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# Mine closure in Brazil: challenges ahead in a country with over 200 operating metallic ore mines

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## Abstract

*Brazil is one of the world's largest producers of ores, in addition to standing out for the variety of metallic substances produced, such as aluminium, lead, copper, chromium, columbite-tantalite, tin, iron, graphite, lithium, manganese, niobium, nickel, gold, vanadium and zinc. Currently there are more than 200 metallic ore mines in operation in the country, with approximately 36% producing above 1,000,000 tonnes/year of run of mine per mine. If on the one hand the numbers are impressive for their magnitude, on the other hand it is necessary to look closely at the liabilities that are created with the exhaustion of mines. The Brazilian mineral sector is governed by many regulatory standards. Among them is Brazilian National Mining Agency (Agência Nacional de Mineração [ANM]) Resolution No. 68/2021, which establishes rules for mine closure plans including the mandatory elements and respective deadlines for their submission. The Resolution repealed norms that had been approved 20 years before for the regulation of mine closure plans and introduced several concepts not previously addressed. Among the new concepts, the temporary structures and remaining structures stand out. Temporary structures are those installed during the life of a mine that can be demobilised, such as ore treatment plants and water and energy distribution systems. Remaining ones are those that cannot be demobilised, such as open pits and deactivated tailings and waste disposal. Such conceptualisation is extremely important, allowing for a greater comprehension of the norm and a greater possibility of maintaining activities in accordance with the normative. This article aims to analyse ANM Resolution No. 68/2021, considering the variable size of Brazilian mining companies in terms of production capacity and the ores produced, as well as the regulations state-of-the-art in relation to the legislation provided for in other countries with a mining tradition.*

**Keywords:** *mine closure plan, Brazilian regulatory rules, ANM Resolution No. 68/2021*

## 1 Introduction

Brazil is among the countries with the largest mineral reserves in the world and is one of the largest producers of several commodities. Data from the Brazilian National Mining Agency (Agência Nacional de Mineração [ANM] 2023) show that the class of metallic minerals, together with graphite, represent more than 80% of the total value of Brazilian mineral production. Combined, aluminium, lead, copper, columbite-tantalite, chromium, tin, graphite, iron, lithium, manganese, niobium, nickel, gold, vanadium and zinc correspond to more than 99% of the production value of the aforementioned class. Currently there are more than 200 metallic ore mines in operation in the country. Approximately 36% of these have a run of mine production of more than 1,000,000 tonnes per year per mine[†] (Figure 1).

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[†] Mining companies' size is considered as follows: large size: annual gross production (ROM) above 1,000,000 t; medium size: greater than 100,000 t up to 1,000,000 t; small size: greater than 10,000 t up to 100,000 t (ANM 2023).

