

# Designing the future of closure governance: what closure practitioners can learn from defined benefit pensions

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## Abstract

*Analysis of publicly available financial records shows external financially reported closure or liabilities have nearly doubled for major listed mining companies over the past decade. Although some increase is expected, the consistency, scale and late-life timing of these revisions, primarily driven by upward changes in cost estimates rather than mechanical accounting factors, indicate that traditional closure governance models have struggled to deliver predictable outcomes, avoid balance sheet volatility or enable durable liability exit.*

*While defined benefit pensions and mine closure may appear unrelated, the parallels are instructive. This paper argues that mine closure faces a similar inflection point to pensions – with first-generation governance models undermined by 3 structural weaknesses: misalignment between site-level incentives and corporate objectives, over-reliance on speculative monetisation of closed assets, and limited integration of quantitative risk pricing into closure decision-making. Together, these factors have driven provision growth, financial surprise and reduced trust with investors and regulators.*

*Drawing on pensions experience, the paper presents a funding-based closure model that treats closure as a portfolio financial obligation rather than a site-led compliance exercise. It focuses on 4 elements: redefining the closure mission to focus on liability exit, clear ownership and decisions, counterparty maturity as a constraint, and financial discipline via consistent valuation, risk pricing, and structured funding and risk transfer.*

*In an environment dominated by heightened uncertainty, mining companies face a narrowing window to reset closure governance before markets and investors impose adjustments. By reframing closure as a capital allocation and balance sheet problem – much like the pensions sector – next-generation models can restore predictability, reduce volatility in liabilities and support credible long-term closure outcomes while preserving shareholder value.*

**Keywords:** mine closure, closure liabilities/provisions, closure strategy, governance, balance sheet risk, shareholder value, incentive alignment, commercial discipline, pensions

## 1 Introduction

Mine closure is recognised as one of the most complex and uncertain challenges facing the mining industry. Closure outcomes sit at the intersection of engineered systems, environmental processes, regulatory expectations and societal consent, all of which evolve over long time horizons (Keneally 2023). Due to this complexity, increases in closure provisions over time are not unexpected.

However, recent analysis shows closure (sometimes referred to as decommissioning) liabilities (or provisions as these terms are used interchangeably in this paper) are large, growing, and increasingly viewed by investors as debt-like exposures rather than technical end-of-life costs (BNP Paribas Asset Management 2023). The scale and persistence of provision growth across major listed miners over the past decade cannot be explained by mine planning evolution alone (Binns & Hancock 2022; Moody's Ratings 2024). These trends point to more fundamental weaknesses in how closure obligations are governed, valued and managed –

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weaknesses that continue to generate balance sheet volatility, financial surprise and credibility challenges with investors, regulators and communities, despite decades of technical advancement.

A defining feature of this challenge lies in how closure liabilities are treated within corporate decision-making. Closure obligations are long-dated present liabilities under prevailing accounting standards yet are rarely supported by dedicated funding mechanisms or robust quantitative risk frameworks (Clarke & Evans 2019). As a result, they are often treated as soft, fungible liabilities, absorbed into future cash flow assumptions rather than managed with the discipline applied to explicit debt – despite evidence that asset retirement obligations can grow materially through late-life scope revision, regulatory change and cost inflation (Moody's Ratings 2024).

Mine closure governance in this respect resembles the early experience of defined benefit pension schemes, where long-term obligations were acknowledged on paper but managed passively. In pensions, optimism was embedded in return assumptions; in closure, it is often embedded in underlying scope, assumed performance and cost estimates (Byrne 2019; Sanders et al. 2024). In both cases, weak alignment between assumptions, funding discipline and liability outcomes allowed risk to accumulate largely unchecked.

The pensions sector has since undergone significant transformation. Confronted with similarly long-horizon, uncertain and balance sheet-material obligations, pension schemes progressively adopted clearer liability definitions, strengthened governance, and embedded financial and risk discipline into decision-making (Ryerson Networks 2022). Pensions were reframed explicitly as a capital allocation and balance sheet management problem requiring active oversight – a shift that, within a single generation, fundamentally reshaped how retirement outcomes are funded, governed and delivered.

This paper explores what closure practitioners and corporate decision-makers can learn from that journey. It examines 3 fundamental contributors to the failure of traditional closure governance – misalignment of objectives, the monetisation trap and the failure to quantify and price risk – and outlines a funding-based closure governance model that reframes closure as a portfolio-level, financially disciplined obligation structured around 4 elements: redefining the closure mission, restructuring ownership and decision-making authority, recognising counterparty maturity as a constraint on transition feasibility, and embedding financial discipline through consistent valuation, risk pricing and funding structures.

