



Australian Government
**Department of Industry, Science,
Energy and Resources**



2022 CRITICAL MINERALS STRATEGY

March 2022



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2022 Critical Minerals Strategy

Department of Industry, Science, Energy and Resources.

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Australia's 2022 Critical Minerals Strategy will grow our critical minerals sector, expand downstream processing and help meet future global demand.

This updated strategy builds on the first Critical Minerals Strategy, published in 2019. It has a vision to put Australia at the centre of meeting the growing demand for critical minerals. It will underpin our prosperity and security by improving access to reliable, secure and resilient supplies of critical minerals.

While global demand for critical minerals is increasing, global supply is uncertain due to the market, technical and commercial risks of critical minerals projects.

The need for robust supply chains has been highlighted by the COVID-19 pandemic. Countries are increasingly seeking access to reliable, secure and resilient supplies of the critical minerals they need. Australia's large critical minerals reserves, technical expertise and track record as a reliable and responsible supplier mean the sector can respond to market demand.

This strategy sets out a long-term plan to leverage growing global demand and develop a thriving and durable Australian critical minerals sector – one that contributes to the national security and economic prosperity of Australia and the Indo-Pacific region.

This strategy complements other major government initiatives, including:

- [Global Resources Strategy](#) – which looks to diversify markets and facilitate new trade opportunities for traditional and emerging commodities
- [Modern Manufacturing Strategy](#) – critical minerals processing is one of the National Manufacturing Priorities under this \$1.5 billion strategy
- [Technology Investment Roadmap](#) – several low emissions technologies in the roadmap rely on critical minerals.

The Critical Minerals Strategy works with these other initiatives to:

- support our economic recovery from the COVID-19 pandemic
- create jobs for ongoing prosperity
- secure Australians' interests in a challenging world.





Message from the Minister

Throughout the COVID-19 pandemic, Australia's resources sector has powered the Australian economy. In 2021, Australian resources and energy exports hit a record high of \$348.9 billion and are projected to hit \$379 billion in the 2021-22 financial year. The Australian Government is proud of the sector's reputation as a reliable and responsible supplier partner and is committed to delivering a supportive and investment-friendly environment.

Increasingly, demand for resources is expanding beyond traditional commodities such as iron ore and gold. The pace of technological development has been accelerating, and with it the demand for minerals critical to sectors including defence, aerospace, automotive, renewable energy, telecommunications and agritech.

The addition of 2 new minerals to Australia's critical minerals list – high-purity alumina and silicon – reflects the expanding significance of mineral inputs in strategic applications like semiconductors and electrification.

Australia has been blessed with extraordinary reserves of the critical minerals needed by these sectors. We produce around half the world's lithium, are the second-largest producer of cobalt and the fourth-largest producer of rare earths. But we have the potential to do so much more.

The Australian Government is taking action to grow Australia into a critical minerals powerhouse, capitalising on the strength of our world-leading resources sector, expertise in processing, and highly skilled workforce. We have committed \$200 million to the Critical Minerals Accelerator Initiative to support strategically significant projects at challenging points in their development. This funding will accelerate projects to market and drive investment. A \$50 million virtual Critical Minerals Research and Development Centre is also being established, leveraging the expertise of Geoscience Australia, CSIRO and the Australian Nuclear Science and Technology Organisation to drive breakthrough collaborative research with industry.

These investments align with the Government's commitment to securing our sovereign manufacturing capability, unlocking a new generation of high wage, high skill, high tech jobs by expanding into downstream processing, and will embed Australia in global supply chains for technology ranging from mobile phones to fighter jets.

The \$2 billion Critical Minerals Facility, announced in 2021, is already providing loans to the sector. Projects are accessing grants under the Modern Manufacturing Initiative and concessional finance through the Northern Australia Infrastructure Facility. The Australian Government is investing heavily in establishing strategic international partnerships on critical minerals and working with the states and territories to establish regional hubs.

This updated strategy is a plan for a thriving critical minerals sector that supports Australian prosperity and security. Continuing to develop and diversify our resources sector strengthens our national economy, delivering jobs and growth opportunities, especially in regional Australia.

The Hon Keith Pitt MP
Minister for Resources and Water



Vision

By 2030, Australia is a global critical minerals powerhouse. We are integral to international critical mineral supply chains and technologies crucial to the global economy.



Objectives

Realising our vision for the critical minerals sector will achieve the following objectives

Stable supply

Australian projects will make a significant contribution to meeting the growing global demand for critical minerals.

Securing investment and commercial offtake agreements for Australian projects will increase the diversity of supply and support secure, robust supply chains.

Sovereign capability

Expanding our knowledge of critical minerals and moving into downstream processing will:

- grow our capability in specialist skills, technology and advanced manufacturing
- ensure our intellectual property stays in Australia
- capture more of the value chain by exporting higher value-added products.

Regional jobs and growth

A thriving critical minerals sector will create plenty of jobs in the exploration, manufacturing and processing of critical minerals. This will support economic growth in Australia's regional communities.






Australia's opportunity

Demand for critical minerals

The global demand for critical minerals is growing.

Critical minerals are essential for the energy, transport, aerospace, defence, medical, automotive and telecommunications sectors. They will also be used in further advanced manufacturing applications.

The International Energy Agency's World Energy Outlook 2021 predicts significantly increased demand for the critical minerals used in solar PV plants, wind farms, electric vehicles and battery storage.¹ For example, electric vehicles use many critical minerals, and the number of electric vehicles in the world is projected to increase 30% every year to 2050.²



Electric vehicles


Global EV fleet size is projected to increase **30%** a year to 2050

Battery

- lithium
- cobalt
- nickel
- graphite

Permanent magnets

- rare earth elements
- copper



Energy storage

Global stationary battery storage projected to increase **8%** a year to 2050


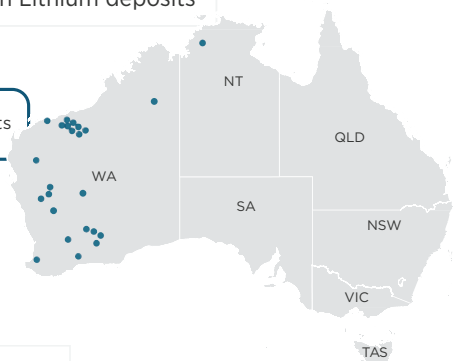


Image source: Office of the Chief Economist, Outlook for Selected Critical Minerals in Australia 2021 report

