A 360° Playbook for Policymakers

Deepening Australia-India Cooperation on Critical Minerals

April 2025

Titiksha Vashist

Maitri Fellow 2024

The Pranava Institute
Center for Emerging Technology and Policy

TECH POLICY DESIGN INSTITUTE

Preface

About this report

This report results from work conducted by Titiksha Vashist as part of the inaugural Maitri Fellowship 2024. Titiksha was hosted at the Tech Policy Design Institute (formerly Tech Policy Design Centre, Australian National University) between July 2024 and April 2025. TPDi is an independent, non-partisan think tank dedicated to tech policy based in Canberra, Australia.

The production of this report was supported by the Centre for Australia-India Relations through the Maitri Fellowship Program 2023-2024.

Author

Titiksha Vashist, Maitri Fellow 2024
Co-founder, The Pranava Institute, New Delhi, India.

Acknowledgements

The TPDi acknowledges the Ngunnawal and Ngambri people, who are the Traditional Owners of the land upon which this report was prepared. We pay our respects to their elders, past and present.

The TPDi thanks everyone who contributed to this work, including over 30 stakeholders in critical minerals across industry, government, policy and think tanks and academia in Australia and India who were interviewed for this research. The author especially thanks Zoe Hawkins and Shyam Krishnakumar for their review of the report, and the team at The Tech Policy Design Institute and The Pranava Institute for their support throughout the project.

Citation

Titiksha Vashist, “Deepening Australia-India Cooperation on Critical Minerals,” Tech Policy Design Institute (TPDi), April 2025.

Contact

Tech Policy Design Institute
W: www.techpolicy.au
E: hello@techpolicy.au
ABN: 94 681 576 394

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Executive Summary

Rising demand, coupled with high supply chain concentration and geopolitical risk, have made critical minerals a strategic priority for countries worldwide. Major powers including the United States, the European Union, Australia, Canada, the United Kingdom, and India have launched critical minerals strategies to forecast demand, address supply chain risks, and tackle security and geopolitical challenges across short, medium, and long-term horizons. Along with increasing domestic reserves, governments are seeking international cooperation to secure and diversify supply chains and build trusted partnerships.

India is Australia's fifth-largest trading partner, with two-way trade in goods and services reaching $49.1 billion in 2023. The 2020 Economic Cooperation and Trade Agreement(ECTA) has set a trade target of $100 billion by 2030. The New Roadmap for Australia's Economic Engagement with India seeks to bolster critical minerals cooperation, proposing a slew of initiatives aimed at strengthening supply chains, adding export value, increasing investment pipelines, and co-developing mining and processing technology.

Critical minerals offer significant economic and geopolitical benefits to Australia, given its leadership in mining and large resource endowments of minerals. India's rapid urbanisation, focus on pushing domestic manufacturing through initiatives such as Atmanirbhar Bharat and Make in India, plus a target of achieving net zero emissions by 2070, makes it a large market for minerals. Australia and India have already inked pacts to deepen research and strategic cooperation on critical minerals, including mechanisms to jointly invest in projects.

While policy mechanisms between the two countries are in place, the complexity accompanying critical minerals policy and its current siloed approach remain challenging. To address this concern, this playbook aims to take a holistic view across three themes necessary for policymakers in both countries: Security and Geopolitics, Economics and Markets, and Climate and Sustainability.

Security and Geopolitics is a key driver for Australia-India engagement on critical minerals, necessitating a comprehensive approach that incorporates geography, technological innovation, diversification, domestic availability, and a nuanced understanding of current and future import dependencies for Australia and India.

Leveraging bilateral and multilateral mechanisms to build supply chain security and hedge against geopolitical risk is crucial. Australia and India need to bridge the knowledge and capabilities gap in the sector, which will allow a better understanding of business and regulatory cultures. Coordination across solid portfolios, financing the sector, streamlining approvals, and improving the perception of India for Australian stakeholders are key enabling next steps.

Global markets for critical minerals are thin, opaque and highly volatile—negatively impacting Australia as a producer, and India as a heavy importer of these minerals. The direct effects on supply chains are also negative, as are the broader effects for investors and access to capital necessary to widen global mineral supply chains. Australia and India must collectively intervene to address market volatility by providing economic safety nets, long-term investment incentives, and price modelling. Measures to support private investments beyond offtake arrangements are also necessary. Indian companies need easier access to credit, and institutions such as India's EXIM bank and Export Finance Australia can play a key role in enabling investments in specific commodities. Private companies and government need to interact more across both states, and work together in innovative ways to deliver on the partnership.

Taking a sustainable approach to minerals policy is critical, given the environmental costs of minerals mining and its impact on indigenous communities in both countries. By centring climate and security in their discourse on critical minerals, Australia and India can lead the global conversation on sustainable supply chains. Australia should treat its high ESG standards as a critical asset, and it should update these to keep its global lead in clean mineral exports. India's green manufacturing ambitions can find an ideal partner in Australia, with technology and knowledge sharing on ESG benefiting Indian companies. New frontiers of collaboration such as under-sea mining can address ecoological concerns at the get-go.

The playbook is a result of research undertaken over six months, including in-depth interviews in Australia and India with government officials, businesses and research groups working on critical minerals, and civil society. It seeks to provide a 360° view of the challenges in critical minerals which Australia and India face and proposes policy options for both countries to deepen critical mineral cooperation and take a leadership role in building more secure and reliable supply chains.

Key Recommendations:

01

Map and prioritise sectoral critical minerals demand

A granular analysis of India's critical minerals demand, particularly in emerging sectors such as clean tech, battery manufacturing, electronics, and chemicals, is essential. This will help Australian stakeholders target high-growth opportunities and align mutual incentives for future collaboration.

02

Position Australia as a trusted supplier for India’s growing mineral demands

Given India's growing demand for critical minerals, Australia should proactively engage key Indian manufacturers and infrastructure and technology giants to establish itself as a preferred and trusted supplier. Australia can leverage its mining expertise and sustainability practices to position itself ahead of competitors.

03

Map comparative advantages to strengthen bilateral cooperation

Australia and India should conduct a comprehensive analysis of their comparative advantages in critical minerals, particularly rare earth elements (REEs) needed for critical sectors such as defence, health, and semiconductors. This strategic alignment can foster deeper, long-term cooperation in critical minerals beyond economic interests.

04

Leverage economies of scale and foster large-scale projects

Australia and India should collaborate to unlock economies of scale, especially given India’s large domestic market. By working together on large-scale mining and processing projects, both nations can benefit from competitive pricing, workforce development, and reduced investment risks.

05

Foster state-level collaboration to address regulatory concerns and unlock new opportunities

Given that environmental and land clearances are primarily state responsibilities in both countries, strengthening communication and cooperation between federal and state governments will help address roadblocks in clearances, certifications, and project timelines. Connecting states such as Western Australia and Victoria in Australia and Tamil Nadu, Gujarat, and Telangana in India can also unlock new financing channels. This will facilitate synergies between businesses, drive innovation, and de-risk investments in critical minerals projects.

06

Streamline approvals, regulatory processes, and establish a single-window mechanism

To enhance bilateral collaboration, a single-window mechanism under the Critical Minerals Mission can be established, simplifying engagement with Indian regulatory bodies. Streamlining approvals and governance processes will ensure timely execution, and reduce bureaucratic friction in critical minerals projects.

07

Collaborate to develop normative regimes, standards and benchmarks for critical minerals markets

Australia and India should collaborate to leverage their unique positions in the minerals supply chain. Australia's status as a reliable economic middle power and India's unique position as an emerging Global South leader can be leveraged to shape norms in critical minerals global discourse, as well as work to develop standards and benchmarks for critical minerals markets through utilising existing cooperation mechanisms.

08

Support Indian companies with financing and credit access

Indian companies should be provided with access to financing and credit mechanisms to enable them to invest in critical minerals projects, both domestically and internationally. Tailored financial support can also encourage smaller firms to build niche expertise in critical minerals markets, driving innovation and specialisation in both countries.

09

Intervene to address market risks, price volatility, and long-term investment

Governments must intervene to address market volatility by providing economic safety nets, long-term investment incentives, and price modelling. Building on the economic integration enabled by the Comprehensive Strategic Partnership, this will safeguard against price fluctuations and ensure the stability and sustainability of critical minerals supply chains, encouraging greater investment from both the public and private sectors.

10

Leverage multilateral mechanisms and ESG leadership to attract global investment. Leverage Australia's leadership in ESG

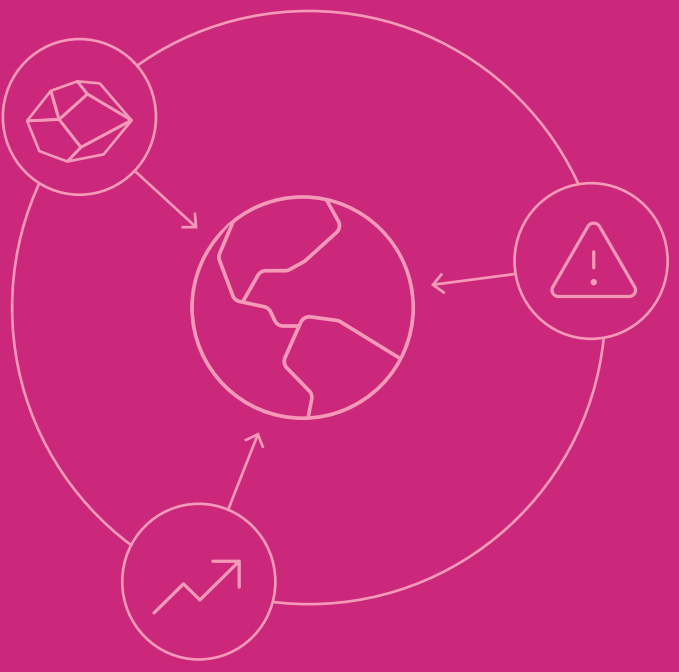
Australia and India should collaborate to leverage multilateral mechanisms, such as the Minerals Security Partnership (MSP) and the Quad Investors Network, to present joint projects and attract global investment. Additionally, both countries should leverage Australia's leadership in ESG standards to assist Indian companies in improving mining practices and promoting sustainable development and corporate social responsibility (CSR) initiatives in critical minerals.

