

# What are we transitioning into? Re-thinking the model of mine closure

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## Abstract

*The track record for achieving a successful 'mine closure' is not filled with an overwhelming number of success stories. But what is success? Is it closing the mine or rather a successful transition from one state to another? This requires a fundamental shift in how we conceptualise mine closure, from the current 'What are we transitioning out of', to the ideal 'What are we transitioning into?' This paper draws on a portfolio of research undertaken between 2020-2023 to explore a model for how mine closure could be re-framed through the lens of transition, with implications for government, mining and post-mine industry and regional communities.*

*Closure concepts are well established and increasingly embedded in regulations with clear definitions within jurisdictions that have relative clarity around roles. However, these ideas are commonly underpinned by a 'make good' conceptualisation ('safe, stable, self-sustaining and non-polluting'), are mining proponent led and have often seen return to pre-existing state as the desired outcome. The end of a mining operation has also traditionally – and understandably – been seen through the lens of the mining lifecycle. This fails to recognise the opportunities presented by re-purposing assets and transitioning value (social, cultural, economic and biophysical) associated with mined land and accrued in regional economies and infrastructure. It also critically misses the point that relinquishment requires agreement between mine and post-mine stakeholders to enable a transition to occur.*

*This complexity emerged as a key limiting factor from the research, which included 22 projects across social, economic, cultural and biophysical themes research.. Across the different research domains, we found there was a lack of systematic language and conceptualisation of post-mine transition. Furthermore, there are no agreed concepts of what post-mine transition is or who is responsible for it. The language of transition is, in fact, barely mentioned in regulation or other forms of governance. This ambiguity contributes to confusion in mine closure planning, post-mine investment and regional planning for communities. Furthermore, this ambiguity creates a lack of clarity and information asymmetry for different voices across Traditional Owners, mining companies, regional communities, post-mine businesses and government. We need a new model that puts transition at the heart of mine closure, underpinned by an understanding of what post-mine transition means from different perspectives, and accompanying roles and responsibilities, before 'successful mine closure' can be achieved consistently.*

**Keywords:** *Transitions, Mine Closure, Values, CRC TiME, Relinquishment, Post Mine Land Use, Repurposing*

## 1 Introduction

Traditionally, mine closure was seen through the lens of the mining lifecycle – the end of a process. Until recently, the economic, social and cultural transition to what's next has received less attention.

Perhaps as a result, there is no systematic recognition or understanding of post-mine transition. By contrast, the meaning of closure and its associated language is relatively clear. For example, the meaning of 'safe, stable and non-polluting' is relatively accepted, as is 'progressive closure' and so on. The language is embedded in regulations with clear definitions within jurisdictions (but differences between jurisdictions) with relative clarity around roles. Conversely, there is no agreed upon language of what post-mine transition

is or who is responsible for it. The language of transition is barely mentioned in regulation or other forms of governance.

This ambiguity likely both reflects and contributes to a mismatch in mine closure and regional economic, community and environmental planning. In turn, this limits opportunities to envision a new future, including how to best leverage existing human, social and physical assets.

Shifting thinking from closure to what's next – or what you are transitioning from to what you are transitioning to – is needed. Developing new ways of thinking about and describing post-mine transitions will:

- help groups work together to envision a positive post-mine future, including how to balance diverse interests
- support clear, informed collaboration and negotiations over mine life, including with Traditional Owners
- support long-term, multistakeholder and coordinated planning
- help identify ways to connect policy and regulation, especially to enable transition to next land use
- unlock commercial opportunities, particularly through land and asset repurposing
- inform practical, applicable and transformative research.

An evidence-based and solutions-focused dialogue on what post-mining transition means from different perspectives, along with a discussion of roles and responsibilities – including of all tiers of government, industry, Traditional Owners and Indigenous organisations, natural resources management and other parties - are needed before transition can be achieved in a consistent manner.