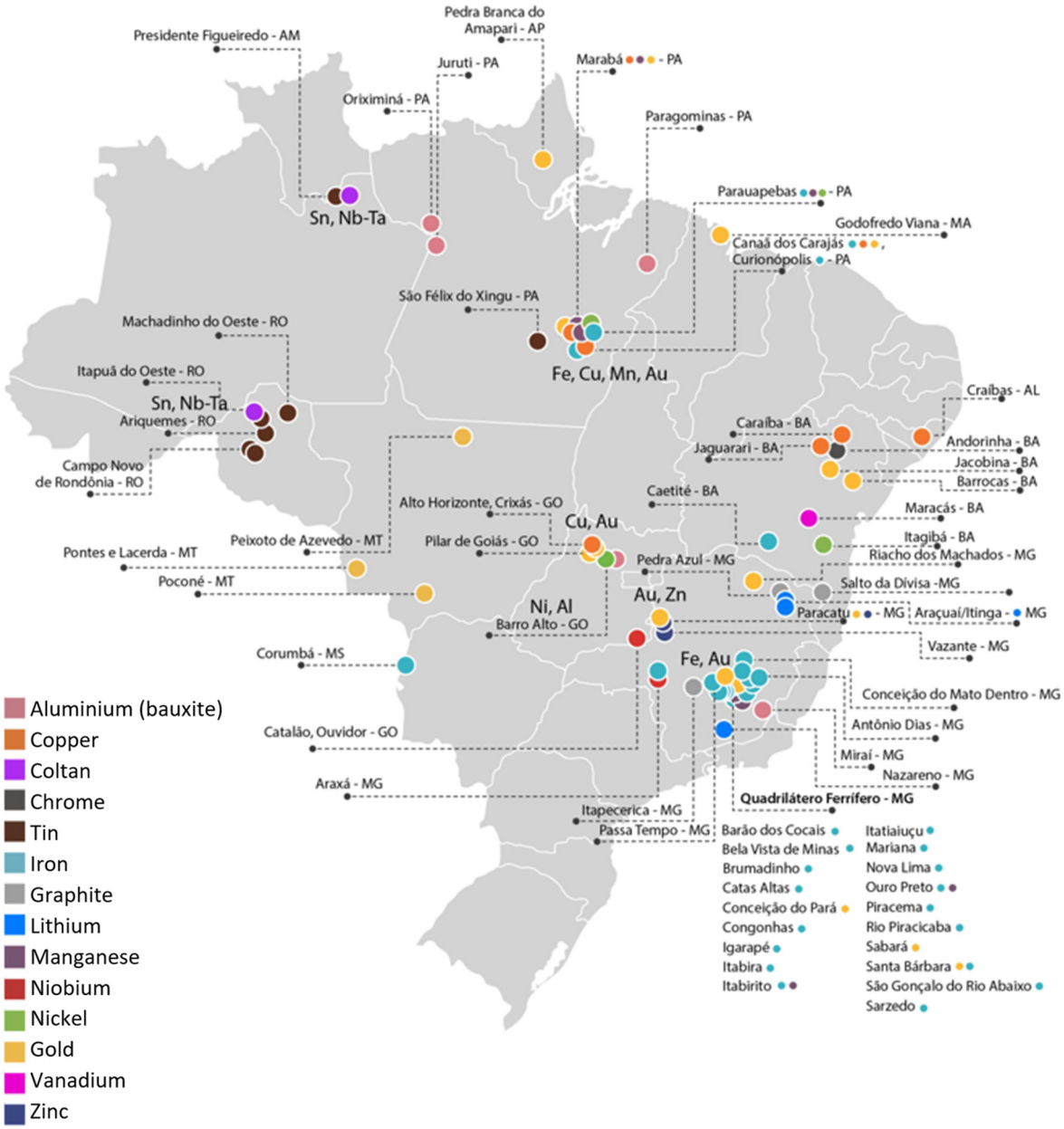


**Figure 1 Brazilian metallic mineral mines with annual run of mine production >1.000.000 t per mine (ANM 2023)**

These impressive figures reaffirm Brazil's importance as a mining country on the global stage. Brazil's mineral industry – which comprises both the mineral extraction and mineral processing sectors – plays a significant role in generating trade surpluses for the country.

These mines extract different types of ore, each with distinct physical, chemical and economic characteristics, requiring varied methods of extraction and processing. The scale of operations also differs greatly: some, like the massive iron ore mines in Carajás (state of Pará, in the northern region of Brazil), run on a large-scale with advanced technology, while others are small-scale, operated by smaller companies or even through artisanal mining, illustrating the complexity and diversity of the Brazilian mining sector. Figure 2 presents the diverse size of Brazilian metallic mining companies.

