THE UNIVERSITY OF SYDNEY

CRITICAL MINERALS FOR A SUSTAINABLE TRANSITION

2024 WORKSHOP REPORT

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ACADEMY OF THE SOCIAL SCIENCES IN AUSTRALIA

Supported by the Sydney Environment Institute, the Academy of the Social Sciences in Australia and Centre for Interational Security Studies.

Contents

1. Introduction and Themes of the Workshop

1.1 The Project

The Critical Minerals for a Sustainable Transition Symposium, hosted by Professor Susan Park at the University of Sydney, brought together a range of researchers, policymakers, and practitioners from across Australia. This symposium is hosted by the Sydney Environment Institute (SEI), which is a globally recognised multidisciplinary environmental research institute tackling the climate and biodiversity crises. In partnership with communities, governments, and industries, SEI works to address critical environmental challenges for a sustainable future. It was also co-funded by the Australian Academy of Social Sciences (ASSA), which promotes excellence in the social sciences in Australia and in their contribution to public policy, and the Centre for International Security Studies (CISS), which is located within the Discipline of Government and International Relations in the University of Sydney, and which analyses security issues facing Australia, the Asia Pacific and the world.

Susan co-leads the SEI research theme on Transformative Governance with Associate Professor Kate Owens and Lee White, to explore the transitions required across a range of institutional spaces including politics, economics, finance, and energy. The theme examines the interconnections, opportunities and barriers, and the myriad ways in which individuals, communities, and governments are responding to these transitions in a climate-changed and nature-threatened world. Research in the transformative governance theme aims to: Examine the opportunities and barriers relating to transitioning systems at a variety of scales; elevate the role of communities in leading systems transitions to ensure communities receive optimal benefits from the transitions that impact them; and develop innovative policies and practices to support just and sustainable transformations for a habitable planet.

This symposium aimed to investigate the political, economic, environmental and social impact of increasing critical minerals extraction, minerals processing and refining, use and disposal, at various locations, scales, and intensities in the quest to rapidly decarbonise. As the urgency to transition from fossil fuels to renewable energy increases, Australia's geological endowment of critical minerals has raised an important debate on balancing energy and national security with the broader imperative for a fair and sustainable transition.

The heart of this event was dedicated to exploring the impacts of critical minerals from a multidisciplinary perspective, not only as raw materials essential for renewable technologies but also the impacts of mining critical minerals on regional development, environmental sustainability, and social justice. The initiative was driven by a desire to understand how state energy and national security demands could be balanced with ethical social and environmental responsibilities, and to assess whether current regulatory standards are robust enough to support a just and sustainable transition. In doing so, the symposium placed a strong emphasis on integrating diverse perspectives from academia, government, non-government organisations and industry.

1.2 Aim and structure of the symposium

The primary aim of the symposium was to create a candid and collaborative environment for practitioners and scholars to address some of the most challenging questions regarding the energy transition.

In conversation with scholars and practitioners, we sought to grapple with the following questions:

1. Are states' energy security demands commensurate with mitigating the environmental and social impacts of critical minerals mining, processing/production, consumption and disposal?
2. Does the urgency for transitioning to renewable energy that is reliant on critical minerals undermine efforts at a just and sustainable transition?
3. How are environmental and social impacts from critical minerals mining being mitigated?
4. What standards, rules and regulations govern the mining, processing and supply of critical minerals and are they sufficient?
5. Is there a possibility for critical minerals extractivism for renewable energy to feed into a broader sustainable transformation?

The event was structured over two days and conducted under Chatham House Rules to ensure open and respectful dialogue. Under Chatham House Rules, the speaker may use the information gained in discussions freely, but without disclosing the identity or affiliation of any speaker, participant, or organisation. Comments and ideas shared are intended to contribute to our collective understanding and cannot be attributed to specific individuals unless they have given explicit consent.