The Australian focussed portfolio of research this paper draws on was undertaken between 2020-2023 and designed to deliver against the following objectives

- Baseline and benchmarking the current state of knowledge in mine closure and transitions;
- Sharing data and knowledge from existing and parallel initiatives;
- Roadmapping gaps, priorities and future research directions;
- Short term field or modelling studies to address key issues in mine closure
- Establishing collaborative infrastructure to underpin future research.

This paper explores some of the key emerging themes from this research that highlight challenges and opportunities for moving from mine closure towards transition based approaches.

## **2 Transition requires recognition of the mining system in regional economies**

Shifting focus from mine closure as an end to a process of transition requires a new way of thinking. This includes recognising the diverse and multi-faceted role mining projects play in regional economies. It also requires acknowledging the mining sector contains a wide range of industries, partners and stakeholders along its supply chain and over the life of mine. Importantly, but often less well-considered, are the complex cultural, social and institutional impacts, contributions and interrelationships formed and change that occur over the life of an asset.

Maher et al. (2022) outlined the relationship between mining systems and regional economies. These systems consist of large-scale extraction operations in the landscape involving heavy infrastructure and processing facilities. These operations sit within and respond to a broader global economy with shifting demands for commodities. The economy in turn, forms part of broader social system of governance, policy, and community expectations.

These components of the mining system shift throughout the mining lifecycle from finance and exploration, through operation to closure and rehabilitation. Their study conceptualised the mining system as including:

- social-economic-environmental context: Finance (Demand, markets, and insurance), Permissions (Policy, approvals, and social license), People (Workforce and community), Environment (Biodiversity, water, ecosystem services).
- industry operations: Technology (used throughout the sector), Exploration, Operation (Development and extraction), Processing, Transport.
- post-mine futures: Closure (rehabilitation, and relinquishment)

To visualise and quantify this network, the authors conducted GIS analysis to identify the nearest settlement to every listed mining project. For each of these we then further identified the nearest urban town, and then in turn the nearest regional city.

The network for the Australian dataset is visualised in Figure 1a, illustrating that mining has truly reached “all four corners” of the continent. Immediately noticeable is how the typical distances to settlements tend to decrease from the west and north of the continent to the south and east.

Using the spatial hierarchy described above and shown in Figure 1a, the relationships between mining and regional economies can be analysed to reveal the dependence of each hierarchical level on each commodity category (Figure 1b). The vulnerability of these regional hierarchies to changes in resource extraction patterns for energy minerals and fossil fuels can then be examined. Recognising these dependencies and relationships are critical to moving beyond mine closure to enabling the optimal transition pathway as mines go through their end of life and regional economies adjust and build post-mine futures.

A need exists across mining regions to develop their own vision of a regional economic transition, including identifying related opportunities and the potential pitfalls and exploring their economic resilience to embark on these alternative paths.

To achieve this, further work may be required to support analytical capacity to support communication from local governments to state and national levels on how the transition fits within broader development and community goals. There is a need to learn from past boom-bust cycles, avoid unwanted outcomes and work towards long-term regional resilience, by retaining more the local benefits from transitions and through reflecting these activities through relevant indicators and regional profiles. Many mining regions are striving do this such as the Goldfields Shire of Coolgardie in Western Australian (see Haslam-McKenzie and Eyles, 2023), and initiatives such as CRC TiME's Economic Transition Framework and Capacity Drivers project ([Project 1.8](#)) and the OECD's Mining Cities and Regions Initiative are creating new tools and building platforms for exchanging good practices and promoting international standards aimed at improving well-being outcomes in mining regions ([OECD, 2023](#))

While the need to have regional socio-economic development metrics, which are relevant locally and can account for community and development goals is well acknowledged, most data analytics available in regional Australia are limited in terms of their capacity to capture local development goals and economic inter-connectivity and trade-offs. For example, there is a need to be able to analyse change, to understand how shifts in one industry, specifically the emergence or retreat of an industry or changes in population can trigger shifts in other industries or other socio-economic factors characterising the development of a region. Available analytics for regional profiles, like Remplan, provide community economic profiles, but not the relationship and trade-offs between industries and socio-economic variables (within and between regions) that can reveal what levers of economic and policy support are needed to direct the region into one direction or another. Through a regional resilience framework development process, CRC TiME research being led by the CSIRO will (Fleming-Munoz and Porusci, 2023):