Lithium



Major Australian Lithium deposits



● Lithium deposits

Lithium facts

- Electric vehicle sales are expected to increase from 3m to 30m by 2030
- Lithium exports contributed A\$1.1b to economy in 2020-21
- Australian lithium exports are tipped to increase to 3.9m tonnes in 2025-26
- In August 2021 Australia began producing lithium hydroxide

Australia's lithium

- Biggest exporter in the world
- Produced 49% of the world's lithium in 2020
- Production ramp up planned for 2 refineries in 2022/23

Image source: Office of the Chief Economist, Outlook for Selected Critical Minerals in Australia 2021 report

1 International Energy Agency (IEA), [World Energy Outlook 2021](#), IEA, 2021, p 271, accessed 28 February 2022.

2 B Gasson, C Lewis and K Martin, [Outlook for Selected Critical Minerals 2021](#), Department of Industry, Science, Energy and Resources (DISER), Australian Government, 2021, p 4, accessed 3 March 2022.

How Australia can benefit

Growing global demand creates a significant opportunity for Australia, thanks to our critical mineral reserves and our reputation as a trusted and reliable supplier.

Australia has some of the world's largest recoverable resources of several critical minerals, including cobalt, lithium, manganese, tungsten and vanadium.

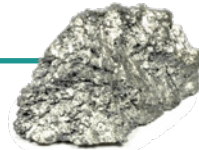
Many countries want minerals that are sourced in an environmentally and socially responsible way. Australia has one of the world's strongest and most efficient regulatory environments, which makes us an attractive supplier of critical minerals products.

Becoming a critical minerals powerhouse will support thousands of jobs. For example, clean energy technologies need a range of minerals, including critical minerals like cobalt, lithium, and rare earth elements. Producing and exporting these minerals could create up to 52,000 jobs in regions like southern Western Australia, the Pilbara and South Australia by 2050.³

Moving into downstream processing will capture more value, keep economic benefit and jobs in Australia and boost our sovereign capability – all while helping meet growing global demand.

Expanding further along battery mineral value chains could support 34,700 jobs by 2030. To deliver on this potential, Australia needs to build its capabilities in downstream refining, manufacturing, and battery integration and services.⁴

Critical minerals projects can help ensure the continued growth of our resources sector and provide high-paying, skilled jobs for Australians, particularly in regional areas and heavy industry hubs.



Rare Earth Elements

World supply dynamics

Country	2020 production (thousand tonnes rare earth oxides)	Share of world
China	140	57%
US	38	15%
Myanmar	30	12%
Australia	23	9%
Rest of world	18	7%

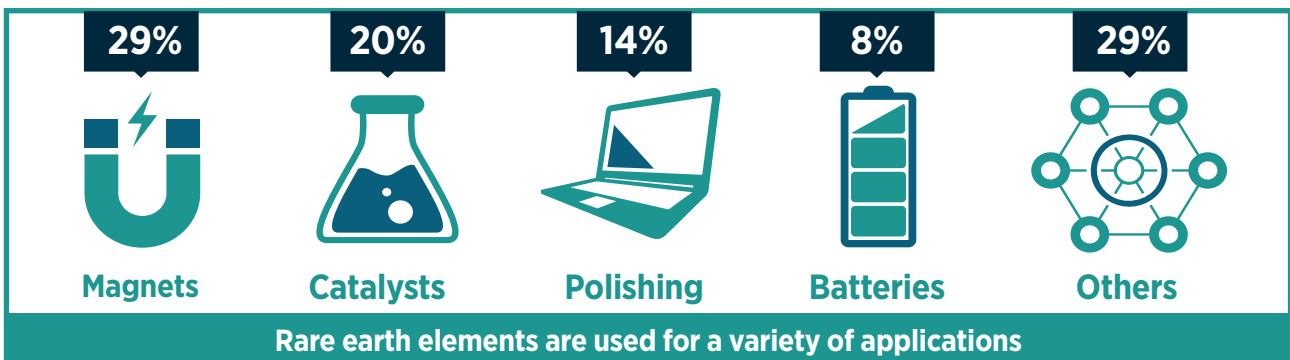
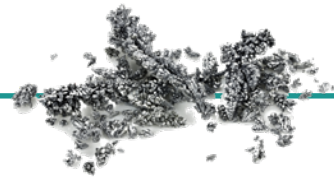


Image source: Office of the Chief Economist, Outlook for Selected Critical Minerals in Australia 2021 report

³ Department of Industry, Science, Energy and Resources (DISER), [Australia's Long-Term Emissions Reduction Plan](#), DISER, Australian Government, 2021, p 84, accessed 14 Feb 2022.
⁴ Accenture, [Future charge: Building Australia's Battery Industries](#), Future Battery Industries Cooperative Research Centre (FBIIRC), 2021, p 3, accessed on 7 October 2021.

Vanadium



Top producers



Top consumers

Country	Tonnes
China	62,000
Europe	12,000
North America	10,000

Australia has two advanced projects evaluating mining as well as downstream processing.



Australia's Vanadium resources are the **3rd largest** in the world, accounting for **18 per cent** of world economic demonstrated resources but Australia's current production levels are **negligible**.

Image source: Office of the Chief Economist, Outlook for Selected Critical Minerals in Australia 2021 report



