitive and profitable local market orchestrated through local first procurement incentivisation for energy storage.

Q3.2 WHAT AREAS COULD AUSTRALIAN-MADE BATTERIES HAVE A COMPETITIVE ADVANTAGE FOR USE IN AUSTRALIA AND FOR EXPORT?

There are advantages to Australian products that are made in line with ESG requirements compared to other countries. Further, there is a large amount of research into the fire safety aspects of batteries that can be leveraged with local manufacturers. Critical electrical infrastructure has specific regulations around its control and monitoring. A locally developed and maintained battery system has significant advantages over batteries monitored and controlled outside Australia by third parties. Locally controlled and regulated companies remain within the framework of Australian law to ensure protections are maintained.

Australia could focus on the following:

- niche markets such as non-Lithium battery products
- medium scale grid deployments such as for regional MW scale installations where we can build specific competence and export solutions internationally

Locally our suppliers would have advantages from:

- improved local services options
- remanufacturing options
- better interoperability with both the grid and regulatory environment
- ability to improve the pairing of solutions providers with financing options (aka our manufacturers and banks working together on financing retail and grid solutions).

Q3.3: WHAT FUNCTIONS OR FORMS OF HELP SHOULD THE POWERING AUSTRALIA INDUSTRY GROWTH CENTRE DELIVER TO SUPPORT AUSTRALIAN BATTERY INDUSTRIES?

An Industry Growth Centre could bring together the complete supply chain, including:

- creating opportunities within the electrical networks to test and trial new and emerging technologies without being penalised for loss of supply in the event of failure within testing scenarios
- identifying co-product integration opportunities such as batteries within charging stations of EVs or other synergies
- coordinating information, resources and funding
- providing an integrated pathway from research to innovation and through to commercialisation
- improving the awareness of local supply-side capabilities with buy-side activities; connecting manufacturers with buyers
- facilitating integrated policy and funding responses across the sector
- creating a world leading industry that specialises in recycling/repurposing of batteries.

Q3.4: HOW CAN THE ADDITIONAL ADVANTAGES OF A PRECINCT MODEL AND COLLABORATIVE VERTICAL INTEGRATION BE ACHIEVED FOR OUR BATTERY INDUSTRIES?

Efficiencies and effectiveness could benefit from utilising a holistic approach to identifying and integrating all the interested parties, including research facilities (academia, CSIRO, private), miners of raw materials, raw material value adders, manufacturers and industry. There may be advantages in the ability to share production lines, source materials more effectively, and access more targeted skills in a local labour market. Locating plants near rural based mines and other rural areas will create jobs in those areas, has cost advantages and is more competitive.

However, the model may also create some disengagement by:

- precluding pre-existing key players, such as refiners of raw materials, to have ease of access to the precinct, or incurring high costs to move manufacturing operations
- R&D and universities may need to be located within the area to take advantage of the collaboration, whereas other locations around the country may already be undertaking research in battery technologies.

Theme 4: Creating the enabling environment for industry growth.

Q4.1: WHAT CAN BE DONE TO DEVELOP THE WORKFORCE NECESSARY FOR DOMESTIC BATTERY INDUSTRIES?

Developing skills and fostering innovation are critical components of developing a battery industry in Australia. Domestic engineering commencements have been declining in Australia since 2014. This trend has continued, making the profession highly reliant on migrant engineering skills. Governments and industry need to work together to improve the uptake of STEM education and engineering qualifications in Australia. Industry also needs to provide more opportunities for graduate engineers to enter the engineering workforce. Engineers Australia's Strengthening the engineering workforce report provides recommendations to overcoming the challenges influencing the engineering profession in Australia.

Engineers Australia views the fostering of STEM skills in the younger generations as crucial for Australia's ongoing economic success and for the development of our future workforce. The key is to inspire students from a young age to be interested in taking up such courses. Engineers Australia works to:

- Build capability through our education outreach in science and maths to increase the skills of young people in school, giving them more career options for the future.
- Attract young people to engineering as a career option by modelling it as an adaptable and sought after skill set needed by many industries.
- Helping our industry partners to retain, promote and value their talented engineering staff.