- develop a new framework to help identify resilience factors and transition capacity drivers.
- develop visualisation tools to support strategic decision-making and policy on regional development.
- pilot the framework and tools in the Pilbara and Bowen Basin, supporting each region's work to diversify and grow the economy, build on existing assets and leverage strategic shifts in resource demand.

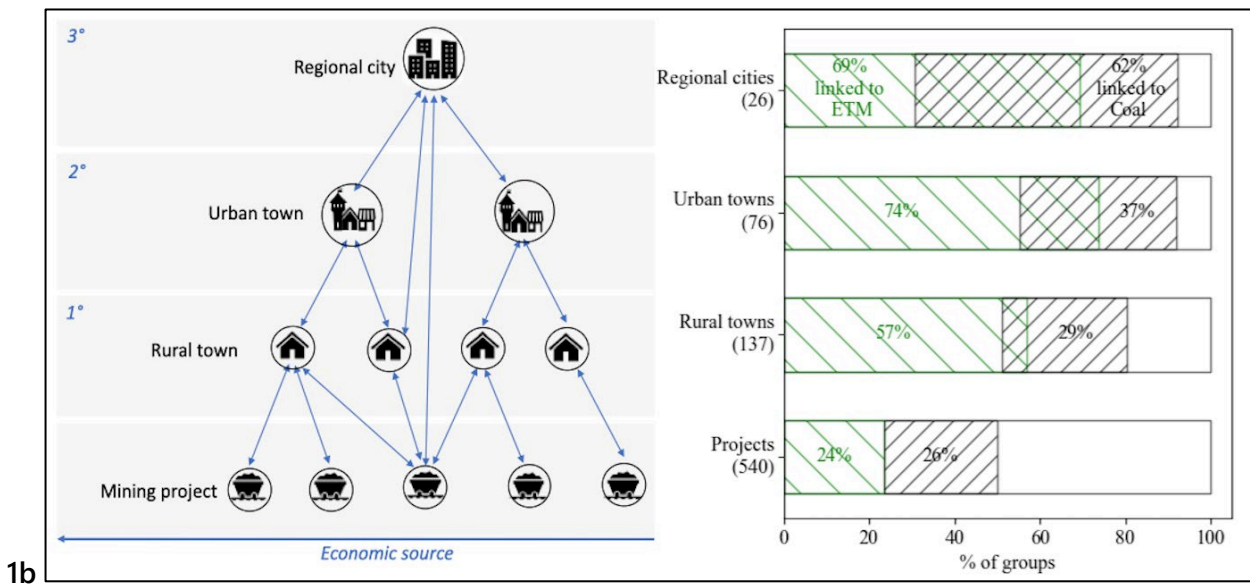


Figure 1 1a) The network of connections between Australian mine sites and regional towns and cities 1b) The relationships between mining projects and regional economies. The left panel illustrates the network structure and its levels. The right panel shows the exposure of each level in the network to coal closure (black shading) and to the boom in mining for energy transition metals (green) (source Maher et al 2022)).

### 3 Transitions and mine closure planning

Mine closure planning has become embedded as a key focus for good governance and company management of mine closure. One of the most fundamental shifts when considering a move to transition based frameworks is considering mine closure planning in the context of a move from a proponent owned and led systems, to one that empowers and recognises the multiple actors involved in executing a mine closure transition. Such a shift, however, requires clarifying the role of different actors, including governments, regional and First Nations organisations, natural resources management, local suppliers and contractors and others, in the regional economic system.