Day one focused on shared insights into the practical challenges and opportunities raised by critical minerals mining. There were four panels on engaging with critical minerals mining, critical minerals mining strategies, critical minerals mining possibilities, and two panels on challenges for sustainability, and challenges for sustainability for Australia and the region. Day two shifted focus to a deeper academic exploration, where experts examined the governance frameworks, ethical considerations, and policy standards that underpin critical minerals mining across five panels: critical minerals stakeholders, geopolitics, the global political economy, governing critical minerals, and the future of critical minerals mining. The workshop was attended by a range of stakeholders from state and Commonwealth government departments to non-governmental organisations working on energy and mining in Australia and the region, labour union representatives, as well as scholars and PhD students across a range of disciplines and from around the country.

1.3 Organisation of the Summary

This symposium summary outlines the key observations and recommendations shared by participants during the discussions held over the course of the event. Section 2 is the key reflections from the symposium, which summarises the main points discussed throughout the symposium. Sections 3.1 to 3.5 synthesise the major themes that emerged from the symposium, around the necessity for addressing competing needs across stakeholders, recognising the demand for greater mining capacity, identifying the structural changes required for a just and sustainable energy transition, and how to create incentives for change. These themes weave together insights from each of the workshop sessions.

1.4 Key themes

Four key takeaways emerged from the individual presenters' remarks that informed our discussions. These takeaways are summarised here not as conclusions or recommendations from the workshop but to frame the material summarised in this report.

1. Competing Needs Across Stakeholders

The discussion highlighted the diverse and often conflicting priorities among key stakeholders in the critical minerals sector, including investors, mining companies, governments, regional communities, labour, environmentalists, and First Nations peoples. For critical mineral mining companies, there are significant challenges including how long it takes to get a project up and running, how to manage market and price fluctuations, respond to long-term demand trends, political cycles, workforce changes, and technological developments. While Australia's mining policies are shaped by its international investment regime and trade relationships, First Nations communities request greater ownership, more benefit-sharing, and participation in decision-making. The transition to clean energy represents an opportunity to do things differently—especially around energy resource ownership and First Nations-led proposals. In other words, it should not just be government and industry working together, but government, community and industry. There is concern that where Aboriginal and Torres Strait lands are under Native Title, that this does not provide the means for engagement regarding community benefits. Despite its significance, nature's needs, such as freshwater, protection of species and ecosystems, and ecological restoration remained largely underrepresented. Some highlighted that the Environmental Impact Assessment provides procedural but not substantive justice because the consultative process for commenting on projects is separate from the democratic process. There is also a need to manage mine dewatering, toxicity, and rehabilitation.

2. Capacity

Junior mining companies often lack the resources and expertise needed to comply with complex Environmental, Social, and Governance (ESG) standards. It is recognised that there is a lack of trained labour for the mining sector as a whole across Australia, while significant investment is required in new critical minerals mining ventures which remain risky given the volatile nature of the market. This is occurring within a fast-changing landscape: technology is changing as well as possibly changing materials, changing national politics, and global pressures. Smaller companies are concerned that they may be expected to have higher ESG standards than the majors. At the same time, both First Nations communities and corporations are expected to participate in negotiations and oversight processes, yet many feel that they are frequently under-resourced and lack adequate support to do so. Additionally, the fragmented landscape of ESG standards, ranging from legal requirements to voluntary guidelines and transnational initiatives, creates additional burdens and complexity for all stakeholders involved. This has also raised the question as to whether there may be new modes of participation for activists concerned with critical minerals mining.

3. Structural Change

Current legislation and regulatory frameworks are often outdated and not suitable for managing long-term projects or responding to evolving global dynamics. There is a call to acknowledge current policy assumptions that may result in unintended consequences, such as stranded assets or the inappropriate fast-tracking of projects. Additionally, the push for friend-shoring must be carefully managed to avoid a "race to the bottom" that prioritises national security at the expense of social accountability and environmental sustainability. Strengthening accountability, harmonising standards, and promoting more inclusive governance are essential steps forward. This is particularly so given the global backlash to the destruction of a sacred site at Juukan Gorge from mining, which questioned the positioning of Australia as having the highest of ESG standards.

4. Creating Incentives for Change

Venture capitalists are playing a role in contributing to the opening of new mines globally while there are also a number of international market players that invest in critical minerals mining in Australia, which requires reflection on the benefits to Australia from its liberal investment regime. Market prices, social license, downstream companies, and consumer preferences were identified as key factors influencing industry behaviour. However, real change depends on aligning these incentives with broader sustainability goals to allow Indigenous People to benefit and to allow nature to regenerate and repair, rather than focusing solely on profit and short-term returns. Achieving this requires ongoing, collaborative dialogue among civil society, industry, and government to develop solutions that benefit both present and future generations.

