



Department of  
Jobs, Tourism, Science  
and Innovation

# Western Australia's Battery and Critical Minerals Strategy

Stakeholder consultation paper 2023





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# Acknowledgement of Country

The Western Australian Government acknowledges the Traditional Custodians throughout Western Australia and their continuing connection to the land, waters and community. We pay our respects to all members of Aboriginal and Torres Strait Islander communities and their cultures, and to Elders past present and emerging.

## Disclaimer

The information contained in this publication is provided in good faith and believed to be reliable and accurate at the time of publication. However, the information is provided on the basis that a reader will be solely responsible for making their own assessment of the information and its veracity and usefulness. The State shall in no way be liable, in negligence or howsoever, for any loss sustained or incurred by anyone relying on the information, even if such information is or turns out to be wrong, incomplete, out of date or misleading.



## Minister's Foreword



*“Western Australia is in prime position to further develop our value-adding battery and critical minerals industries, seizing the opportunities presented by soaring global demand for our critical minerals”*

Western Australia will play a central role in decarbonising the world's economies and the State's battery and critical minerals sector is proving to be essential in this drive.

Our State is a reliable, ethical and cost-effective supplier of battery and critical minerals that make-up the batteries and clean energy technologies steering us towards a net zero emissions future.

The Cook Government is committed to ensuring Western Australia continues to make a meaningful contribution to lowering global emissions by embracing opportunities to grow the State's participation in battery and critical minerals supply chains.

To this end, the initial Future Battery Industry Strategy launched in 2019, which set out to establish a downstream processing industry in the State, is the platform for Western Australia to launch into the next phase of our Battery and Critical Minerals Strategy.

As the industry has emerged, it has become apparent that the wide array of battery and critical minerals proponents in the State have specific needs to be successful in niche parts of the value chain.

The Cook Government acknowledges the complexities associated with the battery and critical minerals business and sees the refresh of the State's strategy as an opportunity to assist industry in overcoming the various challenges faced.

Enhancing our capacity to extract maximum value from our future facing raw materials through downstream processing in Western Australia will continue to be a pillar of the State's strategy, given the success to date in lithium hydroxide and nickel sulphate production and refining of rare earths.

Government and industry have committed to building capacity in the battery supply chain in Western Australia, which is underpinned by a supportive regulatory regime for companies to make generational, multi-billion dollar investments in the State.

So far, the collaborative effort of government, industry, communities and First Nations people, has delivered a significant battery chemical industry that benefits all Western Australians.

Together, I am confident we can achieve more by continuing to nurture existing relationships and breaking ground in new ones, as we forge ahead with our vision to be a world leader as a reliable and responsible producer of battery and critical minerals.

### Hon Bill Johnston MLA

Minister for Mines and Petroleum; Energy



# 1. Purpose

The WA Government is refreshing its Battery and Critical Minerals Strategy (the 2024 - 2030 strategy) and is seeking feedback from stakeholders on how the State can position itself to attract investment and maximise value from our burgeoning sector.

The 2024 – 2030 strategy provides an opportunity to refocus policy frameworks to support the sector through to the end of the decade, as well as address immediate priorities and actions required to achieve our ambitions. It will build on the vision set out in the 2019 Future Battery Industry Strategy for WA to host a world leading, sustainable, advanced manufacturing chemical sector through value-adding to our raw materials, creating local jobs, enhancing skill development, driving economic diversification and benefitting regional communities.

This consultation paper delves into the distinct opportunities and challenges associated with WA's battery and critical minerals sector and reflects learnings garnered from previous industry consultation and research.

## Responding to this consultation paper:

Please submit responses to this consultation paper online at [www.wa.gov.au](http://www.wa.gov.au)

Submissions are to be received by **5pm Monday 4 December 2023**

The following independent resources provide a further perspective on the challenges and opportunities that lay ahead for our battery and critical mineral sector:

[State of Play, Critical Minerals: An Industry Perspective](#)

[Future Battery Industry Cooperative Research Centre. Charging Ahead](#)

[Chamber of Minerals and Energy WA, Accelerating opportunities in Western Australia's Critical Minerals Sector](#)

**Critical minerals are metallic or non-metallic elements that are essential to the functioning of modern technologies, economies or national security and whose supply is at risk of disruption.**

**They are essential inputs in renewable energy technologies, such as rechargeable batteries, electric vehicles (EVs), wind turbines, solar panels and hydrogen electrolyzers, as well as having applications in advanced technologies and defence systems.**



## 2. Why Update Western Australia's Battery and Critical Minerals Strategy?

**Advancing WA's battery and critical minerals sector is a priority of the State's economic diversification agenda.**

Battery and critical minerals represent an immediate opportunity to leverage WA's traditional strengths of mining and mineral processing, and to establish a new, highly-skilled industry focussed on chemical and component manufacturing. This is recognised in the State's economic development framework, *Diversify WA*, and targeted industry development plan outlined in *Future State: Accelerating Diversify WA*.

The size of this opportunity is far greater than first thought. In Australia, a diversified battery industry, comprising mining, processing, manufacturing and recycling industries, is forecast to contribute \$16.9 billion in gross value added and 61,400 jobs to the national economy by 2030.<sup>1</sup> This is more than twice the value estimated in 2021.

**WA is well positioned to capitalise on this opportunity courtesy of attracting major cornerstone critical mineral processing investments.**

Over the past few years, WA has welcomed major industry advancements in the mining and advanced processing of critical minerals. This includes construction and commissioning of large-scale battery chemical facilities, as well as major investments in rare earth element refineries. These projects are a first for Australia. This has put WA in an enviable position of having a local industry and workforce with the skills and experience needed to build and operate these complex projects. Coupled with WA's abundance of raw materials, well-established and reliable resources sector and commitment to upholding the highest environmental, social and governance (ESG) standards, WA has set a strong foundation to continue to grow and diversify the sector.