## **2 Defined benefit pensions and mine closure: instructive parallels**

At first glance, defined benefit pension schemes and mine closure obligations may appear unrelated. Pensions are financial constructs designed to provide income to beneficiaries; mine closure involves the remediation of physical assets and the delivery of agreed environmental and social outcomes. But through a governance and balance sheet lens, benefit pensions and mine closure share structural characteristics that make the comparison instructive.

Both are long-term liabilities highly sensitive to changing assumptions and external conditions. For pensions, uncertainty is driven by inflation, discount rates, longevity and investment performance; for mine closure, by geochemical and geotechnical behaviour, environmental response, regulatory change, stakeholder expectations and timing, noting that this is not an exhaustive list. Unlike pensions, however, closure timing is strongly influenced by commodity cycles, with mines frequently closing or entering prolonged care and maintenance states during downturns, often outside original planning assumptions (Measham et al. 2024).

Closure liability estimation also involves a higher degree of judgement than pensions, reflecting uncertainty in scope, performance criteria, regulatory acceptance and post-closure management requirements. Empirical studies show that optimism is often embedded in these assumptions, with cost estimates tending to escalate late in asset life (Byrne 2019; Sanders et al. 2024). The greater reliance on judgement and exposure to cyclical disruption places correspondingly higher demands on governance, oversight and financial discipline.

A second parallel lies in how these obligations are treated within corporate financial frameworks prior to the introduction of mature funding and risk transfer regimes. Early defined benefit pension schemes recognised liabilities without establishing dedicated assets or funding mechanisms, relying instead on future cash flows

and sponsor solvency (Fuchsman et al. 2025). Regulators responded by introducing funding requirements, solvency tests and tax incentives to secure pension promises.

Mine closure liabilities are treated in a similar pre-reform way. Provisions are recorded as accounting estimates but are rarely supported by ring-fenced assets, explicit funding strategies or systematic probabilistic risk pricing. Financial assurance instruments, where they exist, are typically calibrated to meet regulatory requirements rather than derived from a full market-consistent valuation of long-tail closure risk (Pepper et al. 2021; International Institute for Sustainable Development & Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development 2023; McKinley 2026). As a result, closure liabilities remain exposed to deferral, volatility and optimism bias.

The transformation of the pensions sector was financial in effect. As actuarial methods and market-consistent valuation matured, pension risk became transparent, quantifiable and transferable – enabling large-scale migration of pension liabilities from corporate balance sheets to insurers and specialist institutions through buy-ins and buy-outs (Fuchsman et al. 2025; Lane Clark & Peacock 2023). No comparable mobilisation of capital has occurred in mine closure. The absence of mature risk transfer markets, persistent uncertainty in scope and duration, and limited ability to price long-tail environmental risk have constrained similar balance sheet release.

These parallels and differences are synthesised in Table 1, which compares key features of mature defined benefit pension frameworks with current approaches to mine closure provisions.

**Table 1 Today's pension characteristics versus mine closure provisions**

| Pensions                                                                    | Mine closure provisions                                                                                                                                |
|-----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Long-term liability duration (decades)                                      | Long-term liability duration (decades)                                                                                                                 |
| Uncertainty driven by demographics, inflation, discount rates               | Uncertainty driven by geotechnical/geochemical risks, environmental responses, timing uncertainty, uncertainty in regulator and stakeholder acceptance |
| Predictable, actuarially modelled cash flows with a finite run-off profile  | Irregular, project-based cash flows with some predictable elements but potentially indefinite duration                                                 |
| Market-consistent actuarial valuations                                      | Mixed methodologies; deterministic                                                                                                                     |
| Quantitative, probabilistic and stress-tested risk quantification           | Often qualitative risk quantification with limited probabilistic risk modelling                                                                        |
| Systemic risk exposure managed by pooling, funding and government backstops | Exposed to operator default, commodity cycles and credit market conditions                                                                             |
| Risks transferable via deep, established pension risk transfer markets      | No established financial market to price or transfer mine closure risk                                                                                 |

Governance structures follow the same pattern. Pension obligations were historically managed as an extension of corporate finance or human resources, with limited separation between those responsible for near-term performance and those accountable for long-term liabilities (Goto & Yanase 2023, O'Donnell & Walker 2023, Smith & Jones 2020). Mine closure governance commonly remains site-led, embedded within operational structures whose incentives are dominated by production, cost control and short-term capital efficiency – a structural misalignment between short-term decision-making and long-term liability outcomes.