These themes provide a framework for the report's exploration of the complex challenges and opportunities associated with critical minerals, reflecting the key questions outlined in the previous session.

2. Key reflections

The global urgency to transition to renewable energy has placed critical minerals at the center of a complex and often contested debate. While renewable technologies offer a pathway to decarbonisation, the mining, processing, and disposal of critical minerals bring significant environmental and social challenges that should not be overlooked.

There are five reasons why we are having a conversation about critical minerals and a just energy transition:

1. Demand for critical minerals is increasing. This has been driven by the rapid global shift towards electric vehicles, renewable energy infrastructure, and digital technologies across military, space, agritech, computational and medicinal fields. This demand is essential for achieving climate and security goals, but may lead to greater environmental and social harm if not properly regulated.

2. Critical Minerals mining activities are causing serious social and environmental impacts. Communities near mines often face ecological impacts on their lands, water sources, and cultural heritage, particularly Indigenous peoples who call these areas home. Examples such as the Panguna Copper mine in Papua New Guinea and Lynas

rare earth processing plant in Malaysia reveal the long-lasting consequences of poorly managed mining and processing.

3. Governance frameworks remain inconsistent across jurisdictions. While countries such as Australia have “relatively” strong environmental standards, others may experience weak regulation, corruption, and limited community participation.

4. There is growing recognition of the need for an inclusive and just transition to critical minerals mining. This means ensuring that affected communities have meaningful participation in decision-making, equitable benefit-sharing through community based agreements, and that environmental regulations limit impacts and ensure that rehabilitation is prioritised alongside economic development.

5. Innovations in recycling, alternative materials, and reduced mineral intensity open new opportunities. These developments could lessen reliance on primary mining and improve circularity, but they require investment, research and development, policy support, and international cooperation to become viable at scale.

While the urgency of transitioning to renewable energy is indisputable, it must not overshadow the environmental and social costs associated with critical minerals mining and processing. Instead, this urgency should reinforce the importance of integrating environmental stewardship, social justice, and transparent governance into critical minerals strategies. A just and sustainable transition depends on balancing energy and national security demands with the protection of ecosystems and the rights and well-being of communities worldwide.

3. Critical Minerals Discussion

3.1 Are states’ energy security demands commensurate with mitigating the environmental and social impacts of critical minerals mining, processing/production, consumption and disposal?

States’ energy and national security demands reveal complex relationships between securing reliable critical minerals supply chains and addressing the environmental, social, and governance impacts associated with these activities. Critical minerals, often referred to as essential for the renewable energy transitions, are not actually “rare” or on the brink of depletion. Instead, their extraction and processing are strongly shaped by geopolitical and economic considerations, including the push for seabed mining. For example, countries like Australia have ample opportunity for mineral development influenced by national interests, capability, and global market positioning rather than market demand alone, although the costs of doing so are higher than for developing countries.

Social impacts of critical minerals mining remain high and often inadequately addressed in the push for energy and national security despite having stronger protections than in developing countries. While the mining industry contributes to local communities through employment opportunities and investment, these benefits are not always fairly distributed or sufficiently aligned with long-term social benefits and environmental sustainability. Growing public opposition, sometimes driven by legitimate community concerns, can result in policy decisions that delay or restrict mining projects, even when they are strategically important for a national energy transition.

The environmental footprint of critical minerals mining and processing is substantial and often overlooked in the energy security narratives. Lithium mining, for instance, is linked to water scarcity, biodiversity loss, and social injustices, particularly affecting Indigenous and local communities. In Australia, First Nations communities are often located near mining sites and may be affected by environmental degradation, impacts on sacred lands, and loss of cultural heritage. These types of impacts have raised concerns around the world about "green colonialism" and "land grabbing." Despite the profound impacts on their traditional lands and livelihoods, First Nations' participation in decision-making processes remains limited. The lack of genuine involvement undermines social justice, raising ethical concerns about the social impact of critical minerals mining and processing. Indigenous voices and knowledge systems are essential for guiding more equitable and culturally sensitive mining practices, but current governance frameworks often fail to integrate these perspectives effectively.