Specific, thematically organised recommendations are included at the end of each chapter across this playbook.

Section 1

Critical Minerals in a Strategic Context

“Rising demand, coupled with high supply chain concentration, and geopolitical risk, has made critical minerals a strategic priority for countries worldwide.”



Chapter 1

Critical Minerals: The Strategic Imperative

Introduction

Minerals for tomorrow

Rising demand, coupled with high supply chain concentration, and geopolitical risk, has made critical minerals a strategic priority for countries worldwide.

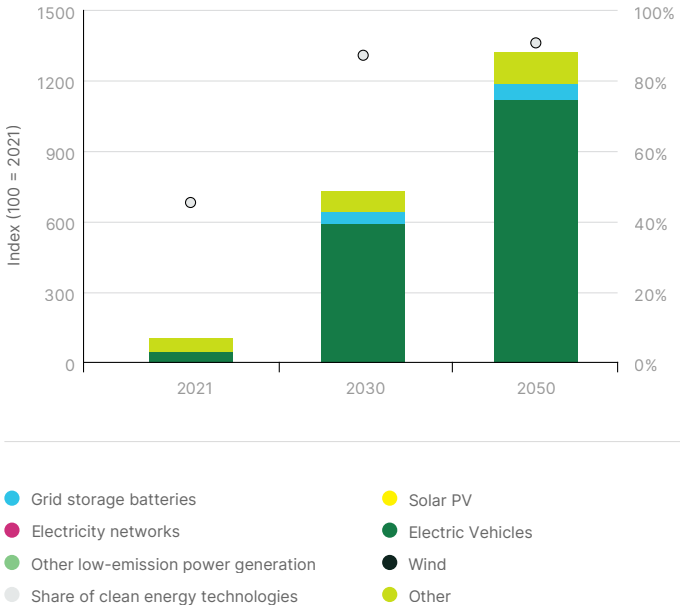
Rising global demand for critical minerals

Critical minerals, such as lithium, cobalt, copper and rare earth metals, are the building blocks for clean technologies such as EV batteries, solar panels, and wind turbines, and are necessary to produce technology components like semiconductors. Critical minerals are also vital inputs for defence systems, telecommunications, automobiles, and the healthcare sector. Accelerating decarbonisation efforts in the face of climate change, and the deepening fourth industrial revolution, mean that countries around the world are demanding more minerals than ever before[1].
Global demand for critical minerals is estimated to be worth as much as USD 378 billion[2]. According to the International Energy Agency, demand for lithium rose 30 per cent in 2023, while demand for nickel, cobalt, graphite, and rare earth elements saw increases ranging from 8 to 15 per cent. At around USD 325 billion, today's aggregate market value of key energy transition minerals aligns broadly with that of iron ore[3]. According to an OECD estimate, 50 new lithium mines, 60 new nickel mines, and 17 new cobalt mines will be required to meet the global demand for critical minerals[4].

As a result, securing critical minerals has increasingly become a part of global strategic dialogues. Critical minerals are a prominent topic for economic policy and development, national security, pathways to net-zero emissions targets (NZE), and foreign policy[5]. Major powers across the world including the United States, the European Union, Australia, Canada, the United Kingdom, India, and the G7 have announced critical minerals strategies[6] that project future demand, analyse supply chain risks, and set the agenda to navigate associated security and geopolitical challenges in the short, medium and long term. In addition to tapping into domestic reserves, governments are also seeking to build international cooperation to secure and diversify supply chains through trusted partnerships. International dialogues and several high-level agreements have been signed to strengthen critical minerals supply chains through financing and diplomatic support.

Figure 1: Total demand for selected minerals by end use in the Net Zero Scenario, 2021 - 2051

Figure 2: Total demand for Lithium by end use in the Net Zero Scenario, 2021 - 2025



Source: https://www.iea.org *IEA. Licence: CC BY 4.0*

The Australia-India partnership

Critical minerals cooperation has featured prominently in both Australian and Indian economic, security, and foreign policy dialogues—with both countries releasing Critical Minerals Lists and strategies in the last few years and prioritising the partnership at various levels. The potential for an Australia-India critical minerals partnership is promising. Critical minerals offer significant economic and geopolitical benefits to Australia, given its leadership in mining and large resource endowments of minerals[7]. India's rapid urbanisation, focus on pushing domestic manufacturing through initiatives such as Atmanirbhar Bharat and Make in India, plus a target of achieving net zero emissions by 2070, makes it a large market for minerals.

Australia and India's relationship presents a prime example of international cooperation on critical minerals, and is the focus of this playbook. The subsequent chapters will explore the nature of this cooperation, and explore pathways in which the Australia-India cooperation can realise its potential in critical minerals.

The Playbook: A Critical Minerals 360

The critical minerals landscape is shaped by multiple intersecting global and domestic factors, including overlapping policy priorities, shifting geopolitical dynamics, and evolving economic demands. Interviews with government officials in India and Australia conducted as part of this study reveal a persistent siloing of critical minerals policy across various departments and ministries, often leading to divergences between strategic pillars, economic imperatives, and foreign policy imperatives. Environmental considerations remain critical and are frequently addressed in isolation, further complicating cohesive policy formulation. Given the sector's strategic importance, cohesive, strategic and long-term policy thinking is essential.

This playbook provides a 360° perspective on enhancing critical minerals cooperation between Australia and India. Specifically, the playbook explores the critical minerals strategic imperative from three core perspectives: Security, Economics and Environment. The motivation for prioritising these three factors is briefly described below, and a detailed analysis of these factors in the context of the Australia-India relationship follows in subsequent chapters.

Security 01

Motivations

Critical minerals are integral to national security, underpinning energy and defence capabilities. Ensuring resilient and predictable supply chains is crucial to maintaining energy security, a challenge increasingly recognized by states.

Vulnerabilities

Critical minerals supply chains are highly susceptible to disruptions caused by trade restrictions, geopolitical conflicts, and great-power competition.

The concentration of mineral processing capabilities poses significant risks: China currently processes 68% of global nickel, 40% of copper, 59% of lithium, and 73% of cobalt[8]. Historical events, such as the 2010 trawler dispute between China and Japan[9], illustrate how such concentration can be leveraged geopolitically. The larger backdrop of US-China decoupling, and its possible deepening under the new Trump administration[10], is also likely to influence how middle powers approach critical minerals security.

An increasing consensus among analysts suggests that no single country can achieve complete sovereign capacity in this sector. As a result, bilateral and multilateral efforts to achieve scalable, secure, and sustainable mineral supply chains have proliferated[11]. Recent years have also witnessed the rise of strategic dialogues and groupings aimed at "friend-shoring" to mitigate monopolistic and geopolitical risks.

Takeaways

This makes security a key driver for states' engagement on critical minerals, necessitating a comprehensive approach that incorporates geography, technological innovation, diversification, domestic availability, and a nuanced understanding of current and future import dependencies.

The chapter on security unpacks the geopolitical and supply chain challenges both Australia and India face in critical minerals and makes the argument that both countries make for ideal partners at a time when these tensions are likely to grow. The chapter also offers policy recommendations to leverage mechanisms in both the bilateral and multilateral relationships to advance minerals security.

Motivations

The global shift towards greener, technology-driven economies has led to a surge in demand for critical minerals. In addition, middle and advanced economies which are seeking to expand domestic manufacturing ecosystems (like EV battery manufacturing in India) will also require critical minerals for these sectoral demands.

Vulnerabilities

Economic and trade dynamics in the critical minerals market remain volatile and opaque. Research suggests that there is a mismatch between the existence of reserves and countries having access to mine production for most minerals, including India[12].

According to the IEA, market transparency of commodities such as cobalt, lithium, and rare earth elements remains limited, challenging price-hedging and discouraging investment and risk assessments. Market transparency covers both *pricing*—including efficient market price discovery mechanisms and financial tools to hedge price risks—and *information*—the importance of publicly available data on consumption, supply, inventories, trade, and ESG performance[13]. These economic factors pose challenges to India as a country with a rapidly growing demand, as well as for a critical minerals producer, like Australia.

Takeaways

The demands created by critical minerals will require restructuring current commodity markets and creating new mechanisms for states to trade minerals securely. In addition to price volatility and information gaps, policymakers, investors, and companies are also navigating regulatory issues across jurisdictions, domestic and international policies, long project timelines, and technological advancements in sectors that are driving key demand for minerals.

The chapter on economics will focus on the challenges faced by India and Australia in critical minerals trade, and how opportunities for greater economic growth, exchange, and development can be developed within existing bilateral arrangements. The playbook makes the case that Australia and India are ideal critical minerals partners, and draws views from industry experts on how existing roadblocks can be overcome, and new opportunities leveraged.

Environment and Sustainability 03

Motivations

For most minerals, the share of clean energy technologies in total demand was minuscule until the mid-2010s. However, energy transitions are already the major driving force for total demand growth for some minerals. Since 2015, EVs and battery storage needs have surpassed consumer electronics to become the largest consumers of lithium, together accounting for 30% of total current demand, with an accelerating trend. Clean energy technologies become the fastest growing segment of demand for most minerals, and their share of total demand edges up to over 40% for copper and rare-earth minerals, 60–70% for nickel and cobalt, and almost 90% for lithium by 2040[14]. However, producing these minerals in strict adherence to robust environmental, social, and governance criteria will be challenging in the face of rising demand[15].

Vulnerabilities

Current critical minerals policies in several states, including India, demand deeper thinking about the sustainability and environmental impacts of critical minerals. Critical minerals mining is complex—it requires substantial resources (such as land and water), may occur in climate-vulnerable zones, and can involve issues of displacement of communities. While the growth of the minerals supply plays a vital role in enabling a clean energy transition, if poorly managed, the production and processing of these minerals can lead to a myriad of negative consequences, including a significant increase in greenhouse gas emissions arising from energy-intensive mining and processing activities, loss of biodiversity, and pollution[16]. Critical minerals mining can also impact vulnerable communities and the rights of indigenous peoples, requiring laws which protect them from unjust resource exploitation.