The review of mine closure planning by Dzakpata et al (2021) explored the key customers (custodians and end-users) of Mine Closure Planning (MCP). The work noted that local government and communities are the primary beneficiaries or recipients of mine closures, and it is becoming increasingly important for mining companies to build and sustain relationships with them. Mine closure should engage stakeholders as early as feasible in the mine life cycle and continue this engagement throughout the mining operation.

Early stakeholder participation in MCP increases the success of social investment programmes, with planning continuing throughout the operations phase leaving a long-term legacy (Everingham, Svobodova, Mackenzie, and Witt, 2020). The possible community participants, perceived advantages and beneficiaries of mine closure plans are depicted in Figure 2. The participation of community organisations and their engagements in MCP can be quantified in terms of the number of social media posts or attendees at events, but in the real world, it is the end-users' perspectives on their involvement in the MCP process throughout the mining life cycle that matters (Dzakpata et. al., 2021).

This recognises that while stakeholder engagement and 'customer' relationships are important in high quality plans (and industry and regulatory standards commonly require proponents to engage), the effectiveness of these plans are limited by a model which relies on proponent-led processes and regulator review as neither usually has focussed interest in the post-mine transition beyond risk mitigation. The model places expectations on proponents to develop a mine closure plan with post-mining land use(s) that have been proposed or agreed with key stakeholders.

Post mine land use planning as a "proponent led" consultative model fails to adequately to create an environment conducive to shared decision making for mining and post mine rights holders or stakeholders. This is further constrained by resources/mining tenure that can limit opportunity for proactive or early transition activity through co-purposing or progressive re-purposing of mining assets or land. The model is further constrained by underlying tenure, which existed and may have been appropriate at the time of the mine approval but fails to recognise the changes brought about by mine activity. Finally, placing the responsibility on mining proponents to consult on post mine options provides limited opportunity for post-mine investors to actively engage in or lead decision making processes. The quotes below from interviews by Dzakpata et al (2021) highlights these issues:

*"While the concept of post-mining transition economies is plausible, the reality is that the mining operator's attention (legal commitment and responsibility) does not extend beyond the transfer to the state of rehabilitated land that is as similar to its original state as possible (in Australia, typically large parcels of pastoral lands). As a result, unless the post-mining land-use effort is properly driven and staged over lengthy periods of time after mining stops, it will fail."* Mine Regulator Perspective (source Dzakpata et al 2021)

*"Significant knowledge gaps in evaluating innovative potential land-uses from a lack of knowledge base that gives the mine operator with a clear, succinct strategy for developing a mine closure plan that complies with regulatory standards. As a result, there is a reliance on outside expertise and a lack of knowledge of the legal ramifications of closure decisions. Mine Industry Perspective (source Dzakpata et al, 2021)*



Figure 2: Key beneficiaries (custodians and end-users) of closure Adapted: Everingham, Svobodova, Mackenzie, and Witt (2020) and sourced from Dzakpata et al, 2021).

## 4 Governance for transitions

There is growing interest towards new governance models to empower custodians, partners and stakeholders, recognising post-mine roles and responsibilities and the value of developing and documenting independent visions for success. This section reviews government-led and industry supported actions to develop new governance models.

Following the Gove refinery closure in 2013, the Northern Territory Government (NTG) commenced a series of internal planning steps to begin preparation for eventual mine closure (Foran et al, 2022). Rio Tinto will continue to undertake closure activities alongside continuing bauxite mining operations, which are expected to continue through to 2030. In 2019, the NTG convened the Gove Peninsula Futures Reference Group (GPFRG). The GPFRG was formed recognising that the land will revert to Traditional Ownership and that Yolngu will be the final decision makers on this land:

*“Traditional Owner organisations, including Gumatj Corporation Ltd and the Rirratjingu Aboriginal Corporation, together with Northern Land Council, Rio Tinto, the Northern Territory Government and the Commonwealth Department of the Prime Minister and Cabinet, have committed to working together to achieve a positive future for Nhulunbuy and the Gove Peninsula post mining for the benefit of Yolngu land owners, local communities, businesses and industry.”* Statement on the Future of the Gove Peninsula (

In 2021, the GPFRG produced a document that outlined the Traditional Owners’ vision for the future of Nhulunbuy and the Gove Peninsula (GPFRG, 2021). Entitled ‘A new journey together’, the document provides some background to the GPFRG, the history of mining on the Peninsula, and Traditional Owners’ previous responses to mining.

