



Queensland University of Technology
response to the
Department of Industry, Science and Resources
discussion paper
Australia's Critical Minerals Strategy

QUT welcomes the opportunity to contribute to the refinement of the new Australian Government critical minerals strategy being developed through the Department of Industry, Science and Resources and applauds the strategic and forward-looking spirit of the exercise.

The University strongly supports development of the Strategy including its linkages with other Government priorities including the National Reconstruction Fund, Australia Made Battery Plan and A Future Made in Australia.

QUT, as one of Australia's leading universities, has a number of research projects and Centers ideally placed to support the Critical Minerals Strategy. These include: Faculty of Engineering, Green Manufacturing and Resource Transformation Research Group, and Faculty of Science, Energy Storage Research Group, and the Advanced Robotics Manufacturing Hub (ARM Hub).

We work closely with partners across all sectors, including critical minerals, where we apply our research outcomes to create solutions. We're engaging with government and industry, to translate our research to deliver real-world impacts and harness our technological strengths across different disciplines, to transform research by identifying new opportunities and delivering solutions to real-world problems.

QUT believes that the development and implementation of the Strategy could play a central role in addressing several challenges. These include incentivising the development of key technologies, building sovereign capabilities in the value-add chain, and clean energy technology manufacturing needed to support decarbonisation goals and employment opportunities in regional Australia.

By investing in R&D, improving infrastructure and regulations, and fostering collaboration between Government, industry and academic, Australia is ideally placed to become a leader in critical minerals.

1. Opportunities for Development

QUT identifies several important opportunities to add value to our raw materials and to develop our critical minerals downstream processing capabilities.

Rare Earth Elements (REEs)

- REE demand is being driven by the requirement of wind turbines, electric vehicles & electronics.
- China maintains its pre-eminence in rare earths, owing to state subsidisation of the companies that mine and process them and a lower overall cost base for meeting environmental controls and standards.
- REE deposits require unique R&D for optimal mid-stream processing.

- The nature of the minerals in which the REE are contained varies significantly within the ore and across different ores.
- The cost of energy to conduct the mid-stream processing of REE is significant and a critical ESG requirement in light of reforms such as EU's new mandatory sustainability laws.

Opportunity for Australia

Development of sustainable electrochemical processing technologies, which are much less energy-intensive than traditional processes used overseas.

Lithium

- The majority of Australia's lithium deposits are in the form of spodumene, where conventional extraction is in a rotary kiln & involves very high temperatures (>1000°C).
- The traditional method of extracting lithium is highly energy intensive with a large portion of lithium remaining in the ore post processing.
- There is a strong demand for lithium and lack of projects at the construction and ramp-up stage.

Opportunity for Australia

With the lithium demand being driven by the growing Li-ion battery market, realising the value of lithium from our spodumene deposits through the development of new technology, with vastly reduced energy inputs compared to conventional processing with improved overall extraction, would be of significant value to our critical minerals industry.

Nickel laterites

- Current technologies used to process nickel laterites are not environmentally friendly resulting in expensive waste treatment and disposal of chemicals used in the extraction process
- Many years of nickel sulphide exploitation have depleted these ore bodies and/or made them more expensive to mine.
- Companies are increasingly interested in nickel production from nickel laterites. More than half of Australia's nickel reserves are nickel laterites, however, the nickel (and cobalt) grade is low and the mineralogy is complex.

Opportunity for Australia

Development of sustainable processes for nickel extraction from laterite deposits that meet Environmental, Social and Governance (ESG) requirements.

Iron and Vanadium for Large-scale Battery Energy Storage Systems (BESS)

- There are opportunities we can leverage beyond electric vehicles, particularly in large-scale storage, in the context of recycling. Large-scale flow battery technologies also use vanadium and iron-based electrolytes.

Opportunity for Australia

Queensland has a strong case for developing this area. The State is rich in vanadium and iron deposits and an opportunity exists to value add to these raw minerals to manufacture vanadium and iron-based flow battery electrolytes for domestic and export markets.

2. Develop & Retain IP to Attract IP Investment

The Australian Government can help improve the development, retention and attraction of IP investment by:

- Investing more in downstream critical minerals R&D (as highlighted above), particularly sustainable mid-stream processing of critical minerals and complex mineral ore bodies, waste streams/tailings.
- Investing more in projects that start at a lower Technology Readiness Level (TRL) level (TRL 3 – 6), to generate new ideas and technologies that can be protected through the formal registration of IP rights, i.e., patents, and not just projects in later TRL stages or projects that are predominantly geared toward funding construction.
- De-risking industry investment in new technology development through increased accessibility to pilot plant facilities coupled with subject matter expertise and services required to develop, test and scale new technologies and processing methods.