While Australia generally maintains strong environmental regulations and governance, many less developed countries suffer from poor transparency and enforcement, allowing harmful practices to persist. Corruption can divert mining and processing revenues away from community development and environmental protection, further marginalising vulnerable populations. This governance gap not only undermines sustainable mining efforts but also fuels social conflict and mistrust between governments, companies, and communities.

At a global scale, the governance of critical minerals is affected by geopolitical rivalries and techno-nationalism. Major powers compete aggressively over critical mineral resources to secure technological and economic dominance, especially in sectors such as electric vehicles, renewable energy, military and advanced technologies, particularly semi-conductors. This competition influences how critical minerals policies are framed, not only as industrial but also as foreign policy tools. Countries reliant on exporting critical raw materials, such as Australia, face vulnerabilities due to being positioned lower in the global value chains and the lack of processing capacities, which are dominated by other nations, notably China. While the US previously established the Inflation Reduction Act to help spur the transition to renewables, the current US administration seeks to ramp up fossil fuel use. These dynamics complicate efforts to create secure, sustainable supply chains that align with environmental and social goals. Meanwhile, the European Union is also shaping market dynamics in Australia through its extra-territorial regulations including the Critical Raw Materials Act and Battery Passport.

In summary, the pursuit of energy and national security through critical minerals development exposes a complex web of trade-offs between economic interests, environmental sustainability, social justice, and geopolitical alignment. While critical minerals are essential for the states' energy security and global energy transition, their extraction and processing carry risks that, if left unaddressed, can undermine the goals they aim to achieve. Social inequities, environmental harms, fractured governance, and geopolitical tensions all highlight the need for a more balanced and responsible approach.

Moving forward, managing the demands of energy security while mitigating the adverse impacts requires strengthened governance, transparency, and better integration of social and environmental considerations into decision-making. This includes improving legal frameworks for project approvals, engaging First Nations in decision-making, supporting domestic processing capabilities, moving up the value chain, and fostering multilateral cooperation to mitigate geopolitical risks.

3.2 Does the urgency for transitioning to renewable energy that is reliant on critical minerals undermine efforts at a just and sustainable transition?

The urgency for transitioning to renewable energy has led to an intensifying demand for critical minerals. However, this urgency may undermine the effort of creating a just and sustainable transition by accelerating environmentally and socially harmful practices across the critical minerals supply chain.

One aspect that is often overlooked is mine rehabilitation and closure. The case of the Panguna copper and gold mine in Bougainville, Papua New Guinea, illustrates the consequences of poor closure practices. Operated by Bougainville Copper Limited and abandoned amid the Bougainville Civil War in 1987, the site remains severely degraded. The surrounding river is contaminated by leached copper, causing the river to turn blue, and the open pit is now exploited through illegal mining networks. Local communities have repurposed the abandoned infrastructure for housing and trade, showcasing their resourcefulness but also highlighting the economic vacuum left behind. Similarly, the magnesium mine on Groote Eylandt, Australia, is another example of having insufficient closure criteria. This calls into question the perception of Australia's mining governance as "the world's best practice." In some instances, closure requirements are superficial, as it is not a priority for many companies. Additionally, on-site environmental officers often lack support, training, or funding to conduct proper rehabilitation.

A lack of attention to long-term sustainability also appears in the processing stage of critical minerals, as seen in the case of Lynas, an Australian company that processes rare earth elements in Malaysia. Rare earths are essential for green technologies, but their extraction and processing come with serious environmental issues, including radioactive waste, air and water pollution, and toxic byproducts. Lynas' facility in Kuantan, Malaysia, is built on former tropical peatland and mangrove forest, an area that is unstable, flood-prone and ecologically sensitive. Critics have argued that it has also put nearby communities at risk, with concerns that mining will contribute to higher rates of cancer and respiratory problems.