Cobalt



World production

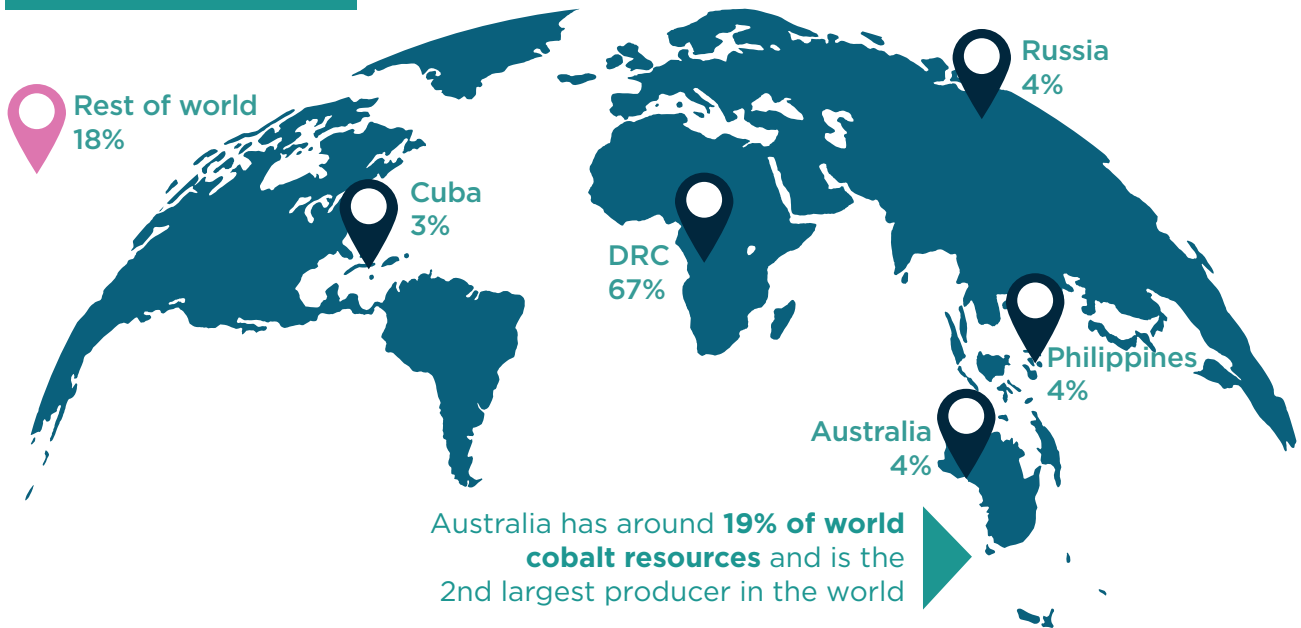


Image source: Office of the Chief Economist, Outlook for Selected Critical Minerals in Australia 2021 report





Challenges

Australia recognises this opportunity is not without challenges. Supply chains for critical minerals are opaque, concentrated and vulnerable to disruption, which creates market risk and price volatility. This makes it difficult for projects to secure offtake agreements and investment.

Developing critical minerals projects is also complex and technically challenging. Projects are expensive, and Australian projects are competing against some countries with lower labour and environmental standards.

Australia's resources sector leads the world. We are well positioned to develop a cost-competitive domestic processing sector that meets environmental, social and governance considerations. This includes drawing on our high labour and environmental standards, our reliability as a supplier, and our technical expertise to drive production efficiencies.

Our high standards and strong resources record give Australia an important point of difference in the global critical minerals market.

As well as addressing the specific barriers that Australian miners and processors face, we need to develop the skills and expertise to:

- meet the technical challenges of production, processing and refining
- manage the sustainability of the critical minerals industry.





Actions

We will achieve our vision and address the associated challenges through 3 actions. These are described in detail in the 'Initiatives to support the sector' section.

De-risk projects

The Australian Government can help de-risk projects at all stages of development to overcome barriers and attract private investment.

We will do this through project facilitation, providing technical support and making strategic investments to scale up processing and lock in finance and offtake for production.

Create an enabling environment

Our policies will create the right environment for Australia's critical minerals industry to thrive. This includes:

- research and development to grow the sector
- standards and accreditation to keep building our competitive advantage
- shared infrastructure and precincts to attract investment.

Strengthen international partnerships

We will build on our relationships with key countries such as the United States, Japan, the Republic of Korea, the United Kingdom (UK), India and European Union (EU) members. We will also look to work with new partners and in new groupings if those opportunities emerge.

These relationships will improve collaboration, share knowledge of critical minerals, and secure commercial offtake agreements that support the Australian economy.





Initiatives to support the sector

The government has implemented a range of initiatives aimed at addressing the main challenges facing Australian critical minerals projects.

In 2019, the government established the Critical Minerals Facilitation Office to provide national policy and strategic advice, and to facilitate the development of the sector. Since then, there has been substantial growth in Australia's critical minerals sector and widespread acceleration of projects under development.

De-risking projects

The government can reduce the risks of critical minerals projects while supporting the industry's long-term viability.

Government investment

By investing strategically, the government can:

- help bring projects to market earlier
- support projects to secure offtake agreements
- give investors the confidence to commit.

Critical Minerals Facility

The government established the \$2 billion Critical Minerals Facility in 2021. The Facility is administered by Export Finance Australia. It will help projects aligned with the Critical Minerals Strategy overcome gaps in private finance to get off the ground. This will support jobs and communities, particularly in regional Australia, and bolster a strategically important sector in the Australian economy.

In February 2022, the Critical Minerals Facility issued its first loans to 2 Australian companies.

EcoGraf Limited is developing the Australian Battery Anode Material Facility in the Rockingham-Kwinana Strategic Industrial Area in Western Australia. The loan of up to USD 35 million will help EcoGraf expand the facility and produce spherical graphite products. Once operational, the project is expected to create over 125 jobs, in addition to 250 jobs in the construction phase.

Renascor Resources is developing an integrated graphite mine and a processing facility in South Australia. The loan of up to \$185 million will support over 100 jobs in the construction phase, and 190 additional full-time roles over the project's lifespan. The loan will also support Renascor's ambition to become a world-leading supplier of purified spherical graphite.

Critical Minerals Accelerator Initiative

The Australian Government is committed to building a pipeline of quality critical minerals projects to help grow the Australian sector. The Critical Minerals Accelerator Initiative (CMAI) will bring new sources of supply online by supporting early and mid-stage projects that contribute to robust global supply chains, build sovereign capability in Australia and create high-paying regional jobs for Australians now and into the future.

The CMAI will help projects overcome technical and market barriers by supporting activities such as:

- feasibility studies
- engineering design work
- pilot testing
- building demonstration plants to help proponents prove the quality of their product and secure contracts with customers.

The CMAI will support strategically significant projects at crucial points in development, setting Australia up as a critical minerals powerhouse. Grants will accelerate projects to market, attracting private sector finance and investment.

Modern Manufacturing Initiative

Mid-stage critical minerals projects can access the government's \$1.3 billion Modern Manufacturing Initiative (MMI). MMI funding helps firms pilot, demonstrate or scale up the techniques and processes they need to achieve commercial close.