Takeaways

At COP28, the UN Secretary-General António Guterres launched an initiative addressing these concerns, stating that the extraction of minerals needed for green energy must be 'sustainable and just', and that the green energy boom is an opportunity for commodity-rich developing countries to transform and diversify their economies[17]. Finally, despite growing policy ambitions, the use of recycled materials has so far failed to keep pace with rising material consumption. These concerns animate both Australia and India with regard to their critical minerals sectors, and open a ripe space for cooperation.

The chapter on climate and sustainability takes a closer look at sustainability challenges concerning critical minerals for both Australia and India and explores how the partnership can unlock long-term sustainability through strategic cooperation. The playbook makes the case that Australia has much to share with regard to its ESG standards, and India's green manufacturing ambitions can find an ideal partner in Australia.

The subsequent chapters will provide recommendations at the end of each chapter, focussing on the thematic area.

Chapter 2

What are Critical Minerals? Mapping Definitions Across Australia and India

Introduction

What makes a critical mineral, *critical*? There is no universally accepted, singular definition of what constitutes 'critical' among minerals. Several criticality assessment methods exist and are adopted by states depending on factors such as industry mix, national interests, and market conditions. When defining the criticality of minerals countries consider factors such as geological endowments, supply chain assessment, economic viability, technological advancement and geopolitical concerns. Various countries have identified over 50 minerals as critical. National-level critical material requirements are highly dynamic, and respond to sectoral trends which drive core demand for minerals. In the renewable energy sector, five key minerals[1] in frequency of appearance on critical materials lists across countries are aluminium, boron/borate, silicon, copper, and graphite[2]. While all strategies emphasise the security and sustainability of supply chains, there are no common standards for these at present[3].

Conceptions of criticality change over time, depending on global demands, national needs, and supply. Scarce mineral resources are subject to high import dependency for several states owing to their lack of abundance and possible geographic concentration. Factors such as supply risks, spikes in demand, concentration, and ease of substitution also impact criticality. Gallium, for example, is ranked as the most concentrated material since China produces a staggering 98 per cent of the world's supply of raw gallium, and processes 95 per cent of it domestically[4]. Minerals defined as critical can be geologically dispersed, concentrated in a few geographic locations, or recovered as a byproduct of another commodity.

However, physical abundance of minerals does not necessarily equate to availability and ease of access. For instance, although copper is not rare, the average lead time for a new copper mine is about twenty years, which means that it takes a long time to translate geological reserves into market commodity, and to obtain government permits. Since the 1980s, criticality research has shifted to emphasise low-volume elements used to produce high-technology goods, renewable energy tech, and defence applications. This is also why innovations in sectors such as renewable energy and semiconductor manufacturing focus on finding ways to substitute materials that are scarce, geographically concentrated, or prone to significant human and environmental impact, with more widely dispersed or abundant materials.

The common definition of critical minerals and materials is neatly summarised by Geoscience Australia. A critical mineral is a metallic or non-metallic element that has two characteristics[7]:

01 It is essential for the functioning of our modern technologies, economies or national security.

02 There is a risk that its supply chains could be disrupted.

Figure 3

Factors impacting criticality of minerals

- Risk of Supply Chain Disruption
- Natural Disasters Disrupting Trade
- Renewable Energy Uses
- Geographical Concentration
- Use in High Technology Goods
- Market Dynamics (a sudden increase)
- Defence and Security Applications
- Production Concentration and Manufacturing of Certain Goods

India's definition of critical minerals

India released its critical minerals strategy in 2023, outlining 30 critical minerals, and 15 strategic minerals crucial for its growing economy, green energy transition, and efforts at building a domestic manufacturing ecosystem under missions such as 'Make in India'. The report published by the Ministry of Mines defined critical minerals as "those minerals which are essential for economic development and national security, the lack of availability of these minerals or even concentration of existence, extraction or processing of these minerals in few geographical locations may lead to supply chain vulnerability and disruption," drawing from definitions in the United States, the EU, and Australia. For defining its critical minerals, India has made use of a study conducted by the Centre for Social and Economic Progress which uses the European Union (EU) Methodology to identify critical minerals for India[8].

India's 'Make in India' policy seeks to make India a global manufacturing hub for 25 sectors for which critical and strategic minerals are essential. These sectors include EVs, electronics systems, electric machinery, and renewable energy technologies[9]. India targets to achieve 50% of its energy requirements from renewable energy by 2030 and achieve net zero emissions by 2070[10].

Mapping critical minerals and strategic minerals across Australia and India

Australia and India are making attempts to stitch a partnership in minerals, they key to which is mapping Australia's minerals potential as a producer country, and India's demand for minerals. However, given the widespread uses of minerals, it is important to unpack what India uses critical minerals for, to pave the way for focussed demand and supply assessments. The tables below seek to bridge this gap in the literature.

The following tables seek to map minerals defined as critical and strategic in Australia and India, alongside India's current inventory, key sectors where these minerals are used, and Australia's identified geological potential. This is done given India's rising import demands, and to set the scene for the thematic exploration of the bilateral critical minerals relationship in the chapters that follow.

Table 1: Mapping Australia and India's Critical Minerals Lists with major uses.

India's CM List[11]	Australia's CM/SM List	India's current import dependence	India's current inventory	Australia identified geological potential	Key industry/ Sector uses
Antimony	✓	Ores: Tajikistan (53%), Russia (22%) Alloys: Oman (36%), China (34%) Powders: Oman (36%), China (34%)	18.6 million tonnes	Moderate	● Electronics (Batteries, semiconductors) ● Energy ● Medicine
Beryllium	✓	Total Dependence: 100% Russia, UK, Netherlands, South Africa, China	None	Moderate	● Automotives ● Defence ● Electronics ● Telecom
Bismuth	✓	China, United States, Italy, Germany[12]	None	Moderate	● Pharmaceuticals
Cobalt	✓	United States (16%) Netherlands (16%), Japan & Belgium, China	44.9 million tonnes	High	● Aerospace ● Medicine ● Renewables (EVs, Battery, Grid storage)

India's CM List[11]	Australia's CM/SM List	India's current import dependence	India's current inventory	Australia identified geological potential	Key industry/ Sector uses
Copper	✗	Ores: Chile (37%), Indonesia (20%) Refined: Japan (86%)	1660 million tonnes	- -	● Construction ● Electronics (Semiconductors) ● Transportation
Gallium	✓	China, South Africa[13]	74 million tonnes	High	● Communications ● Defence ● Electronics (LEDs, solar panels, memory cells) ● Medicine ● Nuclear Applications[14]
Germanium	✓	China, South Africa, Australia, France, United States (100%)	None	High	● Electronics (Optical fibres, satellites, solar cells)
Graphite	✓	Natural graphite: China (41%) Artificial graphite: China (47%) Graphite bricks and shapes: Belgium (99%) Crucibles: China	211.6 million tonnes	Moderate	● Aerospace ● Automotives (lithium-ion batteries) ● Defence ● Electronics ● Energy ● Foundry (crucibles, refractories) ● Nuclear applications
Indium	✓	China, South Africa, Russia[15]	None	Moderate	● Electronics
Phospho-rous	✗	Vietnam, Russia, Kazakhstan[16]	30.8 million tonnes	- -	● Agriculture ● Defence
Potash	✗	Canada (31%), Belarus (18%)[17]	23 billion tonnes	- -	● Agriculture
Silicon	✓	Total dependence: <1 % China, Malaysia, Norway, Bhutan, Netherlands	183.9 million tonnes	High	● Electronics ● Steel
Strontium	✗	China, United States, Russia, Estonia, Slovenia (100%)	None	- -	● Aluminium

India's CM List[11]	Australia's CM/SM List	India's current import dependence	India's current inventory	Australia identified geological potential	Key industry/ Sector uses
Tellurium	✓	Belgium (67%), China (33%)	None	Unknown (interpreted moderate)	● Electronics ● Renewables (Solar cells, PE devices)
Tin	✗	Indonesia (70%), Singapore (21%)	83.7 million tonnes	- -	● Electronics ● Medicine ● Renewables
Selenium	✓	Japan (40%), Republic of Korea (23%)	None	Unknown (interpreted moderate)	● Electronics ● Renewables
Cadmium[18]	✗	China (27%), Japan(17%)	Total installed capacity of Cadmium ore: 913 tonnes per yea	- -	● Aerospace ● Defence ● Nuclear Application (Fission control) ● Renewables (Rechargeable Batteries and Electrical)
Lithium, Molybdenum, Niobium, Nickel, Hafnium, Rhenium, Platinum group elements, Rare Earth Elements, Titanium, Tantalum, Tungsten, Vanadium, and Zirconium are covered in the table below on strategic minerals.					

Note:

1. Iridium, Palladium, Platinum and Ruthenium are listed under Platinum Group Metals in India's 2023 list of critical minerals.

2. Cerium, Dysprosium, Erbium, Europium, Gadolinium, Holmium, Lanthanum, Lutetium, Neodymium, Praseodymium, Samarium, Scandium, Terbium, Thulium, Ytterbium, Yttrium are listed under Rare Earth Elements in India's 2023 list of critical minerals.

Table 1 Data Sources: Australia's Critical Minerals List and Strategic Materials List, Critical Minerals for India - Assessing their Criticality and Projecting their Needs for Green Technologies, Unlocking Australia - India Critical Minerals Partnership Potential, Critical Minerals for India - Report of the Committee on Identification of Critical Minerals, Indian Minerals Yearbook 2022- Volume I, II, III, National Mineral Inventory - An Overview. As on 01.04.2020.

Table 2: Mapping India and Australia's Strategic Minerals lists with major uses.