The evolution of the pensions sector is instructive not because the mechanisms are directly transferable, but because the governance problem is structurally similar. Both domains have evolved into balance sheet-material, debt-like obligations attracting increasing scrutiny from investors and rating agencies. These lessons

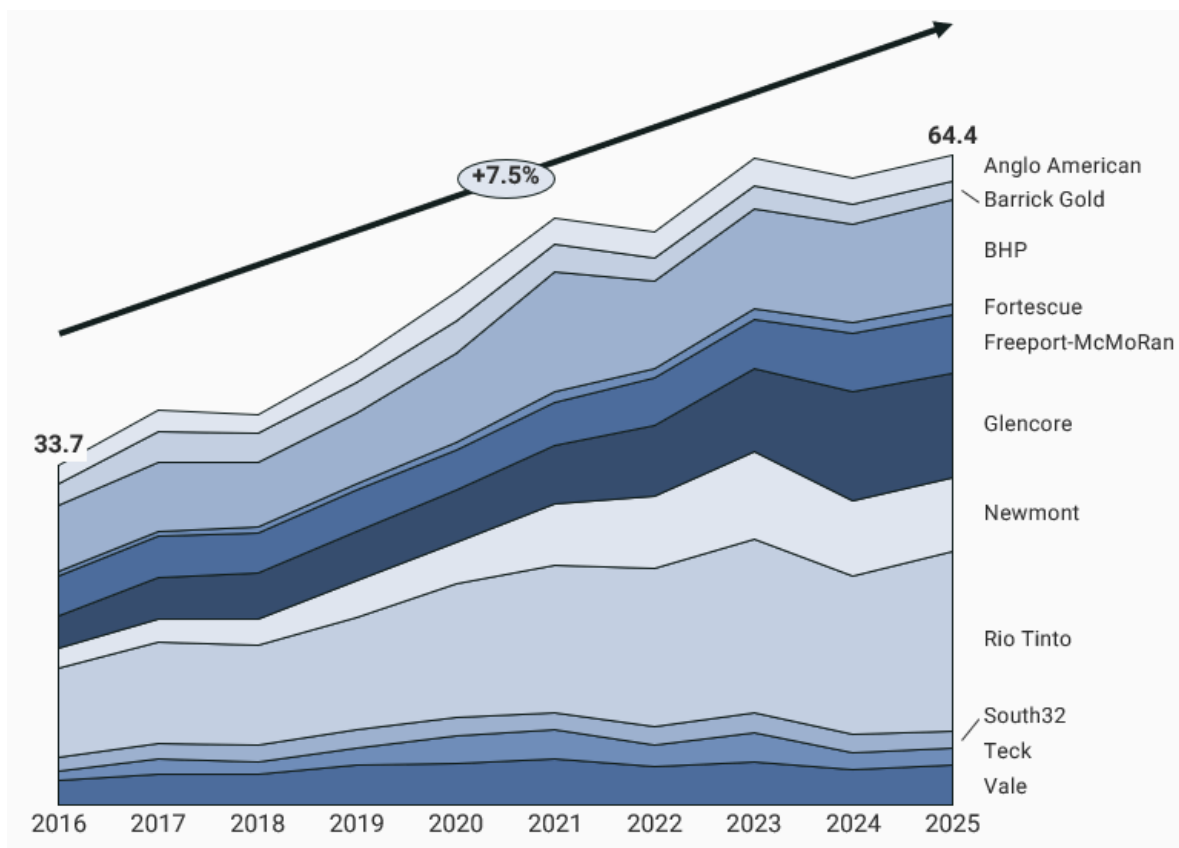
provide a useful lens for examining why traditional closure governance models have struggled to deliver predictable outcomes.