The first round of MMI funding under the Collaboration stream saw 4 critical minerals projects receive grants totalling \$243.6 million. The recipients included:

- Pure Battery Technologies Pty Ltd, which received \$119.6 million to develop a nickel and cobalt battery material refinery in Western Australia.
- Australian Vanadium Limited, which received \$49 million to establish an Australian vanadium battery industry in Western Australia, powered by green hydrogen.
- Alpha HPA Limited, which received \$45 million to construct a high-purity alumina production facility in Yarwun, Queensland.
- Arafura Resources Limited, which received \$30 million to construct the Nolan's Project Rare Earth Separation Plant in the Northern Territory.

In July 2021 the first round of MMI funding under the Translation and Integration streams saw 5 critical minerals projects receive grants totalling \$30.8 million. The recipients included:

- Lynas Rare Earths, which received \$14.8 million in funding to commercialise an improved process for producing rare-earth carbonate
- Australian Vanadium Limited, which received \$3.9 million in funding to fast-track manufacturing of large-scale vanadium redox flow battery systems
- Core Lithium, which received \$6 million in funding to help build a pilot processing facility to produce battery-grade lithium hydroxide
- Albemarle Lithium, which received \$4.9 million in funding to establish a processing plant that will transform waste lithium refinery residue for use in the construction sector
- Brisbane METS Lab, which received \$1.2 million in funding for its vanadium processing pilot plant.

Attracting investment

Austrade is the government's lead trade and investment facilitation agency. It supports the critical minerals sector by developing commercial partnerships that connect Australia with our trade partners and target markets.

Austrade delivers specialised services to Australian critical minerals companies, including bespoke client engagement programs and targeted trade missions. These initiatives build on the agency's understanding of the specific needs of global critical mineral end-users and their tiered suppliers and in facilitating commercial partnerships with targeted global partners.

Proponents of advanced projects are also working closely with Export Finance Australia, the Northern Australia Infrastructure Facility (NAIF) and the Clean Energy Finance Corporation (CEFC).

Support from these government-backed financing entities will help projects overcome market barriers such as commodity price volatility. This will make them more attractive to private capital investment.



Creating an enabling environment

As well as supporting individual projects, the government can influence sector-wide settings. These initiatives will help critical minerals firms progress Australian projects and compete in a fierce global market.

Research and development

The Australian Government has committed \$50 million over 3 years to establish the virtual National Critical Minerals Research and Development Centre. This will build on Australia's world-leading research capabilities by bringing together expertise from CSIRO, Geoscience Australia and the Australian Nuclear Science and Technology Organisation (ANSTO) for the benefit of the critical minerals sectors as a whole.

These organisations' research partnerships and technical services have already helped develop innovative, safe and efficient ore processing and purification techniques.

CSIRO's [Critical Energy Minerals Roadmap](#) will unlock the economic potential of Australia's energy minerals by creating and demonstrating breakthrough technologies. It identifies ways to take advantage of Australia's advantages and connect our mining, manufacturing and energy sectors.

The government's \$4.5 million investment in the Advancing Research and Development for Critical Minerals Program has helped improve access to Australia's critical minerals reserves. It has also increased research opportunities for our world-class science agencies, including researching and developing new processing and recycling capabilities.

The world-leading work of Geoscience Australia will keep discovering new critical resources and opportunities. This includes expanding our geological knowledge and research base to maximise production and supply chain opportunities.

Virtual National Critical Minerals R&D Centre

The \$50 million virtual National Critical Minerals Research and Development Centre will:

- build Australian intellectual property in critical minerals processing
- target technical bottlenecks in strategic supply chains
- drive breakthrough collaborative research.

The centre will address barriers across the critical minerals value chain and work with industry to focus research and development efforts on national priorities. It will do this by:

- connecting critical minerals projects with the scientific and technical expertise they need
- coordinating, guiding and prioritising research and development efforts by government and industry
- helping scale up and commercialise critical minerals research and development, including by leading and supporting innovative research projects.

Projects will help unlock new sources of economically viable critical minerals and diversify supply chains of interest to Australia and our allies. It will start by focusing on the new additions to Australia's critical minerals list: high-purity alumina and silicon. It will also lead a strategic body of work to assess priority research and development gaps, establish new digital capabilities, and identify where targeted effort could address national vulnerabilities and open new opportunities for Australia.

The centre will develop a second tranche of flagship research projects in 2022–23. These will be delivered in collaboration with firms and other researchers. An independent advisory panel will help develop proposals and ensure the industry guides the centre's agenda.

Regional hubs

Regional hubs are areas where critical minerals producers, users and potential exporters are co-located. Regional hubs have been shown to bolster industrial activity and are a key way to help build the critical minerals sector.

These hubs will:

- stimulate innovation
- attract talent
- catalyse investment in enabling infrastructure
- drive scale through co-location
- create efficiencies
- generate jobs and growth in our regions.

The government has allocated \$4 million to scope investment proposals for regional critical minerals hubs and precincts.⁵ This work is being delivered in partnership with states and territories. It will be informed by industry, the research community and investors.

Hubs and precincts can:

- drive down project costs
- help support streamlined regulatory approvals
- establish common or shared infrastructure
- encourage strategic planning across the entire mining lifecycle from exploration to manufacturing.

Critical minerals hubs can draw on other Australian Government investments, including hydrogen, the Modern Manufacturing Strategy, the Gas-Fired Recovery and carbon capture, use and storage. They can also draw on existing heavy industry clusters and state government policies.

⁵ Department of the Treasury, [Mid-year Economic and Fiscal Outlook 2021-22](#), Department of the Treasury, Australian Government, 2021, p 263, accessed 9 March 2022.





Australia's environmental, social and governance standards

Australia produces its resources safely, sustainably and with robust environmental and labour protections. This provides a point of difference with some competitors that may compete predominantly on cost – often with adverse consequences for workers, vulnerable people, communities and the environment.

Consumers, businesses and governments are increasingly conscious of the origins and impacts of goods. We are already promoting our strong environmental, social and governance credentials to international partners. This is seeing mature markets like the US, Japan, Republic of Korea, European Union and the UK look to us for their critical minerals supply.

The government is working closely with states and territories to develop a national ethical certification scheme for critical minerals. The \$130 million Future Battery Industries Cooperative Research Centre (FBICRC) is a key platform for delivering this agenda, supported by a \$25 million government investment.