**Global competition has heightened creating new opportunities and challenges for WA.**

Critical minerals are fundamental to a decarbonised world, and are in high demand as countries accelerate towards net zero and stake their claim in emerging clean energy markets. Yet supply chain challenges continue to intensify as a result of the COVID 19 pandemic, international conflicts and ongoing tensions between the world's largest economies. Many governments have responded by adopting policies aimed at securing and diversifying supply and growing sovereign processing capabilities, underpinned by attractive financial incentives and other interventions. For example, the United States' (US) *Inflation Reduction Act* (2022) supports the US's domestic processing abilities and encourages manufacturers to source inputs from broader supply chains. This is likely to create opportunities for WA's critical mineral miners and chemical manufacturers, however impacts Australia's cost competitiveness in battery manufacturing.

**For WA's industry to continue its rapid development, better operational and ecosystem connectedness for critical mineral processors is required.**

WA's success in establishing domestic critical mineral processing capabilities has in part been enabled by the state's well-established industrial precincts. However, a recent influx of investment into the state has left some of these highly-coveted sites with limited capacity to accommodate further projects. We are seeking feedback on how WA can continue to attract investment in an increasing competitive investment environment. As advised by industry stakeholders, access to

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<sup>1</sup> Future Battery Industries CRC (2023).  
Western Australia's Critical Minerals Strategy  
Stakeholder Consultation Paper  
November 2023



utilities and chemical feedstock, management of waste by-products, regional logistics and continued improvement of approvals timeframes are areas to be addressed. We welcome further ideas, and greater detail on those industry needs already identified.

**To achieve our goals, coordinated action is needed at a state and national level.**

In June 2023, the Australian Government set the agenda for the country's critical minerals ambitions through an update to the national critical minerals strategy<sup>2</sup>. The Australian Government is also currently developing a national battery strategy, which aims to build competitiveness in battery manufacturing.

The WA Government will work closely with the Australian Government to ensure WA's 2024 – 2030 strategy supports and complements the national approach to maximise outcomes for the state and nation.

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<sup>2</sup>[Australian Government Critical Minerals Strategy 2023-2030](#)  
Western Australia's Critical Minerals Strategy  
Stakeholder Consultation Paper  
November 2023



### 3. Introduction to Western Australia’s Battery and Critical Minerals Sector

In developing the 2024 - 2030 strategy, the WA Government will consider which specific minerals and value chain segments (refer graphic below) hold the highest potential benefits, and what challenges may materially impact the realisation of these prospects. This will help prioritise efforts and support the state in capturing value in the global battery and critical minerals market.

The critical minerals value chain graphic below, categorises different industry activities into specific value chain segments. WA has a long history of upstream activities, such as exploration and mining, with established midstream industries, including lithium hydroxide refining. These successes are creating opportunities to further develop WA’s fledgling downstream industries.



#### Upstream opportunities

WA has a well-established resources sector, and is consistently ranked as one of the most attractive mining jurisdictions in the world<sup>3</sup>. Mining accounted for nearly half (A\$186.8 billion) of WA’s Gross State Product in 2021-22.

In addition to being the world’s largest exporter of iron ore and third largest exporter of liquefied natural gas, WA is a major supplier of critical minerals. The state accounts for around half of global lithium production and is an important source of nickel, cobalt, manganese and rare earths.

#### Western Australia’s battery and critical minerals production 2022



<sup>3</sup> *Annual Survey of Mining Companies, 2022 | Fraser Institute*  
Western Australia’s Critical Minerals Strategy  
Stakeholder Consultation Paper  
November 2023



Underpinning this supply is an outstanding mineral endowment. Our vast state has an abundance and diversity of critical minerals, with further discoveries anticipated following a recent boom in exploration activity. WA hosts almost all the minerals on Australia's critical minerals list, including the majority of Australia's lithium deposits. See Section 6.1 *List of Critical Minerals* and 6.2 *Western Australia's Critical Minerals Reserves* for more detail.

WA is expected to continue to discover and bring into production new critical mineral mines. Exploration activity has increased significantly since 2019 and the state's mining fundamentals remain strong, with the Government-backed Exploration Incentive Scheme (EIS) increasingly being used for critical minerals exploration. Converting exploration activity into producing mines will be integral to WA's ability to continue moving down the value chain.

### **Midstream opportunities**

WA has established advanced critical mineral processing capabilities. Since 2015, almost \$9 billion has been invested in projects manufacturing battery chemicals and separated rare earth oxides in WA, with billions of additional investments in the pipeline. Highlights to date include:

- BHP Nickel West produced Australia's first nickel sulphate from its 100,000 tonnes per annum Kwinana refinery in 2021.
- Tianqi Lithium Energy Australia produced Australia's first battery-grade lithium hydroxide from its 48,000 tonne per annum Kwinana refinery in 2022.
- Albemarle produced lithium hydroxide in 2022 from its Kemerton refinery, and earlier this year, announced a \$2 billion investment to double the refinery's capacity from 50,000 to 100,000 tonnes per annum.
- Covalent Lithium is constructing a 50,000 tonnes per annum lithium hydroxide refinery in Kwinana, with first production planned for 2025.
- Lynas is constructing Australia's first rare earths refinery in Kalgoorlie with capacity to produce 12,000 tonnes per annum of neodymium and praseodymium as rare earth carbonate.
- Iluka is constructing Australia's first integrated rare earths refinery in Eneabba with capacity to produce 17,500 tonnes per annum of separated rare earths oxides. The Australian Government has supported the development through a \$1.25 billion non-recourse loan under the Australian Government's Critical Minerals Facility.

WA's large resource base and robust global demand for battery chemicals and other processed critical minerals supports further investment in the state. Additional critical mineral processing activities are already planned in WA, including the production of battery-grade vanadium, graphite, high purity alumina, cobalt sulphate, manganese sulphate and precursor cathode active materials, with significant funding already committed to many of these ventures. See Section 6.3 *Western Australia's Key Midstream Investments* for more detail.



## Downstream opportunities

WA's success in the midstream sector has created opportunities to advance local downstream industries, including the manufacturing, deployment, maintenance and recycling of batteries and battery components, semiconductors, permanent magnets and other critical mineral technologies. Developing this industry segment represents an opportunity for WA to capture the full value of its critical mineral endowment.

Presently, WA hosts a fledgling downstream battery industry. The majority of operators either import and on-sell lithium-ion batteries to local customers, assemble batteries using imported cells, or are firms that provide integration and battery maintenance services. While there is currently no lithium-ion battery manufacturing in WA, a small number of firms are producing Vanadium Redox Flow Battery systems. Several WA businesses collect lithium-ion batteries for recycling but all waste batteries are exported interstate.