The broader narrative of transitioning to renewable energy also raises important questions about the role of local communities and Indigenous peoples. The Australian government has outlined in its 2023 Critical Minerals Strategy a commitment to First Nations Engagement and Benefit Sharing, along with a First Nations Clean Energy Strategy, and an Interim Engaging with First Nations People and Communities on Assessments and Approvals under the Environment Protection and Biodiversity Conservation Act 1999. This seeks to rectify a consistent pattern of excluding Traditional Owners and community stakeholders from meaningful participation. Australia's Critical Minerals Strategy (2023) discusses the potential for benefit sharing with First Nations peoples, and engagement with Indigenous Peoples

represents one of the seven ‘focus areas.’ However, despite the significant investment dedicated to the industry, there is no funding directed at First Nations communities to allow them to engage with the industry. This is important given that a significant portion of critical minerals are on land subject to Native Title or Native Title claims. Moreover, decisions around rehabilitation and land use are often imposed by external actors, with little regard for cultural values or local aspirations. The principle “Nothing for us without us” encapsulates the demand for co-designed solutions that reflect Indigenous priorities. Research on energy transitions in Australia also supports this principle, emphasising that transitions should be shaped alongside the historical, social, and environmental contexts of affected communities. Yet, regional transitions in Australia are often characterised by top-down approaches, lacking inclusive leadership and coordinated action across government, industry, and the local community. Without well-planned reemployment programs, investment in infrastructure, and inclusion of marginalised groups, such transitions risk deepens existing inequalities.

A just transition also requires structural reforms to the governance of global mineral supply chains. The rise of seabed mining further complicates this landscape. The seabed contains significant deposits of critical minerals essential for the energy transition, including polymetallic nodules, seafloor massive sulfide deposits, and cobalt crusts. Promoted as essential for critical mineral access, seabed mining raises ethical and ecological concerns, particularly because it targets areas designated as the "common heritage of mankind" under the United Nations Convention on the Law of the Sea (UNCLOS). Public influence is restricted, and local communities have no stake in these international waters, yet the environmental implications could be profound. Additionally, access to seabed materials is highly restricted, favouring scientists with specialised knowledge and institutional backing. This raises a fundamental question: Who really has the right to influence seabed mining in areas beyond national jurisdiction?

Building upon these social justice concerns is the shift toward what researchers call the "techno-speculative frontier" of mining. The current boom in energy transition minerals is driven as much by financial speculation and technological promises as by material necessity. Mining is increasingly marketed as “climate-smart” or “green,” obscuring the real and growing socio-ecological harms it produces. Lithium, for instance, is often portrayed as a “green” metal, yet its extraction in regions like South America has led to water scarcity, toxicity affecting human health and ecosystem integrity, and violations of Indigenous rights. Some scholars argue it should be termed a “dark critical metal” to highlight its destructive impacts. Australia’s own narrative of becoming a “renewable energy superpower” leans heavily on such socio-technical imaginaries, a vision of the future shaped by state and corporate interests that gloss over environmental and social costs. These imaginaries marginalise alternative visions from local communities, which could lead to deeper social conflicts and opposition.

The dominance of global production networks (GPNs) in critical mineral supply chains further exacerbates these issues. Lead firms like Tesla or BYD exert immense control over how and where minerals are sourced, processed, and distributed. This top-down power dynamic limits the developmental benefits for mining regions and undermines local communities. Public participation is often limited to commenting on proposals, which does not reflect substantive social justice. This is more representative of a neoliberal technocratic approach.

Lastly, workforce issues remain a major challenge. Mining regions face unstable employment, high FIFO (fly-in-fly-out) labour rates, and poor infrastructure. Government

royalties are often not reinvested into local communities, further eroding trust and undermining the industry's social license to operate. A fair and just transition should include helping regional areas grow in other industries and making sure workers have strong rights and protections. Collaboration with the Net Zero Economy Authority is also vital for economic diversification in affected communities.

In summary, while the shift to renewable energy is urgent and necessary to address climate change, the current approach, which is driven by the need for critical minerals, often overlooks the principles of social justice and sustainability. Across every stage of the mineral supply chain, from mining and processing to closure, social and environmental harms exist. Without meaningful reforms, such as stronger community participation, stricter environmental oversight, a trained workforce, and more transparent governance, the energy transition risks will remain unchanged. A just and sustainable energy transition requires more than shifting energy sources; it should also transform the systems that shape how minerals are sourced, how benefits are shared, and whose voices are heard.