The FBICRC is progressing 2 certification programs in partnership with industry:

- a mineral lifecycle analysis that will demonstrate market advantage
- a trusted battery supply chain traceability solution.

The government has also awarded a \$3 million grant to a blockchain provenance-tracking pilot project led by Everledger. This project's aim is to let consumers track the origin of the critical minerals in their products by creating a 'digital certification' for critical minerals throughout the extraction and movement phases. This will help companies in the sector market their adherence to compliance regulations and increase the demand for Australian products, while also simplifying the process and lowering costs.

This work does not increase the regulatory burden on firms. Instead, it enhances our existing regulatory compliance in Australia to showcase our world-leading standards and help Australian companies access international markets.



International standards

Australia is working with global partners to shape a system of international standards for critical minerals.

This includes chairing the Strategic Advisory Group in the International Organization for Standardization (ISO). The group is analysing current and potential standardisation work in critical minerals and will release its recommendations later in 2022.

Australia is also a founding partner of the Energy Resource Governance Initiative (ERGI), a US-led initiative that provides tools and technical assistance to countries with undeveloped mineral resources. ERGI aims to help establish best practice governance in energy mineral resource mining and resilient energy mineral supply chains.

Australia will continue promoting high standards for raw and processed critical minerals. This will ensure global production is environmentally sustainable and our projects can compete on a level playing field.

Whole-of-economy growth policies

Getting the economic basics right is essential for globally competitive businesses in any sector — but particularly for critical minerals. The government's economic focus areas include:


- reliable and affordable energy
- a flexible and fair industrial relations system
- efficient and supportive regulations
- infrastructure to improve productivity
- a large and mobile pool of skilled workers.

Australia's efficient taxation system encourages investment and employment, which contributes to sustainable economic growth. The Research and Development Tax Incentive encourages companies to do research that drives innovation and investment.

Australia's deregulation agenda is reducing barriers while boosting productivity and competitiveness. Regulations need to be well-designed, fit-for-purpose and support businesses to grow and create jobs. They also need to maintain the high standards recognised by overseas markets.

The government's investment in innovation, science and research supports Australia's intellectual capital, maintains our competitive advantages and helps us meet our national and sovereign needs.

The Technology Investment Roadmap is helping develop and commercialise low emissions technologies, including energy storage. The roadmap will guide \$21 billion of government investment, which will drive over \$84 billion of total investment in low emissions technologies by 2030. Getting these technologies right will reduce Australia's emissions and help other countries make the deep cuts needed to reach net zero emissions by 2050.



Strengthening international partnerships

The government is stepping up international engagement to secure strategic partnerships and promote Australia's high environmental, social and governance (ESG) standards for critical minerals. This is essential for a resilient, sustainable and globally competitive Australian critical minerals sector.

Since the release of the first Critical Minerals Strategy in 2019, we have strengthened relationships with commercial and government stakeholders in crucial markets. We are seeing binding and non-binding commercial agreements for an array of critical minerals, and intergovernmental critical minerals working groups are now common.

Further developing our strategic partnerships will position Australia as a preferred supplier of critical minerals, particularly where countries are seeking ethical sources.

The government is continuing to promote Australia's world-class ESG standards. It has provided more resources to Standards Australia, linking dedicated government support with industry experts to set standards. We are also working with states and territories to develop a critical minerals ethical certification scheme, further improving the quality of Australia's critical minerals to the global market.

Achieving concrete outcomes through international engagement will require:

- strategic analysis
- outreach to international markets
- detailed work to map international supply chains
- matching commercial demands with industry capabilities.

This will help secure commercial arrangements, including new sources of capital and offtake arrangements.

Australia is rapidly developing government-to-government and industry-to-industry links with our priority international partners.

Working with likeminded and technologically capable partners is the only realistic way to quickly build Australia's critical minerals industry. It also lets countries share resources, reduce risks and accelerate outcomes beneficial to all.



International working groups

We are part of critical minerals working groups with the United States, the United Kingdom, India, the Republic of Korea and EU member states. These groups have agreed work agendas to:

- facilitate trade and investment
- enhance global standards
- collaborate on research and development
- assess supply and demand.

Regional partners

Our \$20 million [Global Resources Strategy](#) will strengthen Australia's relationship with regional partners by:

- promoting our resources sector as a reliable supplier of critical minerals and processed material
- developing industry partnerships and supporting research and development in the critical minerals sector
- enhancing government-to-government and business-to-business links with key markets in our region.