To advance WA's downstream capabilities relatively low domestic demand and significant foreign competition are factors to overcome. WA's (and Australia's) domestic demand for batteries and other critical mineral technologies is relatively small compared to other countries, and alone is unlikely to support the scale of battery manufacturing seen elsewhere in the world. This is especially true for countries with electric vehicle manufacturing capabilities. Competition from foreign jurisdictions is also the greatest in this segment of the value chain, as many of WA's trade partners move to bolster or reinvigorate their manufacturing capabilities.

Nonetheless, as Australia's primary source of battery chemicals, WA is well placed to capitalise on the advantages of co-location and niche battery manufacturing opportunities, such as off-grid stationary batteries or bespoke solutions to support the electrification of the mining sector.

### Questions:

In providing a response to the below questions, where possible, please have regard to the potential economic, social and other benefits to the state; likely barriers that will need to be overcome; and commonalities across opportunities.

- 1.1 The primary intent of the strategy is to extract greater value from WA's resources onshore, to create skilled jobs, grow and diversify the economy and benefit regional communities. With this in mind, which value chain segments (i.e. upstream, midstream or downstream industries) should WA prioritise under the 2024 - 2030 strategy, and why? Does this vary for different minerals?
- 1.2 With regards to downstream opportunities, to date the strategy has focused on developing battery industries in WA. Going forward, should the 2024 - 2030 strategy also consider other related downstream opportunities, such as semiconductor and permanent magnet value chains?
- 1.3 WA has a diverse range of battery and critical mineral deposits. Should the 2024 - 2030 strategy include a particular focus on developing specific minerals?



## 4. The Approach

The 2024 – 2030 strategy will establish a clear and robust policy framework to support investment and maximise value to local industry and communities. Given the rapid pace at which the sector is evolving, this framework needs to provide policy makers, researchers and industry with flexibility to adapt to changing market conditions and priorities.

In June 2023, the Australian Government released the Critical Minerals Strategy 2023-2030<sup>4</sup> to grow Australia's critical minerals sector. The aim of the national strategy is that by 2030, Australia:

- has grown the geostrategic and economic benefits of its critical minerals sector;
- is a globally significant producer of raw and processed critical minerals; and
- supports diverse, resilient and sustainable supply chains.

The following focus areas of the Australian Government's Critical Minerals Strategy 2023-2030 were informed by extensive public consultation and have informed the thinking for the development of this paper:



The Australian Government is also in the process of developing a National Battery Strategy.

The WA Government intends to align with and complement this national approach, in order to progress coordinated strategic actions to support industry development.

### Questions:

2. Are there matters outside the scope of the Australian Critical Minerals Strategy focus areas that should be considered for WA in defining the priority action areas of WA's 2024 - 2030 strategy?

<sup>4</sup> *Australian Government Critical Minerals Strategy 2023-2030*  
Western Australia's Critical Minerals Strategy  
Stakeholder Consultation Paper  
November 2023



## 5. Key Considerations for the Strategy

The 2024 - 2030 strategy will consider the relative importance and immediacy of actions required to support the development of WA's battery and critical minerals sector. Through this consultation process the WA Government seeks to clarify the key factors, and areas for improved collaboration, that will further develop the industry to ensure that WA is positioned as a world leading, sustainable and value-adding jurisdiction.

The key considerations discussed below are a non-exhaustive list of factors often raised by stakeholders when considering how to support WA and Australia's battery and critical mineral sector.

### 5.1. Industrial Land and Service Infrastructure

Critical minerals processing requires access to mineral and chemical feedstock, is typically energy and water-intensive, and entails export of often containerised products that necessitates specific transport solutions. As companies strive to fulfil decarbonisation commitments and satisfy ESG requirements of offtake partners, there is increasing demand for reliable and cost effective renewable energy. Waste management is another key consideration, given the high volumes of waste associated with transforming ore containing small quantities of critical minerals into high-purity chemical products.

To date, the majority of WA's critical minerals processing projects have been located in the state's established industrial areas. The Kwinana-Rockingham Strategic Industrial Area (SIA) has emerged as a pivotal hub, strategically positioning industries with access to production inputs, transport networks including the Fremantle Port, and a skilled workforce. Cornerstone projects like Tianqi and Covalent's lithium hydroxide plants and BHP Nickel West's nickel sulphate plant are located in the area. Further investment is anticipated with land allocated to a number of prospective critical mineral proponents.

Through its Global Advanced Industries Hub program, the WA Government aims to de-constrain and optimise land in the Kwinana-Rockingham area. The WA Government has also identified the need to establish alternate locations for mineral processing hubs to meet ambitious industry development goals, and is working to activate suitable industrial land.

In addition to the significant private sector investments in the Kwinana-Rockingham SIA, the State is progressing planning to develop critical mineral processing hubs in other SIAs. WA has a network of Strategic Industrial Areas across the state that aim to support investment in the downstream processing of the state's resources and other strategic industrial activities. These areas are at varying levels of development and include well-established industrial precincts, as well as undeveloped greenfield sites. The 2024 - 2030 strategy will consider where and how to establish WA's next critical mineral processing hubs, and will build upon existing government initiatives aimed at deconstraining WA's industrial areas.

The Kemerton SIA, located in the South West region near Bunbury, and the Mungari SIA, located in the Goldfields region near Kalgoorlie present as the next logical locations for critical mineral processing given the Kwinana-Rockingham SIA is nearing full capacity. The Kemerton SIA, already home to Albemarle's lithium hydroxide plant, contains a significant area of unallocated land that the State is activating through the progression of the Kemerton Strategic Environmental assessment and the exploration of solutions to infrastructure and other constraints. The State is also developing a coordinated approach to land activation activities that will transform the Mungari SIA and nearby industrial land into an attractive location for further private sector investment.



## 5.2. Research and Development

Advancing WA's technical capability across all segments of the value chain is essential for WA to grow its battery and critical minerals sector and improve its cost competitiveness.