3.3 How are environmental and social impacts from critical minerals mining being mitigated?

The demand for critical minerals, such as lithium, cobalt, nickel, and rare earth elements, has grown significantly due to the global energy transition and decarbonisation. However, their extraction, processing, and disposal pose significant environmental and social challenges. Currently, there are strategies being implemented to mitigate these impacts, with a focus on global supply chains, emerging governance and technological approaches that aim to ensure a more just and sustainable transition.

Critical minerals mining has wide-ranging effects on communities, particularly in regions undergoing economic transitions. As Australia shifts away from fossil fuels, the need to ensure high-quality job creation and community renewal in mining regions is essential. Addressing the needs of marginalised groups, including Indigenous communities, women, and low-income households, is a crucial part of this process. However, despite the growing acknowledgement that successful transitions must be rooted in inclusive and respectful community engagement, this remains a gap in many mining regions. In many cases, mining companies contribute financially to some aspects of local development. Additionally, unrehabilitated mine sites and long-term environmental degradation caused by poor mining practices in the past have emphasised the importance of mine closure planning and post-extraction land restoration as key components of environmental impact mitigation.

Innovative approaches are also being explored to reduce dependency on primary extraction. Recycling critical minerals from e-waste and mine tailings is an emerging area of research and development, though its commercial viability remains limited compared to conventional mining. In addition, the development of substitute materials for clean energy technologies, such as magnets that do not rely on rare earth elements, is gaining attention as a practical strategy to diversify inputs and lower environmental impacts. At the same time, state initiatives focus on streamlining regulatory approvals, enhancing community engagement, and strengthening domestic processing capacity to create a more sustainable supply chain. These strategies also recognise the importance of workforce transformation, particularly the retraining of workers in coal-dependent regions to support emerging critical minerals industries.

As mentioned in the previous section, the broader political economy of critical minerals is shaped by global production networks, where multinational corporations exert significant influence over supply chains, often prioritising profit and supply over local concerns. This structural imbalance causes local communities to have limited influence over mining decisions. However, resistance movements in places like Serbia, Portugal, and Spain have shown that communities can disrupt and reshape these processes. In Australia, emerging research aims to map both top-down ownership structures and bottom-up community responses to identify better pathways forward.

In summary, mitigation of environmental and social impacts requires coordinated efforts across multiple aspects, which include stricter and more transparent governance, better public participation mechanisms, investment in recycling and alternative technologies, and policies that prioritise local voices in resource decision-making. A just transition will depend not only on managing the environmental footprint of mining but also on reimagining governance structures and economic models to place equity, sustainability, and community at the forefront of critical minerals development.

3.4 What standards, rules and regulations govern the mining, processing and supply of critical minerals and are they sufficient?

The governance of critical minerals is increasingly coming under scrutiny as nations accelerate the transition to renewable energy. A variety of domestic and international standards, rules, and regulations shape how critical minerals are mined, processed, and supplied. However, recent discussions and research suggest that existing frameworks may be insufficient to ensure equitable, transparent, and environmentally responsible development.

There are three trends that impact governance, which include financialisaton and speculative risk, geopolitical shifts and ‘friend-shoring’ and ESG governance gaps. Markets are relatively opaque. The critical minerals boom is driven by massive speculative investment, projected to reach $1.7 trillion over the next decade. In Australia, critical minerals investments are often dominated by small-cap companies which may lack strong governance, particularly in overseas operations. Australia, while positioning itself as an ESG leader and a secure supply partner for allies, is navigating risks of reduced transparency due to national security framing (e.g. blocking or delaying Chinese investments) and market bifurcation, where high-ESG jurisdictions coexist with weaker ones, potentially encouraging a regulatory "race to the bottom." Domestically, Australia shows significant governance shortcomings. Key concerns include weak protections for First Nations rights, lack of participation in global transparency frameworks such as the Extractive Industries Transparency Initiative (EITI), and lenient lobbying and whistleblower laws. Many accountability mechanisms remain voluntary instead of binding, and there are signs of regulatory rollback under pressure to fast-track approvals. These gaps undermine Australia’s ESG credentials, despite its strong international image.