India Strategic Minerals List	Australia Critical Minerals List	India's current import dependence and major import countries	Australia identified geological potential	Key Uses in India
Lithium	✓	Total dependence: 100% Lithium oxide and hydroxide: Russia (44%) Lithium carbonate: Belgium (41%) Lithium-ion batteries: Vietnam (30%), China (27%)	High	● Medicine ● Pharmaceutical ● Renewables (Batteries, clean technology)
Molybdenum	✓	Molybdenum ores: Chile (48%) Molybdenum and scrap: China (58%)	Moderate	● Electronics ● Metallurgy ● Renewables

India Strategic Minerals List	Australia Critical Minerals List	India's current import dependence and major import countries	Australia identified geological potential	Key Uses in India
Niobium	✓	Total dependence: 100% Singapore (66%) Brazil (22%) Australia	Unknown (interpreted moderate)	● Aerospace ● Automotives ● Electronics ● Energy ● Medicine
Nickel	✓	Total dependence: 100% Nickel and alloys: Netherlands (11%)	High	● Aerospace ● Chemical industry ● Defence
Platinum-group elements	✓	Platinum alloys: UK (37%) Platinum-clad Base: United States (56%) Platinum powder: United States (53%)	Moderate	● Automotive ● Electronics ● Medicine
Rare-earth elements	✓	China (95%)	High	● Aerospace ● Automotive ● Defence ● Electronics ● Medicine ● Metallurgy ● Nuclear applications ● Renewables (wind power turbines, hybrid electric vehicles, fuel cells)
Tantalum	✓	Ores: Mozambique (51%) Alloys: China (54%) Titanium dioxide: China (32%)	High	● Aerospace ● Electronics ● Medicine
Titanium	✓	Total dependence: 100% Nickel and alloys: Netherlands (11%)	High	● Chemical ● Consumer Products ● Electronics
Tungsten	✓	Tungsten ore: Netherlands (87%) Alloys: China (53%)	High	● Construction ● Defence ● Mining ● Oil
Vanadium	✓	Total dependence: 100% Ferro vanadium: Germany (32%), Republic of Korea (31%) Ores and Concentrates: Canada (71%)	High	● Electronics ● Medicine ● Metallurgy ● Pharmaceuticals
Magnesium	✓	Magnesite: China (48%), UAE (28%) Unwrought and Scrap: China (88%)	High	● Electricals ● Medicine ● Metallurgy

India Strategic Minerals List	Australia Critical Minerals List	India's current import dependence and major import countries	Australia identified geological potential	Key Uses in India
Hafnium	✓	China, South Africa, Russian Federation, Brazil[19]	Moderate	• Nuclear applications[20]
Rhenium	✓	Total dependence: 100% Russia, UK, Netherlands, South Africa, China	Unknown (interpreted moderate)	• Aerospace • Petroleum
Zirconium	✓	Total dependence: 80% Ores: Australia (51%) Zirconium scrap: China (76%)	High	• Aerospace • Defence • Electronics • Medicine • Nuclear reactors
Boron	✗	Borax: Turkey (60%) Boric acid: Turkey (61%), Singapore (37%)	- -	• Aerospace • Medicine • Glass and porcelain industries

Table 2 Data Sources: Indian Minerals Yearbook 2022- Volume I, II, III, Australia's Critical Minerals List and Strategic Materials List, Unlocking Australia - India Critical Minerals Partnership Potential.

Section 2

Critical Minerals in the Australia-India Relationship

"India is on track to become the world’s third-largest economy and was Australia’s fourth-largest export market in 2024. India is currently Australia’s fifth-largest trading partner with two-way trade in goods and services reaching $49.1 billion in 2023."

Chapter 3

Critical Minerals within Australian and Indian Policy Priorities

Introduction

India is on track to become the world's third-largest economy and was Australia's fourth-largest export market in 2024. India is currently Australia's fifth-largest trading partner with two-way trade in goods and services reaching **$49.1 billion** in 2023[1]. India's imports for copper, a critical mineral, stood at **$682 million** in 2023[2]. Australia's large resource endowments and the rising demand from the renewable energy sector position Australia to lead in critical minerals supply—offering significant economic and geopolitical opportunities[3].

India is seeking partnerships with trusted countries for its minerals needs

India's critical mineral needs are set to peak by 2050, coinciding with its peak emissions at the current growth trajectory. Clean technologies including solar, wind, EV batteries, grid storage, and infrastructure are projected to drive the majority of this demand. With minerals needs on the rise, India is seeking partnerships with trusted countries for minerals for which it has limited or no domestic reserves. India is an important country for a major mineral producer like Australia.

Table 3: The projected annual requirement of critical minerals such as cobalt, nickel, lithium, neodymium in the next few years is as follows[4]:

Critical Mineral	2025 (in tonnes)	2026 (in tonnes)	2027 (in tonnes)	2030 (in tonnes)
Cobalt	17	49	147	3878
Lithium	58	174	517	13671
Nickel	2629	3057	6663	17492
Neodymium	223	261	830	766

Source: https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2041804

Minerals security as a national and strategic priority

India's mineral security has recently emerged as a national priority, with key government bodies, including the Ministry of Mines, NITI Aayog, and the Ministry of External Affairs working to draft a national-level strategy, secure minerals, and engage in dialogues with partner countries to secure, diversity and build trustworthy minerals supply chains. India is also advancing talks with a range of countries including the United States, the European Union, the African Union, and resource-rich nations such as Bolivia, Argentina, Brazil, Canada, and Chile for minerals security. India joined multilateral security mechanisms such as the Minerals Security Partnership (MSP) in 2023[5] and signed the Indo-Pacific Economic Framework (IPEF) focussed on clean and fair economic development in the Indo-Pacific region in 2024. The IPEF agreement includes a dedicated pillar for deepening the critical minerals dialogue by mapping mineral resources across partner countries, promoting trade, fostering technical collaboration, and enhancing business engagements[6]. While this was seen as a big step both in India and Australia, the long stability of the arrangement may hinge on the degree of resource nationalism that the current US administration and other country members may prioritise.

In 2024, New Delhi launched its National Critical Mineral Mission (NCMM) and announced an allocation of ₹16,000 crores for the exploration of minerals assets outside India from 2025–2031. The mission will support India's public and private sector companies to acquire mineral assets overseas. It has also proposed to set up an Empowered Committee which will provide inter-ministerial support to companies seeking to invest abroad[7]. The mission also includes a slew of new measures including education and skilling, recycling initiatives, and continuous policy updation on critical minerals.

Australia as a leader in critical minerals exports makes it a natural partner

Australia is a key exporter of critical mineral resources and is the largest exporter of lithium, producing nearly 50% of the world's lithium. Research suggests that Australia is at par with the European Union, behind only the U.S., in evolving its policy landscape to include financing, tax incentives, conducting geological surveys, building ecosystems for recycling support, and offering innovation funding for the critical minerals sector[8]. Australia's natural endowments and geological potential, and strong credentials in environmental, social, and governance (ESG) processes offer it an opportunity to lead in the global critical minerals supply chains. Alongside countries such as China, DR Congo, Indonesia, Mozambique, and South Africa, Australia has led the charge in increasing the mining output of low-carbon critical minerals from 2016 to 2022[9].

Capturing more valuable parts of the global critical minerals supply chains and building mid-processing capabilities remains a key priority for the Australian government across several policy documents. This accompanies the economic need for Australia to create domestic job opportunities, and implement policies such as the 'Future Made in Australia' bill[10]. The Critical Minerals Strategy 2023–2030 also outlines Canberra's ambition to leverage its existing capacity, build capacity for mid-steam processing, and establish itself as a global supplier of both raw and processed minerals by 2030[11].

Australia has sought to foster long-term partnerships with countries for minerals, signing over 26 bilateral or multilateral agreements. It also seeks to leverage multilateral mechanisms to expand the global policy dialogue on critical minerals, and set global benchmarks as a global leader in setting ESG standards across the mining value chain.

Australia's Revised India Economic Strategy to 2035

The Revised India Economic Strategy to 2035 reflects Australia's commitment to build strong, long-standing economic linkages with India across sectors such as renewable energy, critical cyber and emerging technologies, and green technologies. Critical minerals demand from these sectors is projected to rise in the medium term. Beyond mineral reserves, Australia is also a global leader in the Mining Equipment, Technology, and Services (METS) industry. Its technical expertise and extractive capabilities present unique opportunities for collaboration with India, which is undergoing a transformation in its domestic mining sector. By combining Australia's advanced METS capabilities with India's growing demand, the two nations can foster mutually beneficial partnerships to bolster critical minerals supply chains.

Many policy stakeholders work on critical minerals

Domestic and international policy action on critical minerals is complex and involves multiple actors, institutions, regulators, and organisations in both Australia and India at both the federal and state levels. Working across and along with these institutions remains necessary to translate strategic and national-level priorities for both countries. This is important given the cross-ministerial nature of critical minerals issues. For example, in Australia, the Critical Minerals Office remains the nodal point of contact for international cooperation, and the DISR is the domestic policy owner for the Australian Critical Minerals Strategy. A holistic approach to the sector will include coordinating with the Ministry of Defense, and CSIRO for research, and state-level governments to understand the local environmental, social and regulatory requirements.

In India, the Ministry of Mines is the key policy and regulatory owner for critical minerals policy. However, international cooperation is also led by the Ministry of External Affairs (MEA), particularly the New, Emerging & Strategic Technologies (NEST) division which moves foreign policy action relating to critical minerals. KABIL serves as the Government of India's investment facilitation body for minerals projects overseas, and has engaged with multiple governments worldwide to explore partnerships with India. Bodies such as Invest India also play a role in bringing investors to India's mining sector. Simultaneously,

NITI Aayog, the Indian government's think tank, plays a critical role in drafting policies such as those relating to incentives for battery and solar PVs, making it important for sectors which require minerals as inputs. India's Ministry of Environment, Forest and Climate Change owns the environmental clearance for mining projects. Agencies such as the Geological Survey of India and the National Mineral Exploration Trust (NMET) undertake mapping activities and exploration across India, and are also crucial stakeholders in critical minerals policymaking.

Recommendations:

01

Position Australia as a trusted supplier for Indian industry ahead of the curve

India's domestic demand for critical minerals is set to increase, and major manufacturers across sectors such as clean tech, battery technologies, electronics, and chemicals (Tata Chemicals, JSW, Reliance and Adani, to name a few) will need to source minerals from trusted sources. Australia should engage with major Indian manufacturers to position itself as a preferred supplier for India's growing mineral demands.

02

Create clarity on working across both regulatory and business cultures

Industry stakeholders have highlighted the need for greater clarity on "whom to engage with" to execute policy and strategic intent. Stakeholders also need support with regulatory maps to envision projects and investments. Understanding business and regulatory cultures is key.