WA proudly hosts the nation's Future Battery Industries Cooperative Research Centre (FBICRC), a \$127 million research collaboration between industry, government and Australia's leading universities and research institutions. The FBICRC aims to enhance the competitiveness of Australia's battery industry, through the delivery of industry-directed research projects, targeting all segments of the battery value chain.

The WA Government helped fund a number of FBICRC research projects, including nickel and cobalt extraction, lithium processing and the flagship Cathode Precursor Production Pilot Plant (CPPPP). The CPPPP is the first of its kind in Australia and established the technology and capabilities to manufacture cathode precursors at a pilot scale and created a pathway for large-scale development.

The 2024 – 2030 strategy will consider how WA can best support ongoing research and development for the battery and critical minerals sector.

### Battery and Critical Minerals Institute

The Mineral Research Institute of Western Australia is developing a business case in collaboration with the FBICRC that will consider the potential for the CPPPP to evolve into a Battery and Critical Minerals Institute, which would leverage the investment, collaboration and momentum built by the CPPPP to date.

The institute would be a collaborative facility with common use pilot plant equipment and resources, designed to support the growth and diversity of WA's battery and critical minerals sector. It would focus on upstream and midstream activities, including minerals processing, high purity metals refining and advanced materials manufacturing. The facility would also emphasise research and training, and support for commercialisation of emerging products, ideas and businesses from across Australia.

Common user facilities and collaborative institutes are increasingly being used to support industry innovation, training and commercialisation across the entire value chain. Examples include the UK Battery Industrialisation Centre, the US Argonne National Labs and National Renewable Energy Laboratory, and Japan's National Laboratory for Advanced Energy Storage Technologies. Each has a different focus and business model and provides examples of possible models for a WA institute.

## 5.3. Access to Capital Funds and Financial Incentives

Access to capital funds can be a major barrier for battery and critical mineral proponents at all segments of the value chain, including junior and mid-tier companies looking to develop more 'niche' critical minerals projects. This is due to often high development costs, and difficulties obtaining finance as a result of immature markets, opaque and volatile pricing, technical complexities and a general unfamiliarity from financiers.



### Focus Project:

#### Tianqi Lithium Australia Kwinana Lithium Hydroxide Refinery

In 2022, Tianqi became the first company to produce lithium hydroxide in Australia. Train 2 is currently under development with further expansion under consideration.

**Production capacity:**  
50,000tpa lithium hydroxide

**Capex:** \$988m

**Jobs:** 200 (operational),  
900 (construction)



One way companies are overcoming this hurdle is by obtaining funding from international offtake partners and foreign governments. This approach to financing has supported a number of WA's battery and critical minerals projects, however in some cases has also resulted in processing infrastructure being built offshore.

WA competes with other jurisdictions to attract investment in value-adding battery and critical minerals industries, with an increasing number of less established jurisdictions in this sector providing significant incentives to attract investment.

For example:

- the US IRA is driving investment in battery and battery chemical manufacturing in the US by offering tax incentives.
- The Canadian Government proposed a 30% critical minerals exploration tax credit (CMETC) along with committing C\$3.8 billion over the next eight years to implement the nation's critical minerals strategy.
- Many other countries, including EU, UK, Japan, South Africa, Chile, Argentina, Indonesia and China maintain policies targeted at promoting critical mineral exploration, production and innovation.

These policies contain a range of investment support options including direct funding, tax schemes, R&D support and innovation capital.

The Australian Government has established financial incentives to support the development of critical minerals proponents. For example, the Junior Minerals Exploration Incentive (JMEI) offers exploration credit incentives for small minerals companies; the National Reconstruction Fund and Northern Australia Infrastructure Facility fund mining technology advancements and facilitate financing for infrastructure projects; and the recently expanded \$4 billion Critical Minerals Facility funds projects aligned with the Australian Critical Minerals Strategy. Over the last two years, the Australian Government has committed \$2.2 billion in WA's battery and critical minerals sector.

The WA Government, through its Investment Attraction Fund, also provides financial incentives to investors, primarily focussed at supporting early stages of development (e.g. pilot scale). The next round of the Investment Attraction Fund will focus on supporting new energy investments, such as battery and critical mineral projects.

The 2024 - 2030 Strategy will consider the best methods for facilitating access to capital across the battery and critical minerals sector and how best to enable industry, while having regard to public value, risks and the potential for negative externalities. The WA Government is seeking to understand the role it should play in supporting companies to access capital by facilitating international investment and partnerships. This is discussed further below.

## 5.4. Investment Attraction and Partnerships

The importance of international partnerships to WA companies and the State's ambitions cannot be underestimated, with collaborations providing access to capital, technical expertise, offtake opportunities and processing inputs that may not otherwise be available.

Increasingly, local companies are realising opportunities to leverage their mining strengths and move into midstream processing through collaboration with international chemical processing companies. This approach saw three of the world's largest producers of lithium – Tianqi Lithium, Albemarle and



SQM – team up with WA companies to build lithium hydroxide facilities. Tianqi and SQM worked with local companies IGO and Wesfarmers respectively, while Albemarle previously partnered with Mineral Resources.

Through Invest and Trade WA and its global network of investment and trade offices, the WA Government promotes WA as an investment destination and facilitates international partnerships across key markets.

The 2024-2030 strategy will consider what the WA Government can do to further foster international partnerships and engagement.

## 5.5. Mining and Exploration

The WA Government understands continued investment in exploration is necessary to develop the mines required to enable advanced critical mineral processing and supports programs that continue to provide a pipeline of critical minerals mining projects.

The State’s Exploration Incentive Scheme, which has been operating since 2009, aims to stimulate private sector resource exploration through regional geoscience data acquisition programs and co-funding drilling. The precompetitive data funded by the scheme is freely available and can reduce technical and financial risks to help exploration companies identify drilling targets prospective for critical minerals.

Further initiatives include digitally transforming the state’s vast repository of geoscience data to facilitate data-driven exploration targeting, and a state-wide passive seismic survey currently underway to unlock more of the state’s resources.

These programs are supported by the \$40 million Sustainable Geoscience Investment package announced as part of the 2023-24 State Budget that specifically targets increasing critical minerals exploration.

The 2024 – 2030 strategy will consider what continued support can be provided to increase and expedite the development of our critical mineral resources.