QUT, together with our partners, continues to have great success with this approach, as highlighted in these case studies:

Case Study 1: National Battery Testing Centre

The National Battery Testing Centre (NBTC) was established at QUT to test multiple types and sizes of battery systems in real-world conditions for Australian applications. The NBTC assist partners in getting their products to market through provision of accredited certification services and pilot demonstration and deployment projects to enable a diverse range of energy storage solution for Australia.

The Centre is a part of the Future Battery Industries CRC, which brings together 50 partners from Australian industry (raw materials, minerals, chemical precursors, etc.), Federal and State Governments and academics to support Australia's developing battery storage industry.

Case Study 2: Advanced Battery Facility (ABF)

ABF has unique capabilities to fabricate and test pilot quantities of custom Lithium-ion (Li-ion) cells in commercially representative formats. The ABF can qualify and benchmark Li-ion battery materials to industry standards, enabling partners 3rd party validation services to assist in entering the battery supply chain. The ABF provides pilot manufacturing equipment for Li-ion active materials to partners to assist in translation of lab-scale innovations to commercial application.

Case Study 3: Lava Blue – QUT Partnership

In collaboration with QUT and with the support of Commonwealth funding, Lava Blue's research is focused on developing a resilient, agile and highly competitive manufacturing process to transform kaolin, an aluminium-bearing clay, into high purity alumina (HPA).

Supporting these types of projects has enabled the development of new processed that are applied to recover a number of valuable minerals from processing waste, including HPA and vanadium. These outcomes significantly improve the economics of mineral recovery and provide new supplies of high-purity minerals into global battery supply chains.

Other ways the Australian Government could help include:

- Supporting projects that value-add as much as possible within the country of extraction (e.g. process ore to form a concentrate rather than export raw ore).
- Promoting IP awareness & Education Programs: how IP can be protected and used to foster innovation and economic growth and attract investment.
- Not investing in commercialisation at the expense of fundamental research, which is the feedstock of all applied knowledge and without which commercialisation will falter and ultimately fail.

3. Key elements for improvement

QUT identifies several key elements of the critical minerals production domain with scope for improvement that would propel the Australian critical minerals sector up the value chain, to develop sovereign capabilities and industries. These key elements are:

Skills development & talent pipeline

- This includes technical skills development plus 'soft skills' to work with stakeholders and identify and address implementation hurdles.
- The industry has shortages in skilled workforce. HDR internships, professional technicians, undergraduates and Masters training will be required to service the industry.

Proposed Solutions

- A review of the Job-Ready Graduates package is critical because of its negative impact on funding for engineering programs.
- Opportunities to upskill engineers transitioning into the critical minerals industry (e.g. processing, supply chains, ESG).
- Support the development of new undergraduate degrees that are cross-disciplinary and more tailored to industry requirements.

Partnership with First Nations Peoples

- Access to and extraction of critical mineral deposits, particularly those in remote areas, require the consent of and partnership with local Indigenous traditional owners. This consent must be fully informed, genuine, not coerced and obtained prior to commencement of works.

Proposed Solution

- Conduct genuine, timely negotiations with local Indigenous traditional owners that recognise Indigenous rights and sovereignty and prioritise fully informed community consent.

Governance

- The UK, USA and Europe are playing catch-up to China in mid-stream processing; to some extent this gap is driven by unnecessarily onerous governance requirements in the former countries, in contrast to China's less stringent regulations.

Proposed Solution

- Streamlining approval processes.

Regulatory and ESG requirements

- Original Equipment Manufacturer (OEMs) are demanding traceability and assurances around ESG (e.g. Tesla requirements stipulate ESG rating), which means supply lines from China are not acceptable. However, at this stage there is no alternative supply lines sufficiently mature enough in development or resources located to meet the projected 2050 demands.

Energy costs

- This influences the geological locations that make mid-stream processing more viable. Australia has access to a range of renewable energy and is an ideal location for mid-stream processing, however we have a significant talent shortfall and high energy costs.

Private finance

- Failing to capture the importance of critical minerals and invest in mining projects because of the 'output' problem. Private finance invests based on past results and yields, and since mining has an undesirable legacy, too few private investors are willing to give the industry a second chance. It is pleasing to see progress in the Canadian and Australian markets due to a policy push.

Conclusion

Australia's critical minerals industry has a major role to play in the global market. Whilst Australia has a well-established mining industry, QUT believes that the Australian Government has a key role to play in addressing several challenges, such as incentivising development of key technologies and education and training programs to address the skills shortage in the industry.

By investing in R&D, improving infrastructure and regulations, and fostering collaboration between government, industry and academia, Australia will become a leader in critical minerals production and processing. This would not only benefit the country's economy, but also contribute to the global effort to meet the growing demand for these materials.

**Brisbane
February 2023**

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