### 3 Key drivers of governance failure

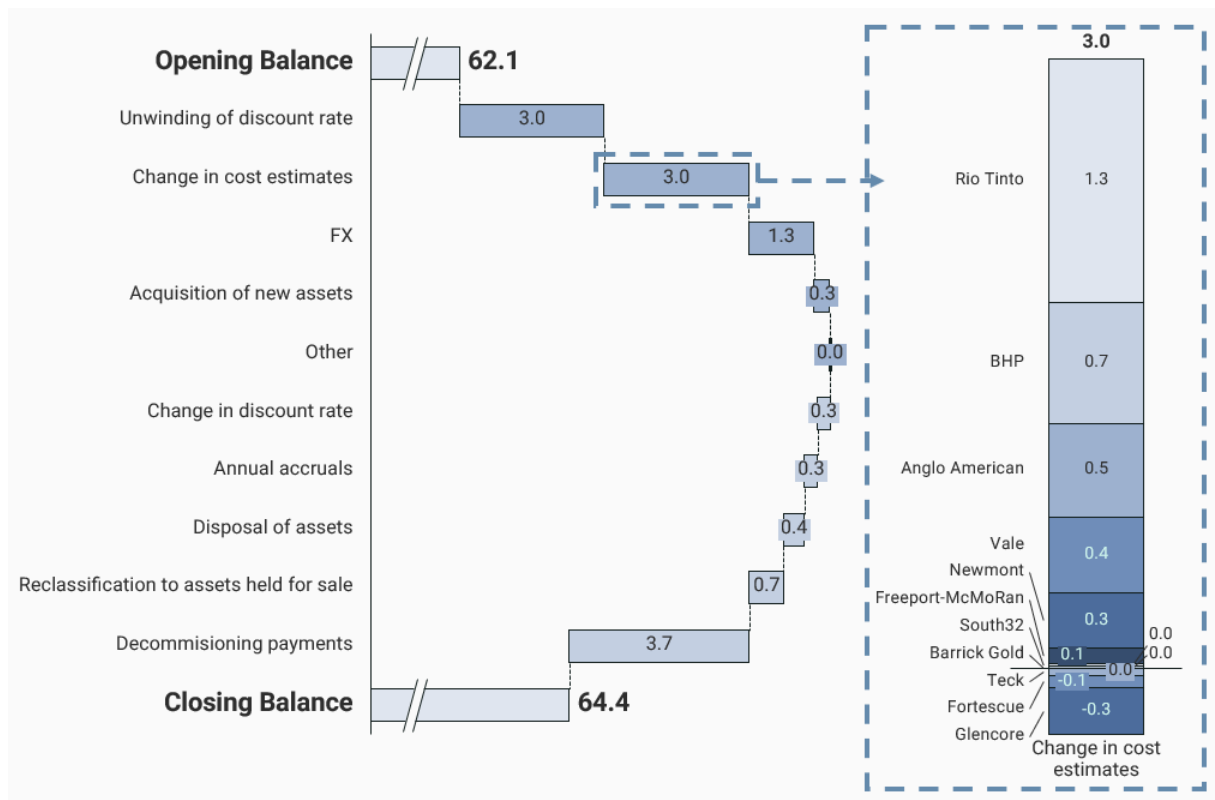
Early closure governance models were established with clear intent: to contain closure costs, reduce financial reporting volatility, and improve confidence among regulators and communities. In practice, many organisations pursued these outcomes by separating legacy assets from core operations, relying on influence-based centres of excellence, and framing closure as a locally optimised technical activity rather than a balance sheet exposure requiring active financial management.

#### 3.1 Misalignment of goals: when subsidiarity breaks down in closure

Ryerson maintains a longitudinal dataset of publicly disclosed closure provisions for a cohort of major listed mining companies covering 2016–2025. Over this period, reported provisions show a clear and persistent upward trend (Figure 1). Decomposition of the movements indicates that growth is dominated by upward revisions in cost estimates, rather than mechanical effects such as discount unwinding or asset additions (Figure 2).