03

Boost exchange and collaboration at the state level

Experts across the critical minerals industry strongly suggest that policymakers and government stakeholders across various levels of government from the federal to state level need to interact and identify roadblocks across levels to address challenges with clearances, certifications, and timelines for projects. This is crucial, given that environmental and land clearances lie with states and local governments. Such exchanges will facilitate innovative ways to connect Indian capital available across states, private houses, and business communities to bridge the financing gap.

Chapter 4

Locating Critical Minerals in the Australia-India Relationship

Introduction

The Australia-India relationship is "full of promise, with a long road ahead."
- Australian critical minerals industry expert

Cooperation on critical minerals has emerged as a cornerstone of the Australia-India bilateral relationship over the past five years. In 2020, the Comprehensive Strategic Partnership (CSP) positioned Australia as a reliable and trusted supplier of high-quality mineral resources[1]. Since then, both countries have made concerted efforts to strengthen bilateral cooperation on critical minerals.

A summary of key bilateral initiatives between 2020–2025 is captured in Table 4.

Table 4: Snapshot of key Australia-India initiatives on critical minerals between 2020–2025.

	Initiative	Critical Minerals Sector Focus
2020	Australia and India sign the **Comprehensive Strategic Partnership** in June.	Signs an MoU on Mining and Processing of Critical and Strategic Minerals[2]. Australia signals that India could consider it as a stable, reliable, and trusted supplier of high-quality mineral resources.
	Ministry of Mines, India and Critical Minerals Facilitation Office (CMFO), Australia sign a **G2G MoU**[3].	The MoU kick-starts the Australia-India investment relationship on critical minerals, and aims to provide a collaborative framework for partnership in the critical minerals eco-system, support strategic national interest and commercial investment in Australian critical mineral projects, and develop a robust and commercially viable critical minerals supply chain.
2021	**The Quad sets up Working Groups** to focus on critical minerals supply chains.	Critical minerals are considered within the purview of the Climate and Critical and Emerging Technologies working groups.
2022	**India-Australia Critical Minerals Research Partnership** announced[4].	Centred around seven resource commodities: lithium, nickel, cobalt, graphite, titanium, vanadium and rare earth elements, on new mineral discoveries, recovery of critical minerals, value add in production opportunities, and support growth in low carbon technologies.
	Australia-India Economic Cooperation and Trade Agreement (ECTA) signed, sets a trade target of $100 billion by 2030[5].	Remove import tariffs on critical minerals, alumina, manganese, copper, zirconium, titanium dioxide, certain critical minerals and certain non-ferrous metals.

	Initiative	Critical Minerals Sector Focus
2023	**India-Australia Critical Minerals Investment Partnership**[6] takes off.	The partnership identifies five target critical minerals projects (two lithium and three cobalt) on which to undertake detailed due diligence.
2024	**Initiative**	**Critical Minerals Sector Focus**
	The **Australia-India Critical Minerals Research Hub (AICMRH)** launched.	Indian Institute of Technology (Hyderabad) and Monash University sets up the Critical Minerals Research Hub (AICMRH)[7] to deepen research collaboration to meet the technological demands for the exploration and extraction of critical minerals.
	India-Australia Renewable Energy Partnership (REP) announced[8]	Prime Ministers Albanese and Modi note progress under the MoU between India's Khanij Bidesh Ltd. (KABIL) and Australia's Critical Minerals Office (CMO) as an opportunity to grow commercial links and advance supply chain diversification interests. The leaders underline the role of research and innovation, skills development, and professional exchange, including participation in each other's conferences, and sustainable practices in developing the critical minerals sector in support of the global clean energy transition, including inputs to technologies such as batteries and rooftop solar.
	India announces the establishment of the **National Critical Minerals Mission (NCMM)** as part of the Union Budget.	Objectives[9] of the mission are to fast-track the expansion of domestic production, prioritise the recycling of critical minerals and incentivise overseas acquisition of assets.
	Australia passes the **Future Made in Australia** bill.	Aims to boost refining and processing of critical minerals in Australia to move along global supply chains to capture more value and contribute to creating more diverse, resilient and sustainable global supply chains[10].
	Australian budget 2024–25 focuses on boosting the critical minerals sectors.	Australian government to invest $8.8 billion over the decade to add more value to resources and strengthen critical minerals supply chains[11]. $566.1 million to support Geoscience Australia to map all of Australia's critical minerals and strategic materials. The budget establishes a production tax incentive for processing and refining critical minerals at an estimated cost of $7 billion over the decade.
2025	**Initiative**	**Critical Minerals Sector Focus**
	India releases **National Critical Minerals Mission (NCMM)** document.	The Indian government allocates 24,000 crores between 2025–2031 to build resilience in critical minerals, including provisions to set up mineral processing parks, recycling, promoting research in critical mineral technologies, and setting up a Centre of Excellence in Critical Minerals[12].

Source: Author's compilation based on various sources. Not exhaustive.

Actualising the Australia-India partnership on critical minerals

Stakeholder interviews revealed insights into how the partnership on critical minerals can be actualised. Australian experts in government and industry remain unclear on India's critical minerals needs and priorities over the medium and long term, often due to a lack of consolidated information and strategic intent on its engagement with Australia. A sectoral analysis of minerals inputs is necessary for building policy and business alignment.

Coordinating across siloed portfolios

Interviews with government officials in India and Australia conducted as part of this study reveal a persistent siloing of critical minerals policy across various departments and ministries, often leading to divergences between strategic pillars, economic imperatives, and foreign policy considerations. Environmental considerations, which remain critical, are frequently addressed in isolation, further complicating cohesive policy formulation. Coordination both with domestic actors as well as with intra-country institutions remains key. This will also pave the way for greater clarity on future action for crucial stakeholders, including public policy officials, private companies, and investors.

Financing the sector and streamlining approvals

While strategic intent and imperatives on critical minerals of both countries align, there is a lack in addressing market challenges, making the viability of projects a major challenge. Despite efforts from the Australian and Indian governments, financing of critical minerals projects remains a key a challenge. According to mining experts, offtake arrangements alone do not adequately support financing projects which require long-term, large CapEx investments. High project costs continue to be the key challenge, especially in the face of an opaque global market. Stakeholders also suggested the need for greater streamlining of approval processing for critical minerals projects. Private sector stakeholders have emphasised the need for establishing deeper business-to-business (B2B) links and strengthening state-to-state relations.

Perception of the Indian market

Experts also state that India has long been an overlooked market for Australian businesses, and there is a need for a shift in perception of India from a poor, post-colonial nation to one of the world's fastest-growing economies with the potential to become the next global manufacturing hub. India offers both cost and scale of labour which can be leveraged for critical minerals—in terms of building technical expertise in mining and critical minerals innovation.

To unlock the full potential of the partnership, both countries must establish mechanisms that translate existing bilateral agreements into actionable outcomes. Engaging the private sector — especially companies and businesses—is crucial to driving progress and bridging gaps in supply chain integration, technology transfer, and investments in critical minerals.

Recommendations:

01

Map India's sectoral critical minerals demands for Australian stakeholders

Experts in critical minerals in Australia see the need for more nuanced data on India's demand forecast for critical minerals, at the national level and across sectors. This analysis needs to prioritise sunrise sectors like clean technology, battery manufacturing, electronics, and chemicals which signal strong future uptake. Making this data available to Australian stakeholders will open new opportunities and create shared incentives.

02

Strengthen exchange between government, business, and investment stakeholders to facilitate collaborations

The Australia-India relationship must evolve and leverage the G2G relationship's success to build more B2B and G2B links in the critical minerals sector. This is necessary given the major role that private sector companies play in India's manufacturing growth story, as well as in the critical minerals sector. Experts interviewed also suggest the need for greater cross-pollination between stakeholders from government, business, and research and innovation across Australia and India. Bridges are needed to ensure that critical minerals policies are engaged with holistically, given the rapid pace of innovation, changing minerals demands by sector, and growing strategic importance.

03

Streamline governance and establish a single-window mechanism for critical minerals projects

India's National Critical Minerals Mission (NCMM) can be leveraged to establish a single-window mechanism for critical minerals projects between Australia and India to enable businesses to engage with the key ministries and regulatory bodies in India in a frictionless manner. Experts suggested the need for streamlining approvals and governance for critical minerals mining projects between Australian and Indian stakeholders, keeping an eye on delivering successful projects on time.

04

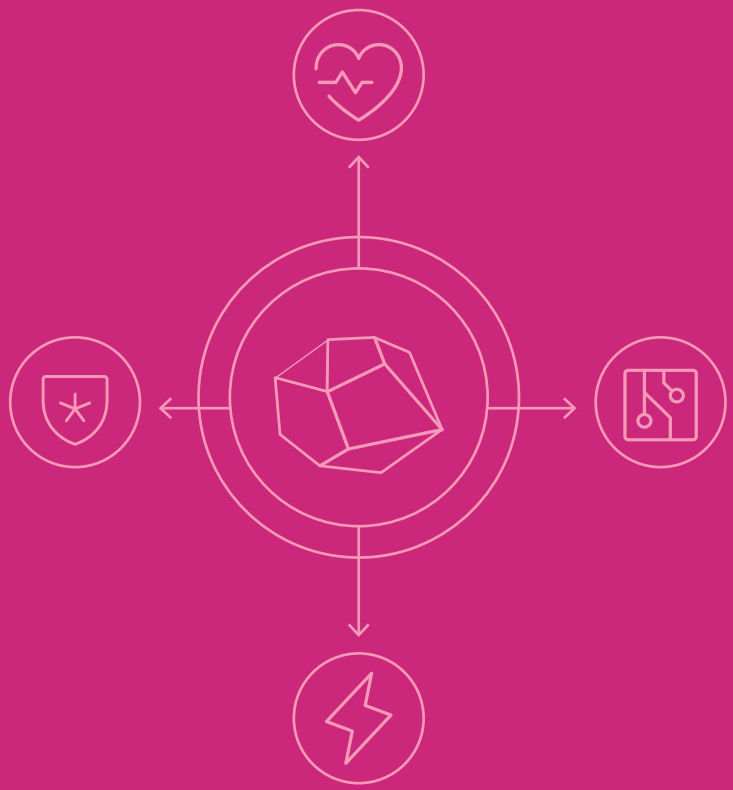
India's strategic thinking on minerals will need to take a long-term view

India should approach its relationship with Australia with an intent to ensure that its growing manufacturing industry gets a stable and reliable supply of raw and processed materials. This requires building partnerships which ensure viability for suppliers, hedges against price shocks, and builds deeper economic integration between Australia and India.