Attracting foreign investment

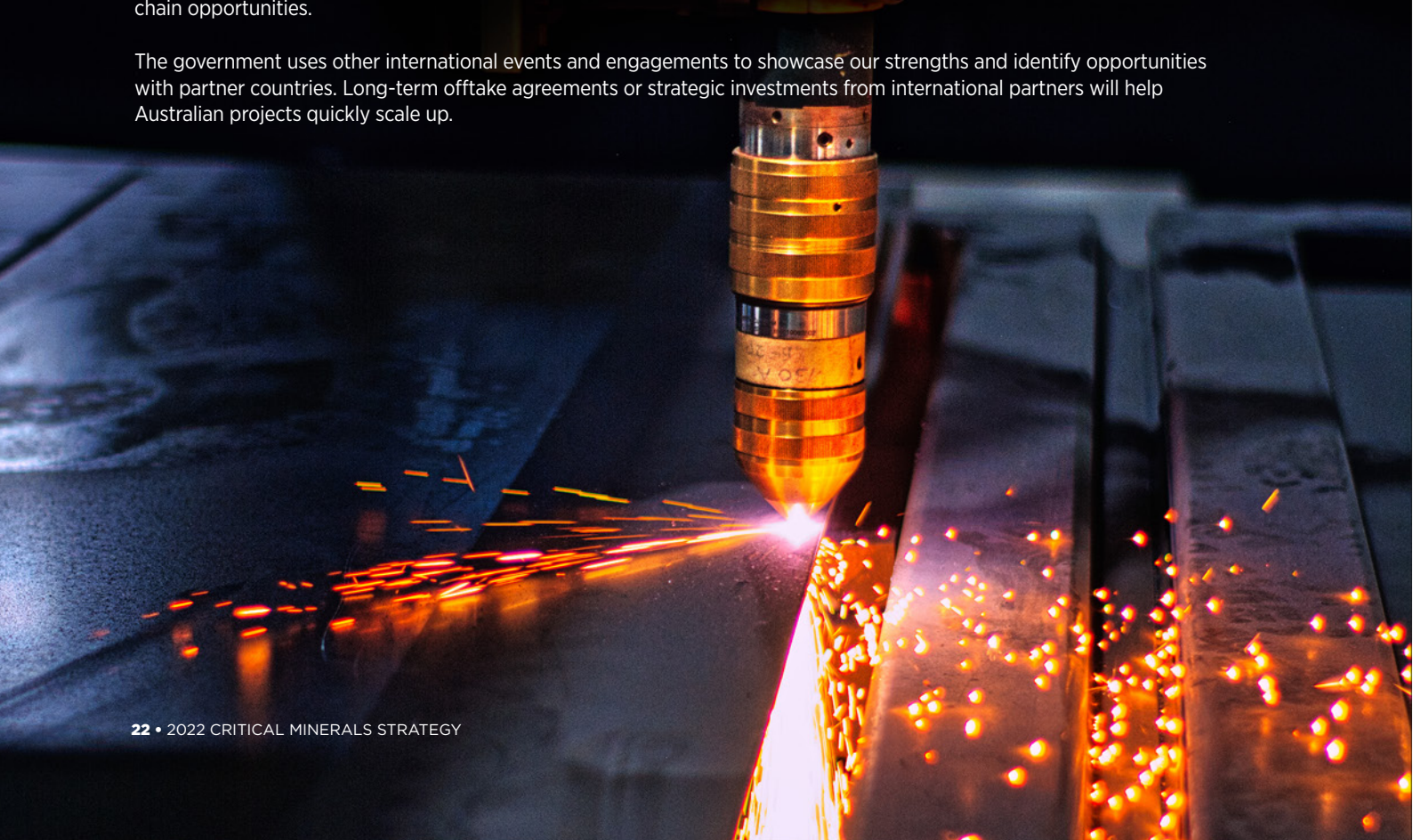
Foreign investment in greenfield and junior projects is important to the development of the critical minerals sector. Policies to capture foreign investment will also help scale the Australian critical minerals sector and promote our capability to the world.

Targeted marketing plays an important role in promoting Australia's critical minerals and related investment opportunities to an international audience. This includes identifying projects' close relationship with our Technology Investment Roadmap.

The [Australian Critical Minerals Prospectus](#) is published by Austrade with the support of Australia's geoscience agencies. It supports the significant efforts already underway to attract investment in Australia's critical minerals projects. The third edition of the prospectus, published in December 2021, highlights 44 advanced projects seeking investment or offtake agreements.

Austrade has published [several other reports on critical minerals](#) to build understanding of specific investment and value chain opportunities.

The government uses other international events and engagements to showcase our strengths and identify opportunities with partner countries. Long-term offtake agreements or strategic investments from international partners will help Australian projects quickly scale up.



Bilateral partnerships

Government-to-government agreements can build investor confidence and help private sector partnerships develop and scale up quickly. We will continue strengthening our links with like-minded countries to support critical minerals investment and reliable supply.

For example, Australia has memorandums of understanding (MOU) in place with countries including the Republic of Korea, India and Japan. These MOUs have objectives such as building on investment in Australian critical minerals projects, boosting our exports and securing supply for the partner country.

Australia will continue working with key trading partners to develop government-to-government and commercial arrangements that support both countries' critical minerals priorities.

Australia-India memorandum of understanding - Co-investment in Australian Critical Minerals Projects

Australia has formalised its partnership with India on critical minerals through the signing of a memorandum of understanding on 10 March 2022. The memorandum will support collaboration between India and Australia to identify opportunities for strategic investment in Australian critical minerals projects

These activities will deliver on the shared ambition of both countries to develop robust and commercially viable critical minerals supply chains.