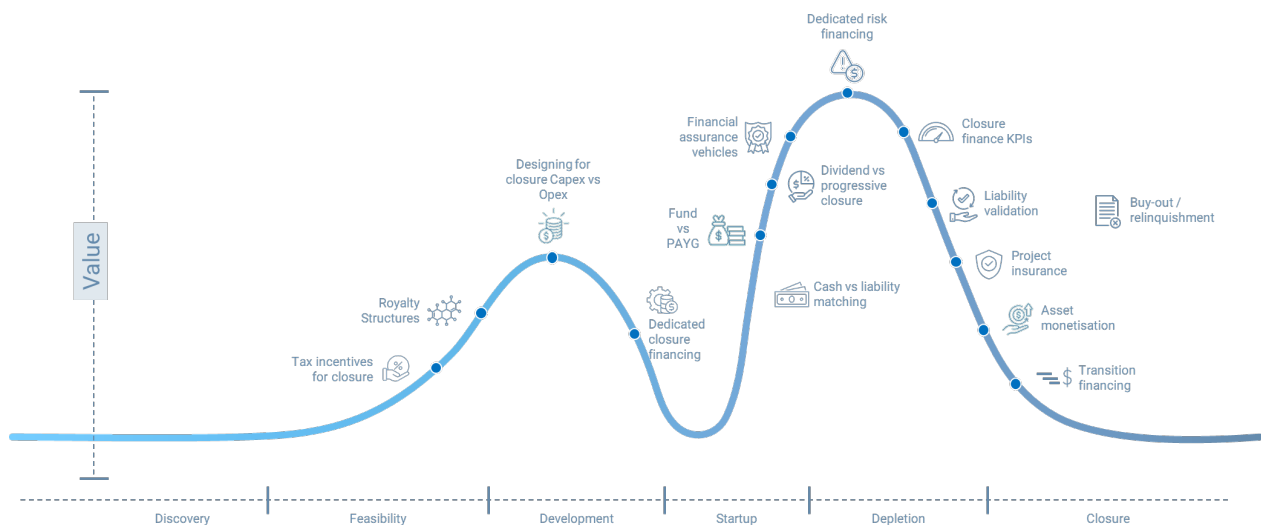
**Figure 1** Reported closure provisions for selected major mining companies, 2016–2025 (Ryerson dataset). Analysis is based on Ryerson’s longitudinal compilation of publicly disclosed closure provisions for a consistent cohort of major listed mining companies over the period 2016–2025, derived from annual reports and statutory financial disclosures



**Figure 2 Drivers of closure provision movements for the 2025 financial year (Ryerson dataset derived from annual reports and statutory financial disclosures)**

These revisions are frequently observed late in asset life, coinciding with the transition from operation into closure execution. While individual provision increases can be justified – reflecting improved information, regulatory clarification or the correction of earlier optimism – the consistency and timing of revisions across the dataset point to a systemic issue rather than isolated estimating error.

As assets approach end of life, closure decisions increasingly involve strategic trade-offs between cost, risk, timing and relinquishment pathways. These decisions differ materially from operational optimisation and require coordinated financial judgement across the portfolio rather than local optimisation at site level. This shift in decision character is illustrated in Figure 3.



**Figure 3 Financial closure decisions increasingly require strategic judgement and financial discipline as assets approach end of life (Ryerson Network 2025)**

Governance structures designed around subsidiarity and site-led authority are structurally ill-suited to managing long-tail closure risk. Subsidiarity works in operating assets where revenue and margin align site and corporate incentives – but breaks down in closure where revenue is absent and uncertainty increases. Without revenue discipline, complexity and lengthy time horizons can justify larger budgets, longer schedules and expanded teams, creating an agency problem where locally rational decisions increase corporate liability exposure.

### 3.2 The monetisation trap: over-emphasising local upside

A second contributor is the tendency to frame closure as a redevelopment or monetisation opportunity without sufficient market validation. While re-use concepts such as tourism, energy or housing may appear attractive, many mining assets are remote, constrained by tenure and poorly suited to viable commercial re-use.

Where third-party capital exists, it is typically risk-tolerant and locally driven, but not aligned with the risk appetite required for long-tail liability transfer. This diverts attention toward speculative re-use options while more reliable pathways – relinquishment or liability transfer – receive less focus.

The outcomes reflect this imbalance. Despite decades of emphasis on post-mining land use, documented examples of fully relinquished mine sites transitioning to productive non-mining uses remain rare, particularly for large and complex operations. Empirical evidence from Australia shows that successful post-mining transitions typically depend on low residual risk or significant public support (Purtill et al. 2026). Closure performance is better measured by realised liability exit than by the sophistication of re-use concepts.

### 3.3 Failure to quantify risk: closure struggles to compete for capital

The third driver is the limited integration of quantitative risk pricing into closure decision-making. Closure is inherently risk-driven, yet risk is often treated qualitatively – making it difficult to demonstrate the value of defensive capital or compete credibly within corporate capital allocation processes. Research has repeatedly identified uncertainty, residual risk and valuation inconsistency as central impediments to effective closure planning and relinquishment (CSIRO 2023; Holloway 2022; CRC TiME 2023).