## 5.6. Skilled Workforce

As the critical minerals sector expands, the presence of skilled workers is becoming increasingly vital. In Australia it is estimated that growth of our battery industries could create 60,000 new jobs by 2030. While skilled migration may be a valuable avenue for advancing Australia's critical minerals industry to address skill shortages and foster innovation, global competition for workers in these industries is expected to be fierce with a shortage of skilled workers to meet demand.

WA has a highly skilled workforce of specialists in mining and minerals processing that has evolved alongside the state’s preeminent resources industry. The state also has well established training institutions. The WA Government identifies the need to ensure our local workforce and training



### Focus Project:

#### Iluka Resources Eneabba Rare Earths Refinery

Supported by a \$1.25b Australian Government loan, Iluka is building a refinery that will be one of few facilities globally to produce both light and heavy rare earth oxides. First production is scheduled for 2025.

**Production capacity:**  
17,500tpa rare earth oxides

**Capex:** \$1.2 billion

**Jobs:** 300 (operational),  
270 (construction)



institutions are ready to meet the industry’s future requirements, including developing skills relating to battery chemical processing and manufacturing.

The skill and job requirements for value-add activities in the battery and critical minerals sector have been assessed at both the state and national level, with the *Vocational skills gap assessment and workforce development plan* published in late 2021. The WA Government has also invested in developing specialised vocational training related to the battery and critical minerals industries, such as the design and installation of on-grid and off-grid battery storage systems. There may be opportunities to develop further vocational training, in collaboration with other states and the Australian Government. Of particular relevance to WA may be the development of training relating to manufacture of high purity battery grade materials.

With regard to skilled migration, the WA Government is currently establishing a strategic framework that will identify and address the barriers and challenges faced by migrants and provide a structure to underpin the development of current and future skilled worker attraction initiatives for WA. The framework will facilitate cross government collaboration to provide better outcomes for WA and skilled migrants. Given the global competition for skilled workers, a longer term strategic approach to the attraction of priority workers will be enhanced and promoted by the WA government’s overseas offices in market.

The 2024 – 2030 strategy will consider expanding government initiatives to attract and train skilled workers which reflect the current and emerging needs of our battery and critical minerals sector.



**Focus Project:**

**Albemarle Corporation  
Kemerton Lithium  
Hydroxide Refinery**

Albemarle’s Kemerton refinery began operation in 2022. In 2023, Albemarle committed to doubling capacity to 100,000tpa.

**Production capacity:**  
100,000tpa lithium hydroxide

**Capex:** \$3 billion

**Jobs:** 850 (operational),  
1000 (construction- trains 3&4)

## 5.7. Social Licence to Operate, Approvals and First Nations

WA offers investors a stable and secure investment environment as the state’s robust and transparent regulatory frameworks ensure projects meet high ESG standards. This key advantage is set to strengthen WA compared to other resource rich jurisdictions, as governments and customers continue to set higher ESG requirements. For example, the European Parliament has adopted new rules to tackle environmental, ethical and social issues associated with battery manufacturing. Further, Australia, Canada, the United Kingdom (UK), France, Germany and the US signed the Sustainable Critical Minerals Alliance in December 2022 committing to environmentally and socially responsible critical minerals mining practices.

The WA Government has invested over \$142 million to streamline the State’s approvals system, including establishing a new unit providing targeted assistance to green energy projects. In addition, the WA Government is investigating opportunities to secure ‘pre-approvals’ for some of WA’s existing Strategic Industrial Areas, where investment in midstream processing is targeted.

The sharing of benefits with regional communities and First Nations Peoples, while respecting the rights and interests of First Nations, is a key consideration when developing WA’s critical minerals sector.

The 2024 – 2030 Strategy will consider how to balance a timely and easy-to-navigate approvals system with robust social and environmental outcomes, whilst highlighting areas of further improvement for the battery and critical minerals sector.



## Questions:

3. What are the most important actions required to support WA's battery and critical mineral sector?

- What is the order of priority to implement these actions?
- How is the WA Government placed to address these to support development of the sector compared to the Australian Government, research institutions and industry?
- Are these actions equally significant across different mineral and value chain opportunities?
- How applicable are these actions to projects in different development stages (i.e. early-stage initiatives versus full-scale development)?

3.1 Critical mineral processing hubs

- What factors need be considered to establish investment-ready industrial precincts?
- How can industry participate?
- Where in WA would a critical mineral processing hub be best located?

3.2 Research commercialisation

- What value is there in establishing a Western Australian Battery and Critical Minerals research commercialisation institute?
- How could such an institute best address barriers to industry development?
- What type of research equipment or activities will be most beneficial at an institute?

3.3 Access to capital and financial incentives

- How can the WA Government address access to capital challenges to support the sector?
- What initiatives should the WA Government consider?

3.4 Investment attraction and partnerships

- Where should the WA Government target efforts to develop further international partnerships to unlock funding, offtake and technical expertise for the sector?

3.5 Mining and Exploration

- What government support is needed to further support and expedite identification and development of new battery and critical minerals resources, including through reprocessing of tailings or waste streams?
- What barriers need to be addressed?

3.6 Skills and Training

- Where should the emphasis be among vocational training, university courses and skilled migration as sources of talent to build capacity in the battery and critical minerals sector?
- What are the immediate training needs not currently addressed in the curriculum? Please identify these.

3.7 Social licence to operate

- How can WA capitalise on its existing advantages to create economic opportunities for all Australians, and ensure benefits flow to regional communities and First Nations Peoples?

3.8 Approvals

- Please identify any specific opportunities to further streamline regulatory processes to support WA's battery and critical minerals sector.

3.9 Stakeholder engagement

- How can industry, governments, investment groups, communities, research centres and other stakeholders strengthen collaboration and broadened information sharing?