Based on the views of the Rirratjingu clan and Gumatj clan Traditional Owners – as the two primary landowning clans on the Peninsula - it outlines the vision for the future and five work streams to begin implementing this vision:

*The Gove Peninsula is one of the most special places in Australia. Our vision is to rejuvenate the region. It will be a place for us to share our culture, and a business and services hub for all of Arnhem Land. We will work together to create a stronger and more secure future for generations of Yolŋu and Njāpaki [non-Aboriginal people] to come. (GPFRG, 2021, p. 6)*

At another scale, state governments have established transition authorities or processes in some regions of Australia to better enable *positive* transitions through mine closure. It is also important to note that the two examples below relate to regions where thermal coal production for local electricity generation is progressively planned to close.

In Victoria, the Latrobe Valley Authority, which was established after the announcement of the closure of the Hazelwood Power Station in Victoria, is the most well-known example. It has a coordination and collaboration role that aims to build on the regions strengths to support its future prosperity (Reeves et al 2022). Brown coal production has been underway in the Latrobe Valley for a century, and remains a significant driver of the local economy. The last of the region's three coal mines is planned for closure in mid-2035.

Another approach to transition planning have also been adopted by the Western Australian government with the formation of the Collie Delivery Unit and a Just Transition Working Group that brings together State and local governments, unions, employers, and the community to work collaboratively to support the regional transition.

In a different context – where metallurgical coal production is expected to contribute for decades -, the Isaac Regional Council is one of several entities that called for the establishment of a regional authority to manage transformational changes in coal mining regions, with the Mayor noting the need for all levels of government, mining companies and communities to be coming together to manage transitions.

At a national level the Australian Government is establishing a new Net Zero Authority. It aims to capture the opportunities and manage the challenges associated with the transition to net zero. Within its role, the Authority will work collaboratively with state and territory governments, and existing regionally-focused bodies to support the change to a clean energy economy, reflecting the shared responsibility of all levels of government ([Prime Minister and Cabinet, 2023](#)).

## 5 Post-mine transitions and residual risk

Central to enabling a transitions-based approach is managing risk through transitions that give confidence. Both regulatory authorities and industry consider a key goal of mine closure and tenure relinquishment to be the absolving of liability for residual risks. Certainty surrounding residual risk liability can have positive impacts on the assessment of insurance costs and generate confidence for future environmental, social and economic management. However, some exposure to residual risks may persist past certification of relinquishment. A CRC TiME review of the regulatory frameworks across Australia noted the largest regulatory gaps may exist in the post-mining landscape (Hamblin et al, 2022).

Post-mine transition and residual risk sits centrally across two policy regimes: one governing mine closure planning, and the other focused on post-mining development. At present, the mine closure planning policy regime and its specific institutional arrangements precede and constrain realisation of particular values associated with the post-mining development policy regime. The value of risk mitigation is often regarded as of supreme importance from the perspective of the mine closure regime. However, from the perspective of the post-mining development regime, risk mitigation is regarded as of high importance alongside values of pragmatism and adaptiveness. Regional planning regulation and strategy is also integral to successful repurposing of mine sites. It can necessitate some cumulative impact assessment be undertaken to determine the compatibility of different projects proposed as alternative land uses. Where progressive-

rehabilitation includes progressive transitioning to a post-mining land user, a consideration of and compliance with land use planning law will be essential to the success of that transition.