A common symptom is the coexistence of multiple closure cost numbers – used separately for bonding, accounting and internal investment decisions – often based on different assumptions, application of risk and discounting approaches to serve the different purposes (Brock et al 2019; International Council on Mining and Metals 2019; Global Investor Commission on Mining 2030 2024). This fragmentation weakens business cases, invites internal debate and obscures trade-offs between near-term expenditure and long-term risk and liability reduction. By contrast, the pensions industry has largely achieved convergence on a single, decision-relevant liability measure used consistently across funding, reporting and risk management, enabling clearer capital allocation and external comparability (Fuchsman et al. 2025).

For closure, the issue is not the use of financial tools such as net present value, but the way they are applied in the absence of explicit risk quantification. Without a defensible price on uncertainty, closure investments are systematically disadvantaged relative to growth capital, despite their potential to reduce balance sheet volatility and future financial shocks.

### 3.4 Synthesis: why first-generation models under-deliver

Taken together, the 2016–2025 evidence and the mechanisms above point to a consistent diagnosis. First-generation closure governance models failed not due to lack of effort or technical competence, but because governance design misread incentives, over-weighted speculative monetisation and under-utilised financial logic. The result has been persistent provision growth, late-life revisions and reduced predictability – precisely the outcomes these models sought to avoid.

These drivers define the problem that the funding-based closure governance model in Section 4 is intended to address.

## 4 A funding-based closure governance model

The evidence in Section 3 indicates that persistent growth in closure provisions is not primarily a technical estimating problem, but a governance problem. Addressing it requires a shift from site-led, compliance-oriented models toward a framework that treats closure as a portfolio-level balance sheet exposure requiring active financial management.

Drawing on lessons from defined benefit pensions, this section outlines a funding-based closure governance model structured around 4 interconnected elements: redefining the closure mission from site-level optimisation to portfolio-level liability management, restructuring ownership and decision rights to reflect long-tail risk and balance sheet objectives, recognising counterparty maturity as a binding constraint on transition feasibility, and embedding financial discipline through unified valuation, quantitative risk pricing and structured funding mechanisms.

Together, these elements reposition closure governance from a technical and regulatory exercise to a financially disciplined, counterparty-aware model capable of supporting executable transition pathways and durable relinquishment outcomes.

### 4.1 Redefining the closure mission

A foundational step is to redefine the purpose of closure governance. Under many first-generation models, closure programs implicitly pursue local optimisation – seeking to maximise site-level outcomes or potential re-use value, even where this increases uncertainty or prolongs liability exposure. A funding-based model reframes the mission more explicitly: to manage closure obligations in a way that minimises long-tail risk and balance sheet volatility across the portfolio.

This reframing requires deliberate triage of closure assets. Some sites may retain credible residual value and justify continued active management, while others are better managed for efficient liability exit through relinquishment, divestment or low-cost care and maintenance. This assessment is made at a portfolio level rather than through isolated site-specific lenses, enabling differentiated strategies and clearer prioritisation of capital and management attention.

### 4.2 Restructuring ownership and authority

Site-led structures are structurally misaligned with the nature of closure decision-making. A funding-based model shifts primary authority towards small, centrally positioned teams with explicit responsibility for closure risk and liability outcomes.

These teams operate with high leverage rather than scale. They are commercially literate, financially fluent and supported by external technical, market and legal expertise as required. Site teams continue to provide essential operational and contextual input, but final decisions on strategy, provisioning assumptions and liability pathways are made centrally, where portfolio-level trade-offs can be evaluated consistently. This separation mirrors the evolution of pension governance, where fiduciary responsibility is deliberately distanced from short-term operational pressures.

Early and structured engagement with regulators and other stakeholders is an integral part of this ownership model. Rather than treating regulatory interaction as a late-stage approval process, a funding-based approach embeds it within strategic decision-making, enabling more realistic exploration of relinquishment pathways and long-term liability transfer options.

This governance shift is consistent with good practice in socio-economic transition planning. The ICMM Handbook on multi-stakeholder approaches to socio-economic transitions in mining emphasises the importance of early, coordinated engagement between mining companies, governments and communities to support credible post-mining outcomes (International Council on Mining and Metals 2025). Its emphasis on early collaboration and shared ownership reinforces the need for closure governance structures that operate beyond individual sites and can engage external stakeholders in a disciplined and sustained manner.