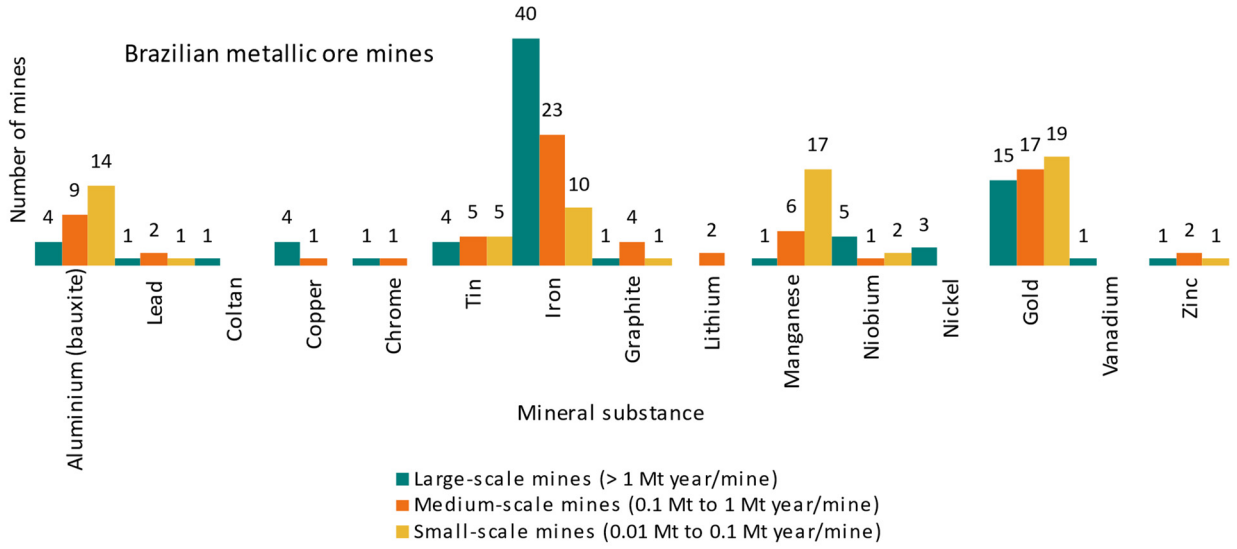


**Figure 2 The variety of metallic minerals extracted in mines of different sizes in Brazil (figure composed by the authors based on ANM 2023)**

The data presented below illustrate how Brazil's mineral industry – which comprises both the mineral extraction and mineral processing sectors – plays a significant role in generating trade surpluses for the country. The figures come from the interactive data platform for official economic information in the mineral sector, known as Comércio Exterior Mineral (ComexMin – mineral foreign trade). Developed by ANM's Regulatory Intelligence Nucleus, this dashboard provides up-to-date statistics and historical data on the foreign trade of Brazil's mineral sector, encompassing both the mineral extraction and mineral processing industries (ANM 2025a).

A methodological tool called the relationship matrix (matriz de relacionamentos) was developed by the ANM Mineral Economics Team. It consists of goods, economic activities and industrial services which aim to represent the production chains of the aforementioned industries that make up the mineral sector and serve as a parameter to systematise, standardise and guide the procedures for selecting and collecting statistical data for this sector. The relationship matrix of product classifications and economic activities in the mineral sector can be accessed at ANM (2025b) and the methodology used for its construction is described in Oliveira (2022).

Results extracted from ANM (2025a) show that, considering the performance of Brazil's trade balance for metallic minerals in the trade balance over the past 10 years (from January 2015 to December 2024), there is a consistent rise in exports. After remaining at an average level of USD Free on Board[‡] (FOB) 43.97 billion during the first six years of the reviewed period, exports of metallic minerals surged to USD FOB 78.30 billion in 2021, stabilising at an average of USD FOB 63.97 billion between 2022 and 2024. During this most recent three-year period, mineral sector exports accounted for 21.32% of Brazil's total exports. Mineral sector imports during the same period amounted to USD FOB 21.60 billion, representing 8.10% of total imports. In 2024 the year closed with mineral sector exports exceeding imports by approximately 173% for metallic minerals, resulting in a trade surplus of USD FOB 39.7 billion for the mineral sector. This figure represented 53.52% of Brazil's total trade surplus. The trade flow of metallic minerals in 2024 – defined by the sum of exports and imports – totalled USD FOB 85.70 billion, accounting for 14.28% of Brazil's overall trade flow.