Section 3

Taking a 360° View: Security, Economics, and Sustainability

"Critical minerals are integral to national security and are essential inputs to strategic sectors including energy, emerging technologies, defence, and health."



Chapter 5

Navigating the Geopolitical and Security Challenge

Introduction

Critical minerals are integral to national security and are essential inputs to strategic sectors including energy, emerging technologies, defence, and health. Mineral supply chains are highly concentrated, even more so than oil and natural gas. China often dominates midstream and downstream segments of critical minerals supply chains, processing 68% of the world's nickel, 40% copper, 59% lithium, and 73% cobalt. It also leads in manufacturing battery cell components, producing 70% cathodes, 85% anodes, 66% separators, and 62% electrolytes[1].

The geopolitics surrounding critical minerals is only rising

Control over critical mineral supply and processing is a key element in the widening competition between the United States and China. Beijing has often used export sanctions on critical minerals as a response to geopolitical events. In 2024, China announced sweeping export controls targeting five metals used across defence, clean energy and other industries, minutes after an additional 10% tariff on Chinese goods imposed by U.S. President Trump came into effect illustrating how supply concentration continues to be a strategic risk[2].

In 2022, Beijing announced rare earth export sanctions on flagship American defence manufacturers Lockheed Martin and Raytheon Technologies, leading to potentially serious supply chain impacts[3]. In February 2025, Trump stated that he expected Ukraine to supply the United States with rare earths in exchange for financial support for its war efforts[4], bringing critical minerals supply centre stage to the US' engagement in the Ukraine-Russia war.

This combination of growing demand, market concentration, and supply chain risk is reshaping critical minerals supply chains as countries and companies evaluate their supply and production. Figure 4 illustrates a few security risks to which the critical minerals supply chain is subject.

Figure 4

Some security risks impacting critical minerals supply chains

Natural disasters
A cyclone in Mozambique in 2000 disabled railway transportation, leading to delays in the supply of chromium.

Political turmoil
Myanmar's military coup impacted China's feedstock of rare earth elements (REEs) in 2021.

Geopolitics and international conflicts
China imposed export restrictions on Japan for REEs owing to a trawler dispute in 2010.

Export restrictions (including as national security imperatives)
China banned the export of gallium, antimony and germanium to the United States as a retaliatory measure against the US crackdown on the Chinese semiconductor industry in 2024.

Factors affecting the production and export of critical minerals
such as labour unrest and strikes.

The geopolitical view from Australia and India

Navigating its strategic relations with both the United States and China remains a crucial geopolitical issue for Australia. This impacts foreign ownership and investment in this sector, which is a centerpiece in the Australian economy, and boosts employment. While Australia sees the United States as both a potentially large market for and a source of investments into its critical minerals sector in the short to medium term, much of its current minerals are exported to China for mid-stream processing and downstream manufacturing. The dependence on China has made Australian miners vulnerable to market shocks and price manipulation. For example, Australian nickel producers have been severely hit due to price manipulation, leading to mining companies such as BHP and government officials urging them to list greener nickel produced in Australia as a premium commodity[5].

Australia's recent policy measures, including the Critical Minerals Strategy, aim to address Chinese dominance in global supply chains by increasing investment and collaborating with like-minded partners. Experts suggest that Australia needs to craft industrial policy to secure national interests and find partners based on complementarity to support its mining industry transition from extraction-intensive to a higher value-added processing sector[6].

India's strategic priorities

Economic growth targets and national security concerns are key priorities that drive India's critical minerals strategy. Critical minerals are essential for India's net-zero emission targets including EV manufacturing, wind and solar energy projects, and battery storage systems apart from ensuring welfare priorities, including food security[7]. India's defence sector needs minerals for manufacturing, as well as nuclear and defence applications—calling the need for developing a domestic industry and resilient global supply chains "an urgent policy necessity[8]." India currently depends heavily on imports from China for several critical minerals. This leaves India's key strategic sectors and its manufacturing ambitions highly vulnerable to supply chain disruptions and geopolitical risks from its neighbour, a concern exacerbated by the recent border stand-off which led to a significant degradation of economic relations.

To address import dependence, India is investing to build domestic capacity and secure international partnerships to mitigate supply chain disruptions and geopolitical risk[9]. To achieve this, India's NCMM will invest Rs.16,300 crores and public sector companies are expected to invest Rs.18,000 crores between 2025–2031. The National Mineral Exploration Trust (NMET) received 1600 crores funding allocation to support critical minerals exploration outside India between 2025–2031. Acquiring mineral assets abroad is a key priority for the mission[10].

Identifying trusted partners to reduce import dependence will likely remain a key strategic priority for India over the medium term. To achieve this India is working on securing multiple partnerships with countries including Argentina, Bolivia, the Democratic Republic of Congo, and Mozambique, in addition to its engagement with Australia. Therefore, while challenges from the current geopolitical environment are largely shared by both countries, their relative strategic priorities may often vary.

Figure 5

What Geopolitical risks surround critical minerals?

Existing avenues for securing supply chains

Shared strategic concerns have resulted in critical minerals cooperation becoming a key element of the Australia-India bilateral relationship. There is recognition among officials of both countries of the major role that an Australia-India partnership can play in securing critical minerals supply chains and in larger initiatives to balance China in the Indo-Pacific. India is a top-tier security partner for Australia[11] and both Australia and India aim to leverage the Comprehensive Strategic Partnership to prioritise practical and tangible cooperation, including in strategic sectors such as defence and critical minerals.

In 2022, Australia updated its India Economic Plan to 2035[12], to give priority status to the Mining Equipment, Technologies, and Services (METS) sector in India. Since then, one of the five priorities of the Australia-India Business Exchange (AIBX) has been mining and resources, and by 2022 about 40 Australian companies were reportedly involved in the Indian mining industry[13].

Critical minerals cooperation benefits from a larger strategic convergence between both countries to ensure an open, stable and prosperous Indo-Pacific. Both countries are partnering on multiple strategic priorities in the region including the development of port infrastructure[14], maritime security, digital connectivity, and development aid among others making critical minerals a part of a larger shared strategic convergence.

In addition to bilateral initiatives, both countries are part of multiple multilateral mechanisms with a focus on critical minerals security including the Quad Dialogue, which includes a working group focussed on critical minerals security and the Quad Investors Network[15].

Economic, operational, and regulatory challenges persist

Despite shared high-level strategic intent, there is a lack of operational mechanisms to translate and implement shared priorities. Government stakeholders interviewed across both countries believe that the current cooperation mechanisms remain underutilised, and can be leveraged to deepen cooperation. Given the geopolitical context, both Australia and India need to work together to build complementary advantages and address market challenges.

Multilateral mechanisms also demand more attention. International relations experts interviewed have stated that while the Quad is well-positioned to take the lead in critical minerals cooperation among Australia, India, the United States, and Japan, which share strategic concerns and have complementary strengths, the lack of a mechanism such as a secretariat, prevents on-the-ground action with continued focus on critical mineral supply chains. There is also a need to harmonise norms and standards (like ESG) among the Quad countries which are crucial for cooperation and to integrate into global supply chains as a grouping.

Further, there is a lack of economic incentives including viable financing mechanisms, support for long-term investments and safeguarding producers from price shocks, hindering deeper B2B partnerships between Australia and India on critical minerals. Experts suggest that Australia and India should leverage multilateral fora to co-finance minerals projects and bring together business and investor communities.

Recommendations:

01

Australia and India can jointly leverage the Minerals Security Partnership (MSP)

The MSP has supported more than a dozen projects for elements including graphite, rare earth, and nickel since its founding two years ago[16]. The MSP can offer a platform for Australian and Indian companies to present joint projects to the group, and raise investments which benefit both countries.

02

Australia and India need to map comparative advantages for cooperation on minerals domestically

This analysis needs to go beyond simple economic imperatives and look at strategic alignment, including an analysis of REEs such as neodymium iron boron and samarium cobalt, which are used for the manufacturing of military weaponry needed to meet defence production goals set by both countries.

03

Experts suggest that Australia and India are well-positioned to collaboratively develop normative regimes, standards, and benchmarks for critical minerals markets

Government stakeholders interviewed across both countries believe that the current cooperation mechanisms remain underutilised. Australia and India should collaborate to leverage their unique positions in the minerals supply chain. Australia's status as a reliable economic middle power and India's unique position as an emerging Global South leader can be leveraged to shape norms in critical minerals global discourse, as well as work to develop standards and benchmarks for critical minerals markets.

04

Leveraging the Quad for critical minerals

India and the United States bring economies of scale to minerals demands, and Australia and Japan can bridge the technology and raw minerals gaps. The Quad remains an underexplored and unattended grouping for critical minerals and green energy technology cooperation, and initiatives like the Quad Investors Network should be leveraged to deliver on critical minerals.