Australia is often held up as a global benchmark for environmental regulation in mining, with some of the most rigorous environmental assessment frameworks. Despite this, questions persist about the integrity and transparency of these processes. Environmental Impact Assessments (EIAs), while formally required, are sometimes seen as procedural rather than

substantive, with limited opportunities for affected communities to influence outcomes. Additionally, some mining projects are located near ecologically sensitive regions, including areas critical to biodiversity and freshwater resources, raising concerns about long-term environmental degradation.

Australia's legal and procedural frameworks are also criticised for prioritising industry-led development at the expense of environmental and social safeguards. Many project approval systems are largely led by the mining industry, which weakens procedural justice, as approval systems often fail to adequately consider cumulative environmental and cultural impacts. The destruction of Juukan Gorge and Bootu Creek highlights the limited opportunities for public objection and the inadequacy of existing legal protections for sacred Indigenous sites.

First Nations organisations are increasingly demanding stronger safeguards, including the legal enforcement of Free, Prior, and Informed Consent (FPIC), reform of the Native Title Act, and the co-development and co-ownership of mining projects. While progress has been slow, the private sector, particularly investors and superannuation funds, appears more responsive than the government to these governance challenges. This suggests market-driven reform may be a better solution for both First Nations and mining companies.

On a global scale, as mentioned in the previous section, governance of seabed mining targeting deep-sea critical minerals is developing within a highly restricted stakeholder framework under the International Seabed Authority. Despite the seabed being designated the "common heritage of mankind" under UNCLOS, current governance mechanisms lack meaningful public engagement or participation.

In addition, as mentioned in the previous section, the case of the rare earths company Lynas highlights the issue of weak regulatory standards. While Australia benefits economically, much of the environmentally hazardous processing occurs in Malaysia, where regulations are looser. The plant has faced strong criticism for storing radioactive waste in a way that would not meet safety standards in Australia, but Malaysia's weaker regulations have allowed the facility to keep operating. A speaker argues that the plant's continued operation has more to do with politics in Malaysia than proper legal oversight, raising serious questions about accountability.

In summary, although various national and international frameworks for critical minerals governance exist, they are often fragmented, voluntary, or poorly enforced. In Australia, weak protections for Indigenous rights, limited transparency, and industry-led approval processes undermine its ESG credibility. Although government reform has been slow, private investors are increasingly responsive to ESG risks. Globally, governance remains inconsistent due to geopolitics and weak regulation in less developed countries and sectors such as seabed mining, which raise accountability concerns. However, traceability efforts are continuing through the EU Battery Passport, the UN white paper by CEFACT on how to trace critical minerals, and discussions within the International Organisation for Standardisation. Increasing traceability will help drive sanctions on poor environmental, social and governance practices. Overall, the current governance falls short of ensuring a just, transparent, and sustainable critical minerals development.

3.5 Is there a possibility for critical minerals extractivism for renewable energy to feed into a broader sustainable transformation?

The expansion of critical minerals extractivism offers both opportunities and challenges for enabling a broader sustainable transformation tied to the renewable energy transition. Government strategies, particularly in New South Wales, Australia, show efforts to align with critical minerals development goals. Strategies emphasise early-stage exploration support, streamlined regulation, community engagement, and the establishment of domestic supply chains. These policies aim to enable economic growth, reduce emissions through local processing, and maintain strong environmental standards, suggesting potential alignment between extractivism and sustainability if governance remains transparent and inclusive.

However, one major concern is the readiness of the labour force. The transition from coal to critical minerals mining has generated a demand for new skills, yet Australia's education system has not kept pace. There is a concerning decline in mining-related education, especially in countries such as Australia. University enrolments in geoscience and mining engineering have dropped significantly in recent years, in part due to the reclassification and streamlining of academic programs, such as geoscience being absorbed into generalist degrees, for example, the Bachelor of Science majoring in Geography. Moreover, some schools are reducing or cutting geoscience-related subjects, further diminishing the perceived importance of mining education. This creates a disconnect between projected job creation in the critical minerals sectors and the availability of educational pathways to fill these roles. Many students and recent graduates find it difficult to envision meaningful, sustainable careers in the industry, contributing to a growing scepticism about the sector's promised opportunities. The decline in mining-related education not only reduces the availability of skilled professionals in the sector but also contributes to widespread misunderstanding about the mining industry's role in sustainability and the energy transition. With fewer students pursuing studies in mining and related fields, there is a growing knowledge and skill gap that affects public discourse and policymaking.