The presence of distinct policy regimes with overlapping values means the governance of mining transition in regions is fragmented (see Table 1). CRC TiME work interviewing stakeholders from three regions across Australia highlighted an acute awareness of this phenomenon, and often frustration with it (Foran et al., 2022). The overarching values expressed by participants could inform new or reinvigorated policy arguments, in turn contributing to refinement of institutional arrangements. For example, reinvigorated arguments are necessary around what constitutes an adequate set of conditions for a licensee to keep mine land under care and maintenance, or alternatively, relinquish it to actors with different capabilities and conceptions of risk and benefit sharing. Consultation with CRC TiME partners has also identified the need to develop a method that incentivizes a subsequent land user to assume some of that additional risk. The intent here is not to pass on all the additional risk, but rather an amount that is proportionate to the expected economic returns to be realised from that subsequent use. That is, there is a need to assume some risk to make a return.

**Table 1: Mine closure planning and post-mining development: summary of policy regimes (source Foran et al, 2022)**

COMPONENT	MINE CLOSURE PLANNING	POST-MINING DEVELOPMENT PLANNING
Values-based policy arguments	(1) Risk mitigation enables net-positive outcomes Relinquishment of a mining lease requires demonstrable achievement of safe, stable, sustainable landform, which is an intermediate means to realise economic and other place-related values.	(2) Realising post-mining land use requires taking a pragmatic, flexible, adaptive (future-oriented) approach to formulation of closure criteria (3) Realising net-positive outcomes requires investment in and attraction of human capital
Core institutional arrangements	Proponent-led model (licensees responsible for proposing mine closure plans with specific closure criteria acceptable to government)	State government-led strategic planning for regions Local government-led statutory planning for local areas (shires and councils)
Type of ‘capital’ emphasised	Natural (landform rehabilitation)	Human (workforce redeployment and training) Physical (industrial land supply)
Mode of financing	Closure bonds Voluntary corporate commitments	State and local government budgeting
Policy instruments	Indicative concept or master planning Latrobe Valley Regional Rehabilitation Strategy (LVRRS)	Statutory and strategic spatial planning Multi-stakeholder visioning Latrobe Valley Authority Transition Plan (2022–2023)
Collaborative structures and processes (examples)	Latrobe Valley Mine Rehabilitation Advisory Committee	Gove Peninsula Futures Reference Group Collie Delivery Unit (WA) Collie Just Transition Working Group

Given the novelty of this activity and the relatively set legal principles and experience with them, there is some reliance on soft law to establish post-closure outcomes (Hamblin et al, 2022). In Australia, the Minerals Council Australia, which represents companies accounting for more than three-quarters of minerals production, has adopted the Towards Sustainable Mining Framework as an expectation of membership and to be progressively implemented to 2025 (MCA and TSM, 2023). Developed in Canada and now in place in a number of countries with large mining industries, this framework is aimed at assisting the industry to assess, manage and communicate about their sustainability initiatives. It is rooted in ESG goals and is the accountability framework to complement the Enduring Value framework previously adopted.



A commitment to Towards Sustainable Mining frameworks are conditions of Minerals Council Australia membership and requires members report publicly on compliance with the frameworks.<sup>734</sup> Compliance will be independently verified every three years, with the verifiable outcomes including:

- A costed closure plan with agreed post-closure land uses developed in conjunction with relevant stakeholders; and
- The closure plan is implemented to the extent practicable over the operating life of the mine and adequate financial provision exists to support full implementation at closure.

## 6 Delivering value through transitions

What makes a positive post-mine transition is essentially about values. Put simply, it's about whether what is feasible and viable aligns with what matters most to the local community. Values are locally specific and dynamic. Each place has its own set of values, meaning what people and communities give importance to in one region will be different to another.

Understanding local values is essential for post-mine transitions to be net-positive (where benefits outweigh costs) and mutually beneficial for different interests incorporating multiple tangible and intangible dimensions (social, cultural and economic). Understanding values, especially those held by Traditional Owners, requires an investment in relationship-building and deliberation.