In a country with such a tradition and expressiveness in the mineral industry, however, it is important to pay close attention to the liabilities created by the exhaustion of mines. It is estimated that more than 2,100 mining

[‡] International shipping trade term to indicate the location where the seller's responsibility for the goods ends and the buyer takes on ownership and any further costs.

concession operations, mainly linked to the extraction of metallic and non-metallic minerals, show signs of abandonment, which may have been caused by the cancellation of the National Registry of Legal Entities with the Federal Revenue Service, requests for resignation or the suspension of mining (Rodrigues 2025).

# 2 Brazilian regulation on mine closure

On 10 July 1934 the first Brazilian Mining Code was published. At that time, the National Department of Mineral Production (Departamento Nacional de Produção Mineral) – DNPM – was created. It became one of the most important federal mining institutions in the mining sector, given its responsibility for managing and inspecting mining activities throughout the country to ensure that mineral resources were exploited in a rational, controlled and sustainable way. In January 1940 the Mining Code was revised and the DNPM continued to play a key role within its scope. It also maintained its relevance during the period governed by the subsequent Mining Code, enacted in 1967, which remains in force today – albeit with updates introduced by more recent laws and decrees.

Over the past decade several revisions to the country's mining regulations, along with the introduction of new, specific regulatory frameworks, have been driven by the need to modernise and adapt to the current mining landscape – particularly in response to changes in mining companies' modus operandi due to technological advancements. These developments have also led to the restructuring of the mining sector as a whole. The institutional framework of the former DNPM and its governance tools proved insufficient to effectively fulfill its role as a regulatory authority. Consequently, the National Department was dissolved and Provisional Measure No. 791, issued in 2017, established a new regulatory body: the National Mining Agency (Agência Nacional de Mineração) – ANM – a special regulatory agency for the mining sector.

Like other regulatory agencies, the ANM has administrative and financial autonomy, and its regulatory decisions are issued by a collegiate board, enabling it to operate independently in fostering a secure and stable regulatory environment for private investment in mining. With the creation of the ANM, many of the responsibilities previously held by the DNPM were fully integrated into the structure of the new agency. DNPM employees were transferred to the ANM, and the agency's technical and field teams were strengthened by the addition of new mining and geotechnical engineers, as well as geologists. Under the oversight of the Ministry of Mines and Energy, the ANM is a vital institution for Brazil's mineral sector.

Within this broader context of regulatory reform, the rules specifically governing mine closures have also been revised, leading to the adoption of new regulations.

## 2.1 Mining Regulatory Standard No. 20 from 18 October 2001

The 22 Mining Regulatory Standards (Normas Reguladoras de Mineração) – NRMs – approved by DNPM Ordinance No. 237 of 18 October 2001 were created with the objective of regulating the rational use of deposits, considering the technical and technological conditions of operation, safety and environmental protection, to make the planning and development of mining activities compatible with the ongoing pursuit of productivity, environmental preservation, and worker health and safety. The NRMs are in force to date. However, some have undergone changes and had clauses revoked. Among them, the suspension, mine closure and Resumption of Mining Operations (Norma Reguladora de Mineração) – NRM – No. 20 regulated mine closure plans (MCPs) for almost 20 years in Brazil. The topic was specifically addressed in the article 20.4, entitled mine closure. In simplified terms, NRM No. 20 established that the mining company was required to formally notify the Minister of State for Mines and Energy of its intention to close a mine. An official request had to be addressed to the minister, containing, among other registers, a report of the work carried out, the characterisation of the remaining reserves, monitoring and follow-up programs, control and suitability plans, and the intention for future use of the area (Republic of Brazil 2001).