The current extractive boom is more globalised, speculative, and financially driven, with significant emphasis placed on future technological needs rather than present realities compared with historical ones. As mentioned in the previous section, the rise of "climate-smart mining" and the concept of a "techno-speculative frontier" reveal how technological optimism often obscures the socio-ecological harms it produces. Indigenous communities, in particular, continue to assert sovereignty and challenge extraction that commodifies nature and disrespects traditional rights. The involvement of Indigenous peoples and affected communities in decision-making is vital to ensure that critical minerals extractivism contributes to justice and sustainability.

Geopolitical and market dynamics add another layer of complexity. As mentioned in the previous section, critical minerals are increasingly tied to national security and global competition, especially between China, the US, and its allies. Identifying this supply chain dominance as a significant vulnerability, Western countries are now employing a range of strategies to 'de-risk' their supply chains and associated vulnerabilities of an (over)reliance on China. This leads to aggressive investments and "friend-shoring" strategies to secure supply chains. A recent example of the friend-shoring concept is the Minerals Security Partnership (MSP) established in mid-2022, which includes the US, the EU, Australia, the UK, Canada, Finland, Germany, Sweden, France, Japan, and South Korea as founding members.

Australia is deeply embedded in this geopolitical landscape, and while its positioning may offer economic benefits, it also risks abandoning sustainable development goals to short-term strategic interests. Additionally, the critical minerals market is relatively small and fragmented, dominated by junior and mid-tier miners, as large companies mostly avoid this market. Price fluctuations frequently lead to unsustainable investment cycles and production shutdowns. This volatility threatens long-term planning and makes it difficult for smaller actors to implement environmentally and socially responsible practices without robust financial support.

In summary, while critical minerals extractivism could feed into a broader sustainable transformation, this outcome is far from guaranteed. Government strategies in places such as New South Wales aim to align economic growth with environmental goals, yet Indigenous communities continue to push back against extractive practices that disregard their rights. Additionally, a decline in mining-related education threatens workforce readiness and public trust, and geopolitical competition and speculative investment further complicate responsible development. To ensure extractivism feeds into a broader sustainable transformation, stronger governance, inclusive planning, and long-term financial support are essential.

4. Conclusion

While the transition away from fossil fuels is both urgent and necessary to meet climate goals, the symposium revealed that the expansion of critical minerals mining and processing presents profound social, environmental, and governance challenges that must not be ignored. If not carefully managed, the activities intended to enable the energy transition and decarbonisation may undermine the principles of social justice and sustainability.

Across two days of dialogue between scholars, practitioners, and policymakers, it became clear that the energy transition cannot be measured solely by technological advancement or national energy security. Rather, it must also be judged by how well it safeguards ecosystems, protects cultural heritage, upholds Indigenous rights, and contributes to the resilience and well-being of communities, both locally and globally. Participants highlighted persistent gaps in regulatory frameworks, uneven capacity across stakeholders, and the marginalisation of First Nations voices in decision-making processes. Cases such as the Panguna mine and the Lynas rare earths facility in Malaysia are examples of environmental degradation and social conflict that result from weak governance and insufficient oversight.

The symposium's discussion consistently suggested the need to reframe the narrative around critical minerals, not simply as inputs for the energy transition, but as deeply embedded in the systems of politics, economy, cultural values, and environmental protection. This requires moving beyond narrow resource-focused or techno-optimistic solutions and moving toward an approach with inclusive governance, robust environmental regulation, workforce transition, and transparent, enforceable standards across jurisdictions.

Despite the challenges, there is a window of opportunity. Innovations in recycling, alternative materials, and circular economy models, along with rising public awareness and investor pressure for strong ESG compliance, can create positive change. A just and sustainable energy transition is possible, but only if it transforms not just the energy systems, but the institutional, economic and social frameworks that support the extractive industries, one that is socially inclusive, sustainable, and globally equitable.

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