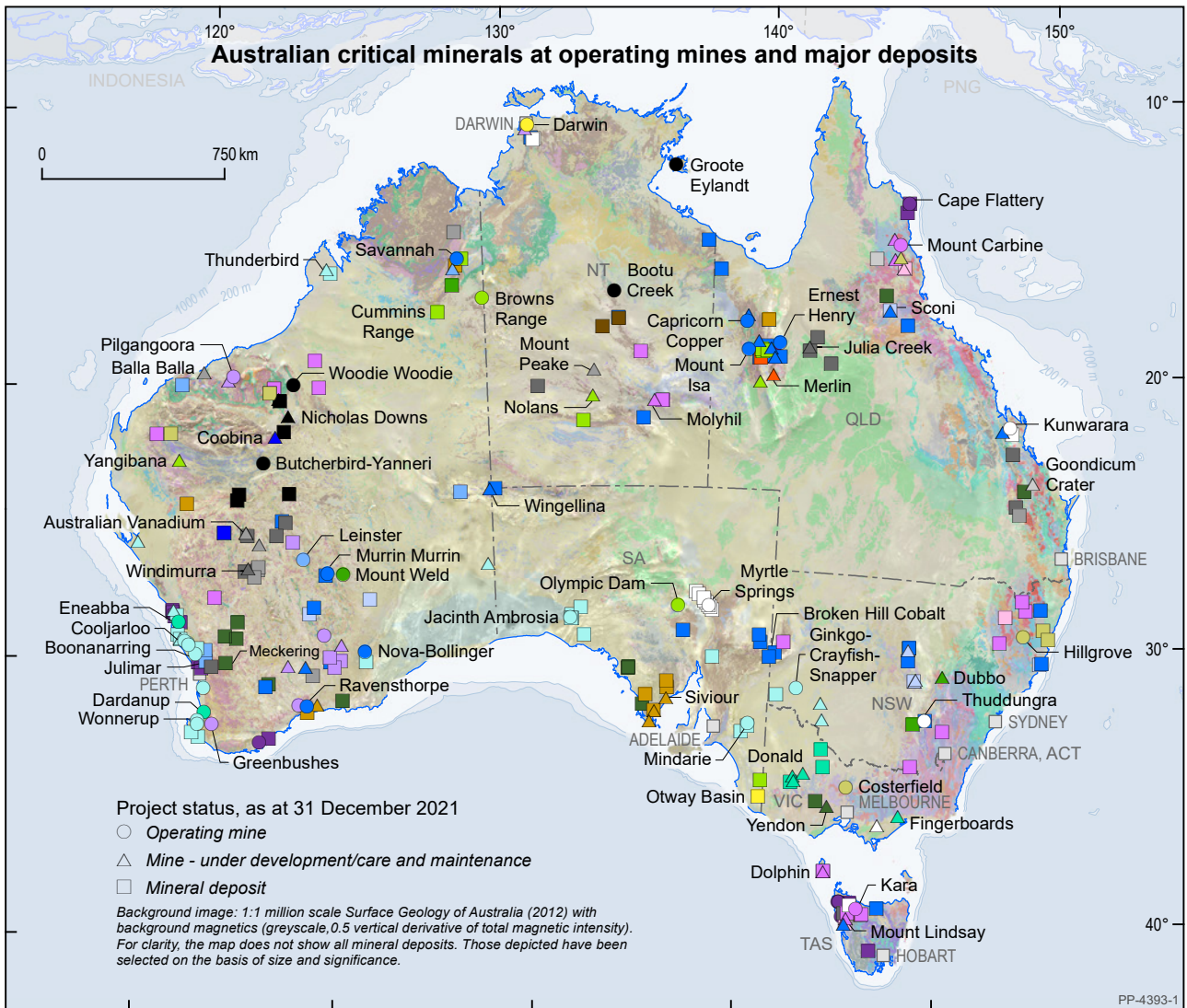


International supply chains

Australia is working with other countries to create more diversified and secure critical minerals supply chains. This includes mapping the supply chains of critical technologies and materials, such as semiconductors through the Quad. This work recognises the importance of transparent, market-focused government policies and support measures.

We are particularly focused on working with other countries in the Indo-Pacific region. Australia could become one of the region's largest skills and capability centres, supplying processed critical minerals to international component manufacturing hubs. Components from these hubs would be used for advanced manufacturing applications in other markets, supporting an independent and cost-competitive end-to-end supply chain.





- Commodity type**
- | | |
|---|--|
| ● Aluminium (HPA) | ● Manganese ore |
| ● Antimony | ● Heavy Mineral Sands (HMS) - Titanium, Zirconium |
| ● Bismuth, +/- Cobalt, +/- Indium | ● HMS - Titanium, Zirconium, REE |
| ● Chromium, +/- Cobalt, +/- PGE | ● Rare Earth Elements (REE) |
| ● Cobalt | ● REE, Zirconium, Niobium, +/- Hafnium, Lithium, Tantalum, Gallium |
| ● Platinum Group Elements (PGE), +/- Cobalt | ● Rhenium |
| ● Scandium, +/- Cobalt, +/- PGE | ● Silicon |
| ● Graphite | ● Tungsten |
| ● Helium | ● Titanium |
| ● Indium | ● Titanium, Vanadium |
| ● Lithium, +/- Tantalum, +/- Niobium | ● Vanadium |
| ○ Magnesium | |

Australia's critical minerals list


Australia's critical minerals list highlights our priority critical minerals. The list is based on global technology needs, particularly around electrification, advanced manufacturing and defence. Table 1 shows Australia's current list of 26 critical minerals.

Critical minerals on this list will benefit through:

- project facilitation
- increased government engagement, capturing foreign investment and securing commercial offtake agreements
- government investment.

However, different critical minerals projects have different needs. For example, rare earth elements processing is a new industry. That means rare earth projects are riskier than lithium projects, which have a longer history.

Australia's critical minerals list is regularly reviewed to ensure it reflects evolving technological, economic and global conditions.



The government is adding 2 new minerals to the critical minerals list as part of the 2022 Critical Minerals Strategy. They are:

- high-purity alumina
- silicon

These minerals are used in a variety of technologies, including lithium-ion batteries and semiconductors.

The government added these 2 minerals after consulting the critical minerals industry and Australia's science agencies over the past 18 months. Consultation focused on better understanding the challenges and needs of the sector.

The additions were also informed by analysis for the [Resource Technology and Critical Minerals Process Roadmap](#) (part of the Modern Manufacturing Initiative) and CSIRO's Critical Energy Minerals Roadmap.

The government also worked with likeminded countries to understand the impact of international policy settings, including through the United States' 100-Day Supply Chain Review. This work highlighted emerging priorities and areas where Australia could further contribute to global supply chains, including for quantum computing and semiconductors. Semiconductors have already been identified as a key supply chain risk, and demand is expected to rapidly increase in the next few years.

Table 1: Australia's critical minerals

Critical mineral	On US list ⁶	On EU list ⁷	On Japan list ⁸	On India list ⁹	Australian geological potential ¹⁰	Australian economic demonstrated resources (2020) ¹¹	Australian production (2020)	Global production (2020) ¹²
High-Purity Alumina	✓ ¹³	✓ ¹⁴			Moderate	No data	No data	No data
Antimony	✓	✓	✓	✓	Moderate	125.2 kt	3.9 kt	155 kt
Beryllium	✓	✓	✓	✓	Moderate	No data	No data	240 t
Bismuth	✓	✓	✓	✓	Moderate	No data	No data	17 kt
Chromium	✓		✓	✓	Moderate	0	0	40,000 kt
Cobalt	✓	✓	✓	✓	High	1,495 kt	5.6 kt	135 kt
Gallium	✓	✓	✓	✓	High	No data	No data	300 t
Germanium	✓	✓	✓	✓	High	No data	No data	130 t
Graphite	✓	✓	✓ ¹⁵	✓	Moderate	7,970 kt	0	1,100 kt
Hafnium	✓	✓	✓		High	14.5 kt	No data	No data
Helium					Moderate	No data	4 hm ³	140 hm ³
Indium	✓	✓	✓	✓	Moderate	No data	No data	900 t
Lithium	✓	✓	✓	✓	High	6,174 kt	40 kt	82 kt
Magnesium	✓	✓	✓		High	Magnesite: 286,000 kt	Magnesite: 799 kt	Magnesite: 26,000 kt

6 J Burton, 'U.S. Geological Survey Releases 2022 List of Critical Minerals', United States Geological Survey (USGS), U.S. Department of the Interior, Federal Government of the United States, 2022, accessed 3 March 2022.

7 Joint Research Centre, 'The Fourth List of Critical Raw Materials for the EU', European Commission, 2020, accessed 3 March 2022.