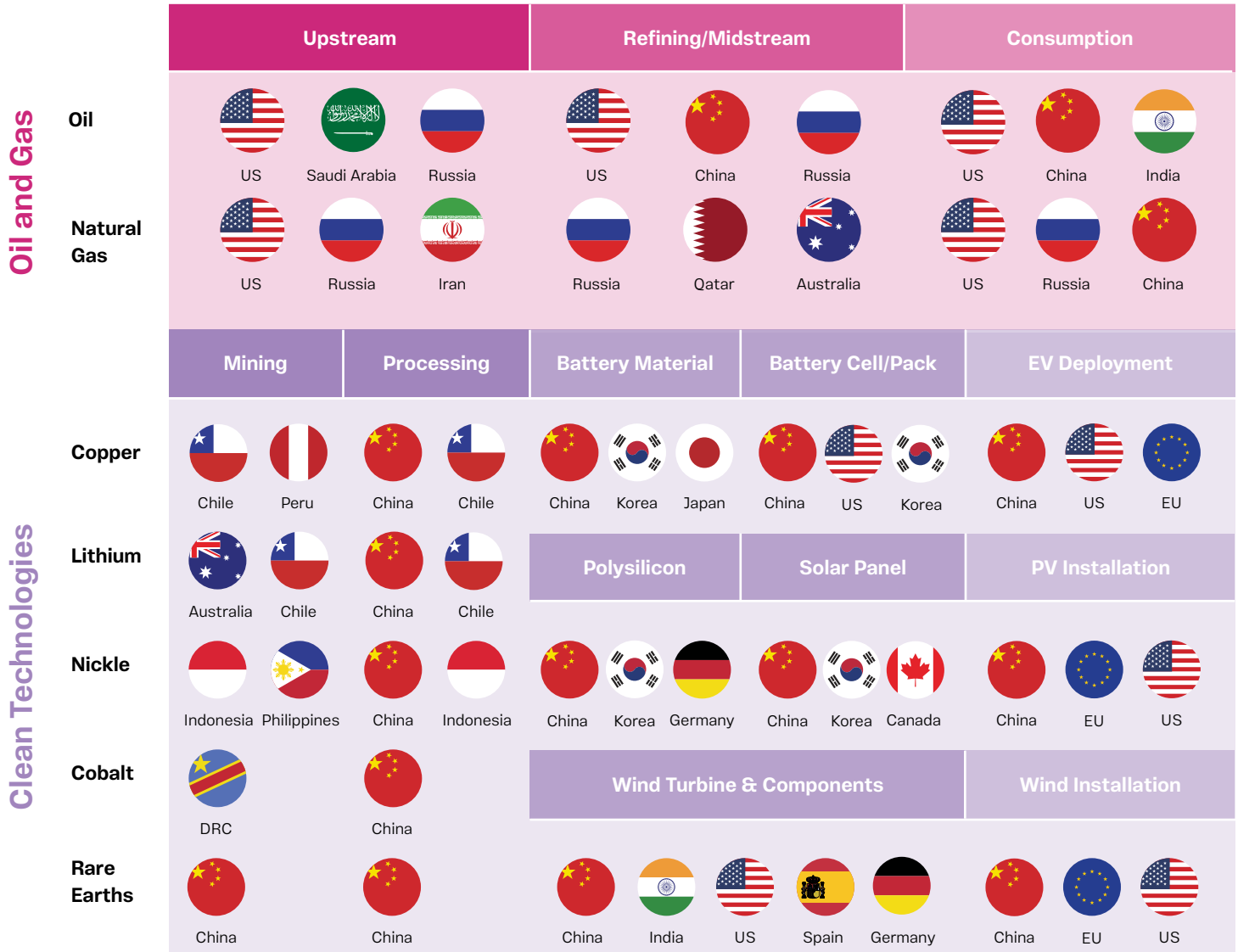
Chapter 6

Making the Economics Work

Introduction

The increasing demand for critical minerals has led to the expansion of global trade in critical raw materials which grew faster than overall merchandise trade (38% between 2007-09 and 2017-19, compared to 31% for all products). Lithium trade recorded the largest increase of all critical raw materials (438%), while manganese, natural graphite, cobalt, titanium, lead, and rare earth elements, as well as arsenic and zinc, all recorded growth rates which were higher than the average for all critical raw materials. Minerals prices rose significantly during the COVID-19 pandemic, peaking in 2021. However, navigating challenges posed by global critical minerals markets is central to the success of the Australia-India collaboration on critical minerals.

Figure 6: The transition to a clean energy system brings new energy trade patterns, countries and geopolitical consideration into play



Indicative supply chains of oil and gas and selected clean energy technologies

Source: https://iea.blob.core.windows.net/assets/24d5dfbb-a77a-4647-abcc-667867207f74/TheRoleofCriticalMineralsinCleanEnergyTransitions.pdf

Addressing challenges in critical minerals markets

Critical minerals markets are thin, opaque and volatile

Supply volatility and fluctuating prices of commodities are major challenges for countries seeking critical minerals security. Markets for these minerals are thin, opaque and hence highly volatile—and, as an economic commentator has stated, "perhaps good for commodity traders, but not for producers or consumers"[3]. Countries therefore do not enjoy the global structure and trade mechanisms currently existing for natural gas or iron ore. The direct effects on supply chains are negative, as are the broader effects for investors and access to capital necessary to widen global mineral supply chains. In March 2022, the London Metals Exchange suspended nickel trading after prices spiked over 250% in a shockingly short period of two days, before plummeting and soaring again within 8 months, impacting the Australian economy[4]. This is one example of several cases of market distortion concerns which plague critical minerals trade globally.

Lack of price and information transparency poses challenges for Australia

Volatility and opaqueness impact both Australia as a producer of minerals, and India which relies heavily on imports. According to the IEA, market transparency of commodities such as cobalt, lithium, and rare earth elements remains limited, challenging price-hedging and discouraging investment and risk assessments. Market transparency covers both *pricing*—including efficient market price discovery mechanisms and financial tools to hedge price risks—and *information*—the importance of publicly available data on consumption, supply, inventories, trade, and ESG performance[5]. Interviews with experts in Australia also suggest that the lack of market transparency leads to challenges in pulling larger investments, especially from formal financial institutions, into the Australian critical minerals mining sector. A buyer club (like the one proposed by the EU) which will trade on behalf of members, negotiate favourable prices, and shift benefits from producer countries to consumer countries, may not be the best way forward for countries involved in producing critical minerals. The rising demand for critical minerals will require restructuring current commodity markets and creating new mechanisms for states to trade minerals securely.

In addition to price volatility and information gaps, policymakers, investors, and companies are also navigating regulatory issues across jurisdictions, domestic and international policies, long project timelines, and technological advancements in sectors that are pulling key demand for minerals.

Australia-India trade is on an upward trajectory

Australian exports to India rose to $33 billion in FY2023, 50% higher than the pre-COVID (2017-19) average. Higher Indian spending on roads, bridges and other infrastructure has helped boost demand for Australia's resources and energy exports, a trend that is likely to continue[6]. While a leading exporter of critical minerals, Australia's resources and energy exports are forecast to fall from record highs of $466 billion in 2022-23 to $417 billion in 2023-24 and $366 billion in 2024-25[7]. Prices for critical minerals have fallen sharply from their highs in late 2022 and early 2023 in response to slower growth in demand for electric vehicles and increased material supply, impacting Australia. However, export returns in general through 2028-29 are forecast to remain higher than historical standards amid continued industrial demand from key Asian markets, particularly India—owing to its infrastructure and manufacturing push[8]. Lithium and base metals (and their raw material inputs) will account for almost as much export revenue as all coal types by 2027–28 for Australia[9].

Co-financing critical minerals projects

Critical minerals projects need more than offtake financing support

The Australia-India cooperation includes initiatives for critical minerals cooperation, including financial incentives and creating offtake arrangements for new mining projects. However, interviews with industry experts and academics reveal that offtake financing may not be a sufficient policy tool, especially for projects which require long-term investments, or are in the exploration phase.

Smaller players in the mining sector need more support

Minerals projects are also plagued with higher entry barriers, as downstream buyers concentrate power over time. Smaller players in the Australian critical minerals space need financial support, especially for exploration projects, according to an expert. This is essential because larger players within Australia are pivoting to critical minerals slowly, given that their core traditional business continues to be the steady revenue driver. Junior miners, therefore, take risks in the critical minerals sector and get acquired over time as they establish a presence in the market. These companies often build a niche for themselves in the global market. A successful example is Lynus Rare Earths, which mines rare earth minerals from the Lynas Mt Weld mine in Western Australia and operates the world's largest single rare earth processing plant in Malaysia to produce high-quality separated rare earth materials for export to manufacturing markets in Asia, Europe, and the United States[10]. In 2024, the company produced 10,908 tonnes of rare earth oxides (REO).

Critical minerals projects will also require support in testing and setting up due diligence mechanisms for critical minerals mining. Experts suggest, however, that Australia's critical minerals industry remains disparate, and there is a need to tie up producers and buyers to unlock its full potential. Addressing financial challenges to create investments remains key to actualising the Australia-India partnership on critical minerals. While the India-Australia Critical Minerals Investment Partnership seeks to address these gaps, more needs to be done on the ground.

Private investments are key to making the partnership successful

While the Australia-India strategy on critical minerals cooperation is well in place to deliver, there is a need to address how the economics of the critical minerals market can be worked out. High costs in investments remain a key challenge, especially in the face of an opaque market.

Enable Indian companies to invest in critical minerals

An industry expert in critical minerals from Australia stated that "private investments are key in making the Australia-India critical minerals partnership successful." Australia has been looking towards large Indian companies and conglomerates such as Tata Chemicals, Vedanta and the Adani group to acquire assets in Australia or work together with Australian companies. According to an economic policy expert in India, however, this is far from straightforward. Indian companies currently face capital scarcity which acts as a hurdle to overseas mine acquisition, especially in the face of a volatile global minerals market. Indian companies need more affordable finance, access to credit, and better credit rates to boost investments in minerals and create an affordance to take a long view on critical minerals. According to some experts, given the nascent stage of India's manufacturing and infrastructure development push, demand for raw minerals is not yet high enough to justify investing in mineral projects as a necessity or an effective economic measure. However, this scenario is likely to change within this decade.

Despite challenges, exports interviewed across sectors in both countries saw the Australia-India relationship as being in a new, extremely optimistic place. The more businesses and states interact and work together in innovative ways while focussing on delivering what the global market needs, the better the partnership is leveraged.

Recommendations:

01 Leveraging economies of scale is key to holistic growth in minerals

Australia and India need to tap into and build global expertise in building cooperatives which allow for economies of scale necessary for critical minerals. According to experts, the Indian market offers scale–which can act as a powerful asset to the Australia-India cooperation on minerals. Scale can allow for both countries to join hands for competitive pricing, training a vast workforce, and jointly developing processing capacities.