The Future Battery Industries CRC worked with stakeholders, including the South Metropolitan TAFE in WA, to conduct a *Vocational skills gap assessment and workforce development plan*. Their research found that many of the training packages required already exist. However, they identified three areas where new vocational skills and knowledge are needed for:

- growing industry; building on our strength in mining, to build capacity in cell and component manufacturing, BESS manufacturing and battery recycling
- support the uptake of BESS and EVs, including safety requirements
- ensuring more accurate and timely data on industry needs is available to ensure we have the workforce with the right skills.

The required knowledge for a thriving local battery business environment requires many specialisations working together in a multidisciplinary approach. Solutions include:

- funding relevant master's programs in electrochemistry and electrochemical engineering
- cadetships or other staffing programs
- import some of the skill base from overseas
- multi/interdisciplinary approach to training students
- micro-credentials for existing engineers, such as fire safety, system control or electrical engineers.

<u>Industry/academic collaboration</u>

Government can play an important role in fostering collaboration between industry and academia, including embedding new technologies/developments into courses and practicals to assist graduates to be ready to work in the industry.

Upskilling rural people to maintain BESS and other systems would make those communities more sustainable and assist to spread the technology into remote areas where these systems are needed.

Q4.2: HOW CAN AUSTRALIA BEST MAINTAIN A WORLD LEADING ENVIRONMENTAL, SOCIAL AND GOVERNANCE REPUTATION FOR PRODUCTS?

The focus on battery (or material) passports (as well as EPDs) in the issues paper is appropriate given the growing demand for traceability. Engineers Australia suggests consideration of the EU's taxonomy for sustainable activities or similar. (This taxonomy is intended to guide investment into environmentally sustainable economic activities in the EU and provides a good checklist of terms to align with.)

Australia should focus on reducing transport distances required throughout the lifecycle of the batteries where possible.

We need to leverage and build on our ESG credentials as a competitive advantage over other countries that focus less on these issues.

Standards

We need to develop standards for how batteries are manufactured, installed, re-used, recycled and disposed of to ensure public safety and interoperability. Good standards will contribute to a competitive advantage. We note the ACCC is also calling for better standards and regulation around batteries.

- Better communication standards allow devices to talk to each other, improving performance.
- If the grid had a way to communicate with the vehicle, it would allow smart decisions and the opportunity to manage load.
- Developing early detection of fire risk (including chargers and operating systems).
- Developing standards around toxicity and environmental impacts.

In an ideal world, we would have engineering standards set in place, and then the industry would develop with those in place, but we are already playing catch up.

Q4.3: WHAT CAN BE DONE TO GIVE CONFIDENCE THAT AUSTRALIAN PRODUCT SAFETY RISKS ARE EFFECTIVELY UNDERSTOOD, MITIGATED AND MANAGED?

Lithium-ion batteries have caused fires leading to property damage, serious injuries and deaths. A lithium-ion battery fire is difficult to extinguish, and the fire service are still coming to terms with the procedures and training required to deal with them. We need to develop harmonised and clear fire safety guidance for owners, facility managers and emergency services personnel. Battery fires are rare but significant when they occur. As the number of batteries in EVs and stationary uses ramps up, and as they age, this will become a much greater concern. Insurance companies are looking at responsibilities and liabilities with battery fires and this may have serious cost implications in the public arena if not properly addressed.

Engineers Australia have formed a working group on the fire safety of batteries. Over 40 engineers have just begun the work, and there are some identified concerns. The plan is to develop a fire engineering practice guide and a guide for EV fire safety in new buildings, including lessons from countries with higher EV penetration.

Considering the cost of having products certified as compliant or "type tested", many companies will not progress to the point of certification because of cost and time constraints. A process of supporting these tests for locally manufactured products would directly assist companies in demonstrating leading and certified performance. The required safety and environmental regulations need to be in place and suitable training provided and reviews implemented.