## 6. Appendix

### 6.1. List of Critical Minerals

Critical mineral	US 2022	EU 2020	Japan	Republic of Korea	India	Canada	UK	WA Resource Potential
<b>Included in Australia Critical Minerals List, published on 20 June 2023<sup>5</sup></b>								
Antimony	X	X	X	X	X	X	X	X
Beryllium	X	X	X	X	X			X
Bismuth	X	X	X	X	X	X	X	X
Chromium	X		X	X	X	X		X
Cobalt	X	X	X	X	X	X	X	X
Gallium	X	X	X	X	X	X	X	X
Germanium	X	X	X	X	X	X		X
Graphite	X	X	X		X	X	X	X
Hafnium	X	X	X	X				X
Helium						X		X
High purity alumina	X	X						X
Indium	X	X	X	X	X	X	X	X
Lithium	X	X	X	X	X	X	X	X
Magnesium	X	X	X	X		X	X	X
Manganese	X		X	X		X		X
Niobium	X	X	X		X	X	X	X
Platinum-group elements	X	X	X		X	X	X	X
Rare-earth elements	X	X	X		X	X	X	X
Rhenium			X		X			X
Scandium	X	X						X
Silicon		X	X		X		X	X
Tantalum	X	X	X		X	X	X	X
Titanium	X	X	X			X		X
Tungsten	X	X	X			X	X	X
Vanadium	X	X	X		X		X	X
Zirconium	X		X		X			X
<b>Other Critical Minerals</b>								
Aluminum	X					X		X
Arsenic	X			X		X		X
Barite (Baryte)	X	X						
Barium				X				X

<sup>5</sup> [Australia's Critical Minerals List \(2023\)](#)  
Western Australia's Critical Minerals Strategy  
Stakeholder Consultation Paper  
November 2023



Critical mineral	US 2022	EU 2020	Japan	Republic of Korea	India	Canada	UK	WA Resource Potential
Bauxite		X						X
Borate		X						
Boron				X				
Cadmium				X				X
Cesium	X			X		X		X
Coking coal		X						
Copper						X		X
Fluorspar	X	X				X		X
Molybdenum				X		X		X
Natural rubber		X						
Nickel	X					X		X
Phosphate rock		X						X
Phosphorus		X						X
Potash						X		X
Rubidium	X							X
Strontium		X						
Tellurium	X					X	X	X
Tin	X					X	X	X
Uranium						X		X
Zinc	X					X		X



## 6.2 Western Australia's Critical Minerals Reserves





## 6.3 Western Australia’s Key Midstream Investments

### Western Australia’s key midstream investments

- Operating/committed
- Planned – with government funding in place

#### Lithium

- **Tianqi Lithium Australia**  
Production capacity:  
48,000 tpa of lithium hydroxide  
Capex: \$700 million

#### Lithium

- **Covalent Lithium**  
Production capacity:  
50,000 tpa of lithium hydroxide  
Capex: \$1.9 billion\*

#### Nickel

- **BHP Nickel West**  
Production capacity:  
100,000 tpa of nickel sulphate  
Capex: \$60 million

#### Graphite

- **Ecograf**  
Production capacity:  
20,000 tpa of spherical graphite  
Capex: \$100 million

#### Rare earths

- **Hastings Technology Metals**  
Production capacity:  
15,000 tpa MREC<sup>^</sup>  
Capex: \$948 million\*\*

#### Vanadium

- Australian Vanadium**  
Production capacity:  
11,200 tpa of vanadium  
Capex: \$600 million

#### Rare earths

- **Iluka Resources**  
Production capacity:  
17,500 tpa of rare earth oxides  
Capex: \$1.2 billion

#### Lithium

- **Albemarle Lithium**  
Production capacity:  
100,000 tpa of lithium hydroxide  
Capex: \$3 billion

#### Rare earths

- Lynas Rare Earths**  
Production capacity:  
9,000 tpa MREC<sup>^</sup>  
Capex: \$575 million<sup>^^</sup>

### P-CAM in WA

The WA Government continues to support and encourage investment in Precursor Cathode Active Material (P-CAM) production in WA. Companies including IGO and Wyloo Metals (in partnership with a battery chemical manufacturer), Austvolt and Pure Battery Technology are pursuing this opportunity, which would make WA the home of Australia’s first commercially produced P-CAM.

tpa = tonnes per annum

\*inclusive of mine and concentrator

\*\* Total project cost for stage 1 and 2

<sup>^</sup> Mixed Rare Earth Carbonate (MREC) containing Neodymium and Praseodymium

<sup>^^</sup> Figure inclusive of Malaysian plant upgrades

Production capacity and capex figures are provided as estimates only. Actual production and costs may vary



## 6.4 Key Commodity Summaries

### Lithium

#### *Current state*

- WA has the second largest lithium reserves in the world (28% of global reserves in 2021).
- In WA, lithium minerals are mined from hard-rock sources.
- WA is the largest lithium supplier in the world, accounting for 52% of global supply in 2022.
  - Greenbushes is the largest hard-rock lithium mine in the world and accounted for 48% of the state's lithium production in 2022. Other major lithium mines included Mt Marion, Pilgangoora, Wodgina, Mt Cattlin and Kathleen Valley.
- In 2022-23, the value of WA's lithium sales increased to \$21 billion.
- WA has existing lithium hydroxide manufacturing capabilities.
  - Tianqi (24,000 tpa – operational; 24,000tpa – under construction) and Covalent (50,000 tpa - under construction) have refineries in Kwinana. Albemarle (50,000 tpa – operation; 50,000 tpa – under construction) has a refinery in Kemerton, which is currently being expanded to 100,000 tpa.
  - By 2027, around 20% of all lithium mined in WA will be converted into lithium hydroxide at local WA refineries (based on current projects under development).

#### *Future opportunities*

- Increase lithium production through mine expansions and development of new mines.
  - A number of projects are under construction or committed; Pilgangoora expansions, Kathleen Valley, Greenbushes expansion and Mt Marion expansion.
  - There are a number of further projects planned and under consideration, including the Manna and Pioneer Dome projects and further expansion of Greenbushes.
  - Over the past year, new Maiden lithium resource estimates have been announced for the Marble Bar, Manna, Mt Ida, Split Rocks, Mt Edwards (Faraday) and Niobe projects and exploration activity is producing significant results across a number of other lithium prospects.
- Increase lithium chemical manufacturing.
  - There are opportunities to significantly increase midstream processing of lithium in WA, through the expansion of existing facilities and development of new operations.
  - WA lithium miners are exploring opportunities to process lithium onshore, including the manufacturing of lithium hydroxide, as well as intermediary chemicals such as lithium sulphate and lithium phosphate.