02 Take a hub and cluster approach to project development

Governments in both countries need to look to states and create links which allow the flow of finance, businesses and ecosystem advantages for minerals projects–such as Western Australia and Victoria, and Tamil Nadu, Gujarat and Telangana in India. There is a need for an industry hub and cluster approach at the national level to make minerals projects work. State-level/ federal projects around infrastructure and water development help de-risk the process for companies making investments in mining projects.

03 Support Indian companies to invest in critical minerals

Indian companies need support such as access to finance and better credit rates to invest in critical minerals projects ahead of the curve. There is space for Indian companies to create subsidiaries and enter the critical minerals market, while also allowing for smaller companies with a niche to build specialisation in the critical minerals market.

04 Agencies such as India's EXIM bank and Export Finance Australia can work more closely on specific commodities

Experts suggest more focus on commodities such as lithium and nickel to leverage the current relationship in order to boost trade. Indian companies too need to find ways to pool demand and be able to secure minerals as they expand their footprint.

05 Jointly address market issues and co-develop varied policy responses

Experts also suggest that governments will need to step in and address market issues, not only through creating subsidies and investments but also through economic safety nets which allow for private companies and capital investors to take long-term risks. There is also need for deeper price modelling analysis to co-develop safeguards against price volatility and ensure viability for minerals suppliers during hard times.

Chapter 7

Thinking Sustainability: Greening Critical Minerals

Introduction

Clean energy technologies including EVs and battery storage systems have become the fastest growing segment of demand for most minerals, with a share of total demand up to over 40% for copper and REEs, 60-70% for nickel and cobalt, and almost 90% for lithium by 2040[1]. However, producing these minerals with robust environmental, social, and governance will be a challenge[2]. India is navigating the need for minerals for its climate goals and clean manufacturing ambitions, and Australia seeks to position itself as a responsible producer amidst a lack of global ESG industry standards while safeguarding Australia's biodiversity and the rights of its indigenous communities.

Mining critical minerals in Australia comes with environmental risks

Environmental challenges of mining and processing critical minerals including habitat destruction, water pollution and biodiversity loss will need to be mitigated[3]. Several critical minerals have low recycling rates and the shrinking secondary demand for copper and nickel[4] shows the need for incorporating sustainability in manufacturing and recovery processes. According to IEA estimates, successful scale-up of recycling can lower the need for new mining activity by 25-40% by 2050, a scenario that meets national climate pledges[5].

Critical minerals mining impacts land, water, and indigenous peoples

Terrestrial ecosystems face high impacts owing to critical minerals mining, which requires space for exploration, extraction, and processing. Mining operations also require substantial amounts of water for mineral extraction, processing, dust suppression, and equipment cooling. Similarly, metal refinery and processing production processes, and solar thermal power generating technologies also require large amounts of water for cooling purposes[6]. At the same time, mining, manufacturing, and electricity supply sectors are extremely vulnerable to disruption by climate change. Mining is Australia's largest sector by share of GDP accounting for 10% during the 2022 financial year[7]. About $7 billion of the Future Made in Australia bill's funding will go to downstream refining and processing of the 31 critical minerals over the medium term[8]. Given that environmental costs rise as downstream processing develops, keeping Australia's environment secure will have to go hand in hand with the opportunity minerals offer.

In addition to ecological concerns, more than 60 per cent of Australian resource projects operate on land covered by a Native Title claim or determination[9]. In the Northern Territory, approximately 50 per cent of the landmass is freehold Aboriginal land where Traditional Owners have the right to veto any land access use proposals. First Nations landholders and communities are key stakeholders in the resources sector and essential to its future sustainability. These communities need to be included as Australia expands its critical minerals footprint.

Australia's ESG standards are an asset needing continued investment

Australia seeks to leverage its high ESG standards as an asset and use it as a key leverage in the minerals market. Australia has often proposed setting up international standards for ethical and environment-friendly mining to command higher prices.

Experts argue that Australia's high ESG standards are a critical asset and it should update these to keep its global lead in clean mineral exports, especially in the face of increasing competition.

Canberra is also working with partners including the EU and Canada to to improve transparency in critical minerals supply chains and to promote recognition of strong environmental, social and governance (ESG) standards in critical minerals markets globally[10].

As Australia develops mid-stream processing capabilities, businesses will need resources and support to maintain the country's lead in ESG efforts. This is crucial because 95% of the total footprint of several mined commodities is generated from processing and use, known as value-chain emissions (or Scope 3), which require working with downstream suppliers and customers for decarbonisation[11]. Companies in Western Australia are also undertaking trials of electric and hydrogen-powered trucks to replace diesel-run ones. This is crucial given that diesel engines are responsible for up to 50 per cent of emissions from the global mining industry[12].

India's decarbonising ambitions and challenges in clean manufacturing

India committed to a series of climate actions at the 26th Conference of Parties (COP-26) in 2022, of which achieving Net Zero Emissions (NZE) by 2070 is a key goal. The same year, India also committed to reaching a non-fossil fuel energy capacity of 500 GW by 2030, while meeting 50 per cent of its energy requirements from renewable energy by the same year. To achieve these targets, India introduced policies to bolster its solar and wind capacity and incentivised the adoption of Electric Vehicles (EVs)[13]. Solar energy constitutes the largest share of India's non-fossil energy capacity, with an installed capacity of 87.2 GW, followed by wind energy (47.8 GW) and hydropower (46.9 GW). The Indian government has implemented several schemes to incentivise domestic manufacturing through the Production-Linked Incentive (PLI) scheme, including the solar PLI to encourage domestic manufacturing of polysilicon, ingots, wafers, cells, and modules[14].

India needs multiple policy strategies for its clean growth ambitions

However, PLIs have not resulted in the expected growth of upstream domestic manufacturing capacity of raw materials and components[15]. Benefits under the PLI scheme can also be claimed when most components are imported and the product is finally assembled in India[16]. This does not help in reducing India's import reliance on raw materials that are essential for domestic manufacturing of green energy technologies. Incentives must focus on different stages in the supply chains, starting from the procurement of minerals and their processing[17]. India's newly announced National Critical Minerals Mission aims to recycle at least 10% of the nation's annual critical minerals demand and reinforce a circular economy to reduce dependency on raw primary minerals[18]. While India's current demand for raw minerals may be low, its green transition goals and specific sectoral needs in clean manufacturing will shape demand in the medium to long term. Experts in the Indian energy sector suggest mechanisms which help project the demand for specific materials, as well as find ways to pool current demand scattered across private players.

Australia and India can share technology, equipment and research

Australia and India are working together to advance their respective clean energy ambitions. In 2023, both countries elevated their cooperation on energy to launch the Australia-India Renewable Energy Partnership[19], which aimed to advance "practical cooperation and promote dialogue in the field of renewable energy, to create new markets and support efforts to diversify clean energy supply chains and reinforce energy security". The Partnership also established a 1.5 Track Dialogue to better connect Australian and Indian research, investment and industry in renewable energy. In 2023, India's Reliance Industries signed an agreement with Brookfield Asset Management to explore the manufacturing of renewable energy and decarbonisation equipment in Australia—signalling the key role the private sector can play in joint ventures, including in giga-scale projects[20]. However, shared clean energy ambitions do not necessarily translate into a natural procurement preference for Australia's environmentally mined critical minerals. Price sensitivity continues to be a critical factor in driving India's sourcing decisions.

New initiatives such as research in deep-sea mining for critical minerals is an emerging frontier for India-Australia collaboration. However, research suggests that this could have unintended harmful consequences, and Australian Minister Tanya Plibersek stated that she is "concerned about the broad and unknown environmental impacts"[21] citing the need for strong environmental regulations. This highlights the trade-offs between the importance of critical minerals mining for the national energy supply and the need to protect environmental and food security.

Recommendations:

01

Australia's leadership in ESG standards and cleaner technologies in mining can help India's domestic mining industry

Australia's leadership in ESG can help Indian companies. Indian companies are keen on leveraging Australia's leadership in ESG and building on the corporate social responsibility (CSR) model in India which helps bridge the social development gaps in contexts where they operate. Social impact measures can be used by Indian companies to create value and offset the impacts of critical mining abroad.

02

Joint minerals investment projects need government support on ESG

Indian companies require support to navigate the local contexts and needs in Australia. This is because mining is a complex activity involving the resolution of water land and settlement, as well as indigenous community rights issues. Risk-averse Indian firms will need support from governments to place bets in the critical minerals sector with regard to ESG standards and norms.

03

Co-invest in new frontiers of critical minerals research, such as undersea mining through mutual knowledge and capacity building

Experts have suggested the need for collaboration on new frontiers of critical minerals mining, where both Australia and India bring unique strengths, and can address in ecological concerns from the get-go.

04

Australia and India need to build a dialogue on critical minerals between governments, businesses, and civil society

Building acceptable governance standards which balance economic development in critical minerals with sustainability concerns requires deeper dialogue between both countries and requires bringing together multiple stakeholders including government, businesses, and civil society groups. The Australia-India Renewable Energy Partnership and the cooperation on critical minerals can be leveraged to bridge this gap.

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About the Author

Titiksha Vashist

Maitri Fellow 2024, Tech Policy Design Institute

Titiksha Vashist is a recipient of the inaugural 2024 Maitri Fellowship supported by the Centre for Australia-India Relations and sponsored by the Tech Policy Design Institute. The Maitri Fellowships program supports leading Indian policy thinkers to undertake secondments with prominent Australian think tanks. Titiksha is co-founder at The Pranava Institute (TPI), a New Delhi-based research organisation which works at the intersection of emerging tech, policy, society, and design to build sustainable technological futures. She is also an AI and Market Power Fellow 2025, focussing on Democratising AI Infrastructure in India.

At TPI, Titiksha's work focuses on emerging technology regulation and the socio-political implications of technology in India. She drives research projects focussing on technology, ethics, design, and policy at the Institute. She has worked with multiple global organisations on responsible technology, focussing on AI, trust and safety, digital wellbeing, and youth and media. Titiksha has presented her work at several international forums including the UN Internet Governance Forum, Asia Pacific Regional Internet Governance Forum, The Leverhulme Center for the Future of Intelligence in the UK, RightsCon and Re:Publica in Germany, among others. She lives in New Delhi, India and can be reached at titiksha@pranavainstitute.com.


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