We need to improve record-keeping and data collection. If you have a little fire in your shed, you might take a vehicle like a scooter, toss it outside, and not even report it. So, we don't know what the accurate statistics are here yet. Recently in Australia, there were some e-scooters sold on an online auction that had been through flood damage and caught fire when people charged them. The thermal runaway on those was exacerbated by flood damage as Lithium-ion batteries are damaged by submersion and develop

thermal runaway when next used. This has been the case with EV's in recent flooding events in Florida USA where a number of vehicles caught fire after trying to start them after being in flood waters.

Developing safer batteries enhances public safety and can be leveraged as a competitive advantage.

Explosion risk

It isn't just a fire safety risk. We also have the explosion risk from the off-gassing of batteries. Moving to a technology like lithium phosphate/iron phosphate with a higher cathode temperature, they are less likely to catch fire but more likely to have a large toxic vapour cloud in an enclosed space, which is an explosion hazard.

Safety concerns in old and new building stock, as well as the EV charging network

STRATA management are expressing concerns about the significant uptake of EVs in residential areas and in residential car parks, both in new construction and in existing stock where the infrastructure is not there. Some estimates are that in seven years, 50 per cent of sales of vehicles in Australia will be EVs. With this market penetration, based on 2022 experience in China, we can expect three or so EV fires a day in Australia. Building compliance pathways are opaque, and we are scrambling to ensure we are comfortable with the fire safety strategy, and this has insurance and liability implications if not managed appropriately.

Capacity for public EV charging in high-density areas will require improved electrical infrastructure on an already weakened network that is undergoing its own transition, and this may require targeted incentives to support EV integration.

Q4.4: HOW CAN GOVERNMENTS AND INDUSTRY ENSURE CIRCULAR ECONOMY PRINCIPLES ARE INCORPORATED INTO THE LIFE CYCLES OF BATTERIES MADE AND USED IN AUSTRALIA?

The issues paper focuses mostly on recycling, which is the lowest order strategy of a circular economy. This focus on recycling should be maintained, however greater focus is required for higher order strategies: refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle (and the recover). The primary focus should be on reducing demand/need for battery storage through energy efficiency and other strategies. For example, in scenarios modelled by the Australian Government, increasing solar PV and battery product life avoids the generation of 60,000 tonnes of e-waste at the source (DCCEEW, 2021, e-Stewardship Evidence Report).

In R&D and manufacturing activities, enablers for a circular economy will include design for disassembly, repair and recoverability. In the market, enablers for a circular economy will include supported repair, remanufacturing and reuse markets, coupled with State of Health testing and logistics, increased Extended Producer Responsibility, take-back schemes and product-as-a-service models.

Lack of feedstock is only one of many challenges preventing recycling. Other challenges include: uncertainty regarding future dominant chemistries, lack of on-demand information on how to test, disassemble, repair, recycle batteries (end-of-use manuals or similar through battery passports), issues around who bears the cost and when.

CSIRO and the Future Batteries Industries have estimated lost value of somewhere between $603 million to $31 billion due to poor lithium-ion battery collection, offshore recycling and landfilling. Their stakeholders view re-use, recycling and materials recovery as one of the top opportunities for the sector.

Australia can leverage our expertise from the mining industry in using technologies such as hydrometallurgy and pyrometallurgy. We should aim for production using 100 per cent recycled materials where possible, for example, cathodes made with 100 per cent recycled nickel, manganese and cobalt.

The circular economy for batteries can only be established and maintained through legislation, regulation and standards. Priority solutions include:

- a comprehensive review of regulations and guidelines for battery waste, and proper enforcement of the policy

- proper labelling/barcoding/QR coding of batteries and cells so the type of battery can be easily identified and handled appropriately
- a system for national product stewardship put in place
- designing and building batteries to be recycled
- development of a battery waste transportation policy
- provision of special industrial zones set aside specifically for product recycling
- investment and funding will be required to sustain the recycling facilities until volume and technology allow the process to be a commercially viable business.

We need the R&D and regulation from the beginning to close that loop and establish a competitive advantage for the Australian industry. We can build new technology and the circular economy in parallel, so we create an industry that is growing in terms of our competitive advantage and ESG priorities.


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