New economic value paths are also emerging that recognise the value of mining assets beyond the mine. Mining is a capital, technology and infrastructure-intensive industry. In many regional and remote areas, extensive new infrastructure – such as airstrips, water, energy, processing and logistics facilities – need to be established for mining to occur. Beer et al (2021) concluded this creates more than mining infrastructure, it creates significant regional assets.

There are many examples globally – and nationally – of mining-related infrastructure being repurposed and integrated into post-mine regional economies. CRC TIME, for example completed eleven case studies of mine site repurposing in Australia that included renewable energy, tourism, research infrastructure and conservation based repurposing (Beer et al, 2021). At the same time, there is a drive to minimise waste, including calls for 'zero tailings' mines, and recognition that regional industries can be developed around new uses for waste and decommissioning related products. Commitments to nature positive goals, and requirements from financial markets to disclose changes in natural capital are also driving an investment in nature based solutions.

Research is underway to further quantify and develop new ways of extracting economic value from mine closure activities, including mine wastes, repurposing of land and infrastructure for new uses and rehabilitation activities (see [project 3.14](#)). This includes potential to repurpose mines and mining-related assets for new social, community, commercial and environmental purposes, including renewable energy generation, tourism and biodiversity conservation. Opportunities, especially for First Nations and regional businesses, are significant and can help mitigate mine closure and transition impacts.

Unlike in manufacturing, professional services or some types of construction, there is no system-wide response available for the re-use of mine sites that is able to be applied at scale with uniformly positive outcomes (Beer et al. 2021). Each repurposed mine site must be considered individually, with solutions shaped to those conditions. For this reason, to unlock the value that could be captured from a move beyond closure to a transition centred system, we provide the following six recommendations:

**Recommendation 1:** Incorporate post-mine transitions as a focus area.

Governments can reinforce the importance of post-mining transitions being recognised as a point of intersection between mining regulation and post-mine planning development policy regimes. Incorporating a focus on future post-mine transitions would provide a platform to:

- signal the importance of seeking to leverage economic opportunities for long-term community and regional economic resilience, including by First Nations communities.
- encourage new ways of thinking about mine closure, including how to unlock commercial opportunities from mine wastes and mine closure activities, particularly for regional and First Nations businesses.
- further facilitate knowledge-sharing and leading practice, especially to support consistently high-quality processes and outcomes and to improve certainty for all stakeholders, including industry.
- recognise the pre-competitive value of ESG and legacy mine site data, and further build the business case for increased accessibility and the value of shared private-public data
- recognise post-mine transitions are a shared activity, requiring action by the mine operator as well as regional and First Nations communities, governments, suppliers and contractors and others. Long-term, coordinated and strategic planning is essential.
- recognise increasing expectations by regional and First Nations communities, investors, financiers and others about the importance of managed social and economic as well as environmental transitions.

**Recommendation 2:** Recognise work underway to support consistently high post-mine transitions processes and outcomes nationally and internationally.

There is a growing evidence base to improve post-mine transition policy and processes, enhance certainty for all stakeholders and strengthen post-mine outcomes. This needs to build on but differentiate itself from risk mitigation and mine closure focussed evidence. There is substantial opportunity to capture transition based learning from the increase in transitions occurring globally as part of the drive towards net zero, while able to apply this innovation as the world responds to a rise in mining to supply the minerals needed.

Work is required to:

- develop clear, common definitions for core mine closure and post-mine transition terms to inform future policy and practice development.
- propose new policy frameworks to address barriers to repurposing mined land for new uses. This includes how to appropriately address risk while making mined land and infrastructure available for new purposes, such as renewable energy generation.
- demonstrate how nature positive commitments and disclosure frameworks can support improved decision-making and on-site biodiversity conservation and environmental management beyond the mine
- deliver Regional Transition Frameworks to support regions to realise long-term, sustained and equitable benefits from new mine development and mining activity.
- provide case studies on regional cumulative effects assessments
- provide First Nations communities with the opportunity to document their aspirations for mine closure and post-mine transitions and identify the barriers and enablers to better Indigenous-led outcomes.
- provide new knowledge, tools and guidance to address some of the most significant mine closure challenges, including management of acid mine drainage and pit lakes.