### 4.3 Counterparty maturity as a binding constraint

A commonly overlooked constraint on closure transition is the maturity of the counterparty expected to assume responsibility for the site and its residual liabilities. While closure governance typically emphasises internal capability, regulatory engagement and funding sufficiency, successful transition ultimately depends on whether the receiving entity – such as a government body, community organisation or specialist third party – can credibly govern, fund and manage long-tail obligations. Where counterparty capability is misaligned with site complexity or transaction structure, closure risk is not eliminated but displaced, often re-emerging as funding shortfalls, governance failure or renewed regulatory intervention.

In practice, counterparty maturity must be assessed across a small set of critical dimensions, including technical oversight, fiduciary governance, long-term financial stewardship, contract execution capability and access to insurance or alternative risk transfer. Weakness in any one domain materially increases transaction risk and typically requires higher upfront capitalisation or more conservative structuring. Critically, maturity is not static: it can be developed over time through staged transition and continued operator involvement. Recognising this reframes closure from a single transaction to a managed progression. The binding constraint is not engineering feasibility, but misalignment between liability complexity and counterparty capability.

The feasibility and pacing of such transitions are shaped not only by technical and organisational maturity, but also by fiscal and treasury constraints that condition how funding discipline can be implemented in practice, as discussed further in Section 4.6.

### 4.4 Embedding financial discipline and risk pricing

A funding-based model treats closure obligations as probabilistic liabilities rather than deterministic point estimates. This requires the use of unified valuation frameworks across bonding, accounting and internal decision-making, reducing inconsistency and improving transparency in capital allocation discussions, in line with what the pensions industry has been able to achieve.

Quantitative risk pricing plays a central role. By assigning defensible values to uncertainty – particularly for low-probability, high-impact outcomes – closure teams can articulate the value of defensive capital and compete more effectively for resources alongside growth investments. Stress-testing and scenario analysis provide a mechanism to challenge assumptions and surface optimism bias, and understand the sensitivity of provisions to changes in timing, regulatory conditions or technical performance.

In practical terms, this converts closure from a compliance-driven cost centre into a disciplined capital allocation problem. Investment decisions can then be evaluated based on their impact on liability distribution and balance sheet resilience, rather than on local preference or qualitative judgement alone.

### 4.5 Expected outcomes of the model

A funding-based approach alters not only how liabilities are measured and managed, but also the range of practical outcomes available to operators over the mining cycle. By strengthening financial discipline and improving visibility of long-term obligations, the model enhances predictability in closure provisioning and reduces reliance on late-life estimation adjustments that have historically driven balance sheet volatility.

An additional and often overlooked outcome is the creation of strategic optionality. Where closure obligations remain effectively unfunded, downturns frequently leave operators with limited choices beyond deferral, prolonged care and maintenance or value-destructive asset sales. Improved funding discipline preserves the capacity to act under stress, enabling operators to close, remediate, transfer or retain assets based on shareholder value and long-term risk considerations rather than immediate cash constraint alone. In this sense, funding-based governance supports better decision-making across the cycle, not merely improved end-of-life compliance.

This optionality is particularly relevant in the context of late-life asset transitions. Regulators and investors have increasingly expressed concern that divestment of mature or marginal assets to lower-credit counterparties can transfer, rather than reduce, long-tail closure risk. By improving funding credibility and



transparency, the model reduces dependence on ownership change as a risk management strategy and supports more durable closure outcomes regardless of whether assets are retained or transferred.

Taken together, these effects position funding-based closure governance as more than an accounting refinement. The model strengthens managerial flexibility, improves resilience during cyclical stress and enhances confidence that closure liabilities can be managed proactively rather than deferred. These outcomes form a necessary bridge between internal governance reform and the external expectations of investors, insurers and regulators examined in the following section.

#### 4.6 Transition constraints

Funding-based closure governance operates within practical fiscal, treasury and transition constraints that influence how quickly and in what form improvements to containing (or reducing) closure liabilities can occur. Unlike defined benefit pensions, closure liabilities typically sit outside mature funding frameworks, meaning early or full asset segregation may not always be economically efficient and must be considered alongside broader capital allocation priorities.

Transitions from pay-as-you-go to more structured approaches are inherently difficult, particularly in cyclical industries where financial stress often coincides with increased closure activity. Progress is therefore most likely to be incremental and pathway based, achieved through clearer internal discipline, softer forms of ring-fencing and closer integration with established treasury and risk functions. Funding-based closure governance is best understood as an evolutionary shift toward greater resilience and predictability rather than a discrete structural change.