8 J Nakano, translation of a Ministry of Economy, Trade and Industry (METI) publication as presented in 'The Geopolitics of Critical Minerals Supply Chains', Centre for Strategic & International Studies (CSIS), 2021, p 22, accessed 3 March 2022.

9 V Gupta, T Biswas and K Ganesan, 'Critical Non-Fuel Mineral Resources for India's Manufacturing Sector—A Vision for 2030', Council on Energy, Environment and Water (CEEW), 2016, pp 73–74, accessed 3 March 2022. Minerals that are identified as of high economic importance, high supply risk, or both for 2030 are highlighted here.

10 Geoscience Australia, Australia's Identified Mineral Resources 2021, Geoscience Australia, Australian Government, unpublished, accessed 3 March 2022.

11 Geoscience Australia, Australia's Identified Mineral Resources 2021, [dataset], Geoscience Australia, Australian Government, accessed 3 March 2022.

12 Geoscience Australia, using estimated world production from USGS Mineral Commodity Summaries 2021, adjusted with reported Australian production in the dataset of Australia's Identified Mineral Resources 2021, accessed 17 January 2022.

13 The US identifies aluminium as a critical mineral.

14 The EU identifies bauxite (an ore of aluminium) as critical.

15 Japan identifies carbon (which forms graphite) as a critical mineral.

Critical mineral	On US list ⁶	On EU list ⁷	On Japan list ⁸	On India list ⁹	Australian geological potential ¹⁰	Australian economic demonstrated resources (2020) ¹¹	Australian production (2020)	Global production (2020) ¹²
Manganese	✓		✓		High	Manganese ore: 276,000 kt	Manganese ore: 4,800 kt	17,200 kt
Niobium	✓	✓	✓	✓	High	216 kt	No data	78 kt
Platinum-group elements	✓	✓	✓	✓	Moderate	107 t	0.522 t	380 t
Rare-earth elements	✓	✓	✓	✓	High	4,200 kt	20 kt	240 kt
Rhenium			✓	✓	Moderate	No data	No data	53 t
Scandium	✓	✓			High	30.34 kt	No data	No data
Silicon		✓ ¹⁶	✓	✓	High	No data	No data	8 kt
Tantalum	✓	✓	✓	✓	High	99.4 kt	0.1 kt	1.8 kt
Titanium	✓	✓	✓		High	Ilmenite: 274,000 kt Rutile: 35,300 kt	Ilmenite: 1,100 kt Rutile: 200 kt	Ilmenite: 12,000 kt Rutile: 1000 kt
Tungsten	✓	✓	✓		High	577 kt	<1 kt	84 kt
Vanadium	✓	✓	✓	✓	High	7,408 kt	0	86 kt
Zirconium	✓		✓	✓	High	Zircon: 79,300 kt	Zircon: 400 kt	Zircon: 2,000 kt

¹⁶ The EU identifies silicon metal as a critical mineral.



<h2>High-purity alumina</h2>	<h2>Silicon</h2>
<p>Uses</p> <p>High-purity alumina (HPA) is a step along the value chain from aluminium. It is used in the automotive and aerospace sector and is an important component of lithium-ion batteries and highperformance electronics and optics.</p>	<p>Uses</p> <p>High-quality silica sand is a raw ingredient for the semiconductors used in electronics, computer processors and photovoltaics.</p>
<p>Markets</p> <p>China and India are some of the world’s biggest HPA consumers. Aluminium is also listed as a critical mineral by the US, Canada,¹⁷ and the EU, who note its application in the construction sector and emerging technologies like renewable energy.</p>	<p>Markets</p> <p>The US, Japan and Taiwan are the world’s biggest producers of semiconductors.</p> <p>Silicon metal is included on the EU’s list of critical minerals.</p>
<p>Australia’s participation in the supply chain</p> <p>The global HPA market was valued at \$1.3 billion in 2019. It is expected to grow to \$4.8 billion by 2026, with a compound annual growth rate of 20.7% from 2020 to 2026.¹⁸</p> <p>Australia is currently the world’s largest producer of bauxite (the ore used to make aluminium). We are also the second-largest producer of smelting grade alumina.¹⁹ This supports approximately 15,000 direct jobs and annual export earnings of around \$13 billion.²⁰</p> <p>Australia can produce HPA to meet growing global demand thanks to our strong primary aluminium industry and high-purity kaolin clay deposits.</p>	<p>Australia’s participation in the supply chain</p> <p>The global silica sand market is estimated to grow from US\$7 billion in 2018 to US\$20 billion in 2024.²¹</p> <p>Australia has several silica sand projects in the production, exploration and development stages. In the long term, we could work with our international partners to develop and produce chemical, solar and electronics grade silicon with purity levels of 6N to 11N.</p> <p>Australia already leads the world in neutron transmutation doping (NTD) of silicon, which is conducted in ANSTO’s OPAL reactor. NTD silicon is critical for high power and very high power electronic devices.</p> <p>The United States’ 100-Day Supply Chain Review also recommended partnering with countries like Australia to further develop the supply chain.²²</p>

17 Natural Resources Canada, [Critical Minerals](#), Natural Resources Canada, Government of Canada, 2021, accessed 9 March 2022.

18 A Chaudhary, K Yeware and E Prasad, [High Purity Alumina Market Outlook 2026](#), Allied Market Research, 2020, accessed 3 March 2022.

19 D Thurtell, A Nash, M Gibbons, B Gasson, B Aitkenhead, T Nguyen, S Smith and C Lewis, [Resources and Energy Quarterly December 2021](#), Department of Industry, Science, Energy and Resources (DISER), Australian Government, 2021, accessed 3 March 2022.

20 Australian Aluminium Council Ltd, [Fact Sheet – Strengthening Our Aluminium Industry](#), Australian Aluminium Council Ltd, 2021, p 6, accessed 3 March 2022.

21 J-F Bertinocourt, [Australian Silica Sand Sector](#), Evolution Capital Advisors, 2021, p 1, accessed 3 March 2022.

22 The White House, [Building Resilient Supply Chains, Revitalizing American Manufacturing, and Fostering Broad-based Growth – 100-Day Reviews under Executive Order 14017](#), The White House, Federal Government of the United States, 2021, pp 201–202, accessed 3 March 2022.