**Recommendation 3:** Encourage ongoing regional-scale and coordinated planning to support positive long-term resilience and manage risks and impacts.

Mining brings with it significant jobs, training and development and business opportunities. Yet, how to harness these opportunities for long-term economic resilience in mining regions and communities remains a challenge. Encouraging early, ongoing regional-scale planning to harness economic and social benefits arising from new critical minerals development provides opportunity to:

- support early identification of policy and regulatory barriers that may inhibit repurposing
- fully consider potential repurposing options

- develop new and complementary opportunities from existing infrastructure
- address the cyclical nature of commodity markets, which create uncertainty.
- ensure operators have certainty and clarity and can address questions regarding cost and management.

Many communities, including key mining regions and First Nations communities, gained significant employment, training, business and income benefits during the most recent mining construction boom. However, while sustaining higher incomes than in comparable areas, the transition from mine construction to operations phase led to considerable economic challenges in some regions. While activity has or is expected to surge again – including activity associated with critical minerals development – many communities are also aware of the need to take concurrent steps to prepare for the future transitions.

Building capability for regions to engage in and lead aspects of closure transition should be supported by the development of:

- an analytical framework to enable individual regions to identify transition capacity drivers and regional resilience components
- tools to support communities to identify and consider potential future development scenarios
- case studies on regional effects to support improved understanding and management, including Indigenous-led Cumulative Impact Assessments to support decision-making.

**Recommendation 4:** Foster the growth of a specialist mining, equipment and technology sector focused on extracting value from mine wastes, mine rehabilitation and asset repurposing.

Focus on the circular economy provides significant potential to consider how mining wastes can be used as inputs for new commercial purposes. At the same time, global commitment to positive post-mine environmental outcomes and Nature Positive presents opportunity to further develop the sector providing rehabilitation, revegetation and specialist technical services both to directly impacted sites and opportunities presented across the broader landscape. This presents opportunities for regional and First Nations, including Traditional Owners' businesses. At the same time, examples are emerging of global (eg Resolve and Regeneration) and local (EnviroMETS) initiatives specialising in repurposing abandoned and closing mines sites.

Fostering the growth of this sector requires:

- Mapping the economic potential of key value streams including:
  - Extracting value from mine wastes, including materials recovery, alternative uses and reprocessing of tailings.
  - Improving rehabilitation outcomes, including geotechnical activities and managing contaminations.
  - Establishing post-mining land uses, such as renewable energy and energy storage, recycling, agriculture and tourism.
- Establishing pre-competitive industry development opportunities, including access to data.
- Building the required workforce, with support for relevant education, training and skills development programs

**Recommendation 5:** Ensure First Nations and regional communities can access tailored, independent information to fully participate in mine closure decision making across the full mine life cycle.

Mine closure is a fundamental part of the mining lifecycle. And while planning and work to support a positive post-mine transition is undertaken across mine life, many decisions before development and during approvals processes shape what is possible when mining ends and the ability to respond to changing dynamics across a mine a life.

Information asymmetry, resourcing disparity and complex processes create challenges for First Nations and regional communities to meaningfully participate in consultation, negotiation and agreement-making processes.

It can also limit the ability of local businesses, First Nations landholders and communities and others to capitalise on commercial opportunities, including those involved in mine closure delivery such as land rehabilitation or monitoring and emerging market opportunities such as asset re-purposing for energy production or new waste use supply chains.

## 7 Conclusion

The move from mine closure to a transition focussed approach represents a fundamental shift, with implications for stakeholders from across policy, mining, post-mine/alternative sectors, regional and First Nations communities. This paper has highlighted some of the findings from research undertaken between 2020 and 2023 as part of a systematic analysis of mine closure and post mine transitions. . Through further analysis of this research, we provide five recommendations that will support a move to transition based re-framing of mine closure that will enable a value based optimising model, while acknowledging the importance of risk management and transition based planning.

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