## 5 Investor and regulator implications: emerging signals and future constraints

As closure liabilities increase in scale and duration, investors and regulators are responding to mine closure not merely as a technical end-of-life issue, but as a balance sheet exposure with broader strategic implications. While closure is not yet uniformly assessed as a test of governance quality, expectations are evolving – particularly where provision growth is persistent, late-life revisions are material, or transition pathways lack executability.

For investors and credit rating agencies, the immediate focus remains on quantum, disclosure and comparability. But as closure provisions increasingly resemble debt-like obligations, attention is shifting toward the factors that drive volatility and constrain exit. Fragmented ownership, inconsistent valuation, speculative monetisation assumptions and prolonged deferral have attracted growing scrutiny, particularly in periods of market stress or declining cash generation. Funding-based governance models demonstrate that uncertainty is being actively governed rather than passively absorbed – even where full liability exit remains some distance away.

Counterparty maturity will become a more explicit consideration over time, but it operates alongside other signals rather than in isolation. Where transition strategies rely on undeveloped counterparties but are supported by conservative funding, clear decision rights and disciplined risk pricing, concerns may be partially mitigated. Conversely, even credible counterparties offer limited reassurance where governance, valuation and funding frameworks lack coherence. External confidence is shaped by the alignment of governance elements, not by any single attribute.

Regulatory expectations are evolving in a similarly incremental manner. Current financial assurance regimes remain largely static and estimate driven, but regulators are increasingly aware of the limitations of point-in-time instruments for long-dated, uncertain liabilities. The direction of travel is towards broader assessments of stewardship capacity, funding adequacy and transition realism. Governance models that preserve optionality and reduce reliance on deferral or ownership change during downturns will be viewed as more resilient than those dependent on late-life corrections.

An additional challenge lies in the alignment between governance complexity and organisational structure. As closure liabilities grow in scale and balance sheet visibility, there is a risk that internal governance moves in the opposite direction – with greater reliance on site-level discretion as organisations seek to simplify cost structures. While effective for operational decisions, this sits uneasily with the long-dated, portfolio-level nature of closure risk. From an external perspective, fragmented authority makes it harder to assess whether late-life liabilities are actively governed or merely delegated.

These dynamics suggest that expectations regarding closure governance will become more structured and explicit. Governance models that integrate mission clarity, clear ownership, realistic transition assumptions and disciplined financial frameworks position organisations to engage constructively as those expectations evolve. Early adoption improves transparency, preserves flexibility and reduces the likelihood that external conservatism is imposed in response to late-stage uncertainty.

## 6 Conclusion

Analysis of publicly available industry data over 2016–2025 shows that growth in closure provisions is persistent and largely driven by late-life revisions in cost estimates rather than accounting mechanics. The scale, timing and consistency of these revisions across the sector point to a structural governance issue rather than isolated technical error.

First-generation closure governance models are misaligned with the nature of closure decision-making. Site-led subsidiarity, speculative monetisation and limited quantitative risk pricing have collectively reduced predictability, increased balance sheet volatility and constrained effective capital allocation – mirroring challenges previously observed in defined benefit pensions, where passive recognition of obligations proved insufficient once liabilities became financially material.

The funding-based model outlined in this paper reframes closure as a portfolio-level balance sheet exposure requiring active financial management. Its 4 interconnected elements – redefining the closure mission, restructuring ownership and decision rights, explicitly recognising counterparty maturity and embedding financial discipline – address the structural weaknesses that first-generation models have not resolved.

A central insight is that closure outcomes are not determined by technical capability or funding intent alone. Even well-resourced and technically robust closure plans will fail to achieve durable transition where the receiving counterparty lacks the governance, financial or operational maturity to assume long-tail obligations. Recognising this explains why closure transitions are uneven across portfolios and why timing, capitalisation requirements and transition structures must be differentiated rather than standardised.

The intent of the model is not to eliminate uncertainty, but to govern it explicitly. As closure liabilities continue to grow in scale and visibility, the capacity to manage uncertainty proactively – and to acknowledge where it cannot yet be transferred – will increasingly differentiate credible closure governance from compliance-driven formality.

## Use of artificial intelligence disclosure statement

In the preparation of this work, the authors used Microsoft Copilot AI (ChatGPT version 5 and Claude 2) to improve the language and clarity of the writing. The authors have reviewed the content and edited it where required and take full responsibility for said content.

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