### Nickel

#### *Current state*

- A quarter of the world's nickel reserves are located in WA (25% of global reserves in 2021).
- High grade nickel from nickel sulphide deposits, best suited to battery manufacturing, along with medium to low grade nickel laterite deposits are abundant in WA.
- WA is the fifth largest supplier of nickel in the world, accounting for 5% of global supply in 2022.
  - BHP Nickel West's Mt Keith and Leinster mines accounted for the majority of WA's paid nickel production in 2022.



- Murrin Murrin is WA's largest nickel mine and accounted for a large portion of the State's paid nickel production in 2022.
- Other major nickel mines included Ravensthorpe, Nova Bollinger, Forrestania, Beta Hunt and Savannah.
- In 2022-23, the value of WA's nickel sales rose to \$5.7 billion.
- Nickel produced in WA is mainly exported to global battery markets, with over 85% of BHP Nickel West's nickel production sold to battery material suppliers.
- The majority of nickel mined in WA is fed through local smelters and refineries.
  - Approximately 55% is used for production of briquettes and powder at the Murrin Murrin and Kwinana Nickel refineries.
  - Approximately 14% of nickel mined in WA is converted into nickel sulphide at BHP Nickel West's Kwinana refinery.
  - A further 13% is produced as a mixed nickel and cobalt hydroxide precipitate at FQM's Ravensthorpe operations.
- WA has existing pilot-scale infrastructure for the production of precursor cathode active materials.

#### *Future opportunities*

- Increase nickel production through mine expansions and development of new mines.
  - Construction is continuing at the Odysseus underground mine at the Cosmos project and has commenced at the West Musgrave project.
  - There are also a number of projects planned and under consideration, including Wingellina, NiWest, Mt Thirsty, Black Swan, Kambalda Nickel and Duketon.
  - New mineral resource estimates have been announced for the Sabre, T5, Coglia, Mawson, Ridgeline and Baker deposits and mineral resource estimates have been updated for a number of other projects. Exploration also continues across the State, with new discoveries recently announced for Emu Lake, Gillet North, Callisto North, Mlsho, Seahorse and Bookathanna North.
- Increase production of highly refined nickel chemicals for battery manufacturing, such as nickel sulphate.
  - There may be potential to increase nickel sulphate production, leveraging existing capability at BHP Nickel West's Kwinana refinery.
- Develop full scale Precursor Cathode Active Material (PCAM) manufacturing capabilities.
  - Companies including IG, Austvolt and Pure Battery Technology are planning to produce PCAM on a commercial scale in WA.
  - The optimisation of battery chemical operations is still occurring. For example, IGO is planning to develop an integrated nickel sulphate/PCAM refinery in Kwinana, which may lead to increased plant efficiencies, compared to more conventional flowsheets.

## **Cobalt**

### *Current state*

- WA has the second largest cobalt reserves in the world, accounting for nearly 14% of the world's cobalt reserves in 2021.
- In WA, cobalt is produced as a coproduct of nickel extraction.



- WA is the 4th largest cobalt supplier in the world, accounting for 3% of global supply in 2022.
  - Murrin Murrin accounted for the majority of production followed by Ravensthorpe and Nova-Bollinger.
- In 2022-23, the value of WA's cobalt sales was \$368 million.
- WA currently produces cobalt briquettes and powder as well as a mixed hydroxide precipitate product containing cobalt, but does not undertake further value-adding to produce cobalt sulphate for use in lithium-ion batteries.

#### *Future opportunities*

- Increase cobalt production through mine expansions and development of new nickel-cobalt mines.
  - For example, Mt Thirsty is a major cobalt deposit proposed for development, which could produce 19,000 tonnes of cobalt and 25,000 tonnes of nickel per year if developed. The NiWest and Wingellina projects are further examples.
- Develop cobalt sulphate manufacturing capability by consolidating feedstock from WA or importing from interstate.
  - For example, Cobalt Blue has plans to develop a Kwinana Cobalt refinery to produce cobalt sulphate in WA using feedstock from interstate.

## **Manganese**

#### *Current state*

- WA current minerals resources contain over 88Mt of manganese (around 8% of global reserves in 2021).
- WA has a long history of manganese mining with the Woodie Woodie mine producing high-grade manganese since the 1950s.
- WA is the 6th largest manganese supplier, in the world, accounting for 3% of global supply in 2022.
  - WA's manganese production comes from the Woodie Woodie and Butcherbird mines.
- In 2022-23 the value of WA's manganese sales was \$298 million.
- WA currently produces processed manganese ore but does not undertake further value-adding to produce manganese sulphate for use in lithium-ion batteries. Several companies, such as Black Canyon Ltd, are now undertaking manganese oxide High Purity Manganese Sulphate Monohydrate (HPMSM) studies, including hydrometallurgical testwork, to generate HPMSM to meet battery grade specifications of >99% HPMSM Purity.

#### *Future opportunities*

- Increase manganese production through development of proposed mining projects currently in the scoping and exploration phases.
  - High-grade manganese results were recently announced from ongoing exploration drilling at the Bryah Basin project and a maiden mineral resource estimate was announced for the Flanagan Bore project.
  - Substantial increased resources were announced at the Oakover project, which increased from 58.7Mt to 105.8 Mt.
- Develop manganese sulphate manufacturing capability, subject to availability of feedstock.
- Increase manganese production through new discoveries.
- Several new manganese discoveries were recently announced from ongoing exploration drilling at the Balfour South project, including the KR1, Blafour East, KR2, Damsite and Pickering prospects.



## Rare Earth Elements

### *Current state*

- WA's rare earths reserves accounted for 2% of the world's rare earths reserves in 2021.
- Exploration for rare earths in WA has increased considerably and a new mineralisation style of ion absorption clays has been recently discovered.
- WA is the 3<sup>rd</sup> largest rare earths producer in the world, accounting for 10% of global supply in 2022.
  - The majority of current production comes from the Mt Weld mine.
- In 2022, the value of WA's rare earths sales was \$801 million.
- WA is developing rare earths refineries.
  - Lynas Rare Earths is constructing a processing plant in Kalgoorlie to produce rare earth carbonate using feedstock from Mt Weld.
  - Hastings Technology Metals are planning to develop the Yangibana project to produce rare earth carbonate.
  - Iluka Resources is developing an integrated rare earth refinery in Eneabba using feedstock from monazite stockpiled during historical mineral sands mining. The refinery will be the first domestic producer of separated rare earth oxides.

### *Future opportunities*

- Increase production of rare earths through development of new mines and other sources, such as mining waste.
  - For example, there are a number of projects currently planned and under consideration, including the Browns Range, Cummins Range and Mt Mulgine projects.
- Commission full scale refineries/develop new refineries.
  - For example, Tronox is investigating opportunities to develop rare earths refining.
- Develop third party processing/tolling as rare earths processing can be cost-prohibitive for junior producers.
  - Iluka Resources' refinery will have a capacity of 17,500 tonnes per annum and has been designed specifically with the capability to process feedstocks sourced a range of potential third parties to establish a processing hub.
- There may be an opportunity for WA to move further along the value chain and produce rare earth metals.
  - Iluka Resources has commenced a feasibility study to investigate the viability of a rare earth metallisation facility in WA.

## Graphite

### *Current State*

- WA has resources of over 5.85 Mt of contained total graphitic carbon (less than 1% of the world's reserves in 2021).
- There are four defined graphite resources in the state: Munglinup, McIntosh, Springdale and Graphite Bull (formerly the Yalbra project).
- The majority of WA's graphite deposits are flake and amorphous graphite.
- There is currently no production in the state but historical production was recorded at Munglinup.



- Early stage graphite processing is progressing in WA.
  - Following development of a pilot scale micronizing and spheroidising plant in Collie, International Graphite is now commissioning a new qualification-scale plant to refine the case for commercial-scale operations.

#### *Future opportunities*

- Re-commence graphite mining in WA.
  - International Graphite is developing the Springdale project to supply graphite concentrate to the company's downstream processing operations, targeting production in 2024. The company has made new high-grade discoveries in 2023, increasing the Mineral Resource from 15.3 Mt to 49.3 Mt.
  - A definitive feasibility study has been completed for the Munglinup Project to produce 52ktpa of graphite concentrate over a 14 year mine life.
  - Buxton Resources have announced the discovery of numerous zones of thick, high-grade graphite mineralisation at the Graphite Bull project.
  - Green Critical Minerals have announced new discoveries of graphite mineralisation at the McIntosh project, which has the potential to become a significant bulk mining opportunity.
- Develop commercial-scale graphite processing and production of battery anode materials to contribute to WA's battery chemical industry ecosystem.
  - Ecograf has plans to develop a Kwinana facility to process natural flake graphite into battery anode material for lithium-ion batteries.
  - International Graphite is establishing a graphite processing hub in Collie. The company has plans to develop a commercial scale (4,000 tpa) micronizing plant in Collie. In future, International Graphite is planning to do further refining to produce battery anode material.

## **Vanadium**

#### *Current state*

- WA has substantial vanadium resources, equivalent to approximately 26Mt of contained vanadium pentoxide (approximately 20% of the world's reserves in 2021).
- Vanadium is primarily used as an alloy to produce high-strength steel, however, an emerging application is in redox flow batteries for energy storage uses.
- There is currently no vanadium production in the state, however vanadium was historically produced at the Windimurra mine.
- There are a number of vanadium projects at the pre-feasibility, feasibility and scoping stages, including the Australian Vanadium vanadium pentoxide project at Gabanintha, the Speewah, Barrambie and Medcalf projects.
- Australian Vanadium is developing a vanadium electrolyte plant located in the Perth metropolitan area.
- There are a number of early-stage manufacturers of vanadium redox flow batteries in WA, which currently rely on imported vanadium and componentry.
  - For example, AVESS, is aiming to become an Australian manufacturer of vanadium redox flow batteries, with a pilot study currently being undertaken for a Perth-built vanadium redox flow battery.

#### *Future opportunities*

- Develop vanadium mining and processing.
  - For example, Australian Vanadium plans to develop a Mid-West vanadium mining and processing project and has made an agreement to merge with the nearby Yarrabubba and Gabanintha projects.



- Scale up local manufacturing of vanadium redox flow batteries, including manufacturing of components.
  - For example, VSUN Energy, a subsidiary of Australian Vanadium, is working to commercialise vanadium redox flow batteries for long duration stationary storage, with IGO's Nova Nickel operation and Horizon Power trialling the batteries.

## High Purity Alumina

### *Current state*

- High Purity Alumina (HPA) is a premium product containing 99.99% aluminium that can be used in lithium batteries. It is produced from Aluminium oxide present in clays usually mined as Kaolin.
- There are a number of companies looking at the viability of producing HPA in WA from clay and kaolin deposits (Cadoux, Meckering).
  - For example, FYI Resources has completed a feasibility study for the Cadoux HPA Project and have successfully completed studies at a pilot plant in Welshpool.
- There are a number of companies in the early stages of developing HPA processing in WA
  - For example, ChemX is undergoing the final stage of commissioning a HPA microplant in O'Connor under the banner of their HiPurA HPA project.

### *Future opportunities*

- Scale-up production of HPA in WA.
  - For example, FYI Resources is planning to develop a demonstration HPA plant (1000Mt) before expanding to a commercial-scale (8,000Mt) refining facility in Kwinana.

## Copper

### *Current state*

- WA has reserves of over 8Mt of contained copper (approximately 1% of global reserves in 2021).
- The majority of WA copper production comes from mines that also produce gold, nickel and/or lead-zinc.
- WA is a significant supplier of copper globally.
  - The DeGrussa copper-gold mine is WA's largest copper mine. However, production ended in late 2022 due to resource depletion.
  - Boddington, one of WA's largest gold mines, is also the state's second largest copper mine.
  - Other major copper producing mines include mines; Golden Grove, Telfer and Nova-Bollinger.
- In 2022-23 the value of WA's copper sales was \$1.4 billion.
- Copper produced in WA is exported mainly in concentrates for further refining overseas.

### *Future opportunities*

- Increase copper production through development of proposed mining projects.
  - The West Musgrave copper-nickel Project is currently under construction.
  - WA has a number of projects planned and under consideration, including the Mt Mulgine, Caravel, the Nifty project restart, Whim Creek, Havieron, Winu and Sulphur Springs.



Department of  
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