## 2.2 ANM Resolution No. 68, from 04/05/2021

On 4 May 2021 ANM revoked NRM No. 20.4 and No. 20.5 (the latter dealt with the waiver of the concession title) and published, in the Official Gazette of the Union, ANM Resolution No. 68/2021 (ANM 2021), which regulates to this day the preparation and execution of the MCP. ANM Resolution No. 104/2022 was published on 27 April 2022 and amended on 11 May 2022 (ANM 2022). Only some deadlines originally provided for in ANM Resolution No. 68/2021 were modified.

The creation of ANM Resolution No. 68/2021, much more comprehensive and complete than its predecessor, was driven by a series of factors (see Figure 3).


**Figure 3 Main driving factors behind the creation of ANM (2021) Resolution No. 68/2021 (figure composed by the authors based on Resolution No. 68/2001)**

The new proposal was aimed, within the scope of mining legislation, at the following aspects:

- update, complement, better define and standardise the procedures and technical parameters provided for in NRMs 20.4 and 20.5, to be developed in the preparation and implementation of the MCP
- facilitate and make more effective the ANM's inspection actions to verify the implementation and developments of the MCP throughout the mine's useful life
- establish procedures for evaluating and approving requests for waiving mining titles in line with the deactivation of the mining enterprise and the future use of mined areas.

Resolution ANM No. 68/2021 maintained several clauses with wording similar to that provided for in the NRMs published in 2001. Table 1 shows the main similarities as maintained in the new Resolution.

The observations are intended to highlight important points from the perspective of Resolution No. 68/2021, even though there are significant conceptual similarities in relation to the 2001 standards.

**Table 1 Similarities between the Mining Regulatory Standards (NRM) 20/2021) and Brazilian National Mining Agency (ANM) 2021 Resolution No. 68/2021**

| NRM 20/2001 | Resolution No. 68/2021 |
|---|---|
| 20.4.1 (b) characterisation of remaining reserves | Art. 7º I – declaration of remaining mineral resources and reserves<br>Obs: note that it is important to keep not only the remaining declared reserves, but also the "mineral resources" |
| 20.4.1 (c) plan for the decommissioning of facilities and equipment comprising the mining infrastructure, indicating their intended destination | Art. 6º III – plan for the decommissioning of the facilities and equipment that make up the infrastructure of the mining project |
| 20.4.1 (d) update of all topographic surveys of the mine | Art. 12 º II – updated topographic survey of the areas and structures that make up the mining project |
| 20.4.1 (i) measures to prevent access to the mine by unauthorised individuals and to block off dangerous areas with barriers | Art. 6º V – measures to prevent unauthorised access to the mining project facilities and to restrict access to hazardous areas<br>Art. 6º VII – guidelines for adapting the area to the intended future use |
| 20.4.1 (l) suitability and intended future use of the area | Obs: It is now required to have "guidelines" aimed at adapting the area for future use, rather than just the suitability and intention of that use |
| 20.4.1 (o) physical and financial schedule of the proposed activities | Art. 5º VII – a physical-financial schedule of the PMF should integrate actions related to pre-closure, closure and post-closure stages<br>Obs: The integration of actions before and after the actual closure of the mines indicates that ANM Resolution No. 68/2021 now views mine closure as an action integrated into the mine's operational life. This process must be monitored and updated periodically, as will be detailed later |

While ANM Res. 68/2021 bears fundamental similarities to item 20.4 of NRM 20/2001, it also includes new requirements not covered by the 2001 standards. NRM 20/2001 focuses on requiring periodic updates of the MCP when it is not covered by the Economic Use Plan[§] and on providing for the obligation to submit the mine closure to the Minister of State for Mines and Energy. However, there is no express mention of deadlines established for submitting the MCP. ANM Res. 68/2021 (modified by ANM Res. 104/2022), on the other hand, determines compliance with deadlines for submitting the MCP for projects with mining authorisation titles under various conditions, as shown in Figure 4.

[§] The Economic Use Plan (Plano de Aproveitamento Econômico [PAE]), under the Authorisation and Concession Regime, is required for obtaining the so-called Mining Grant Ordinance.

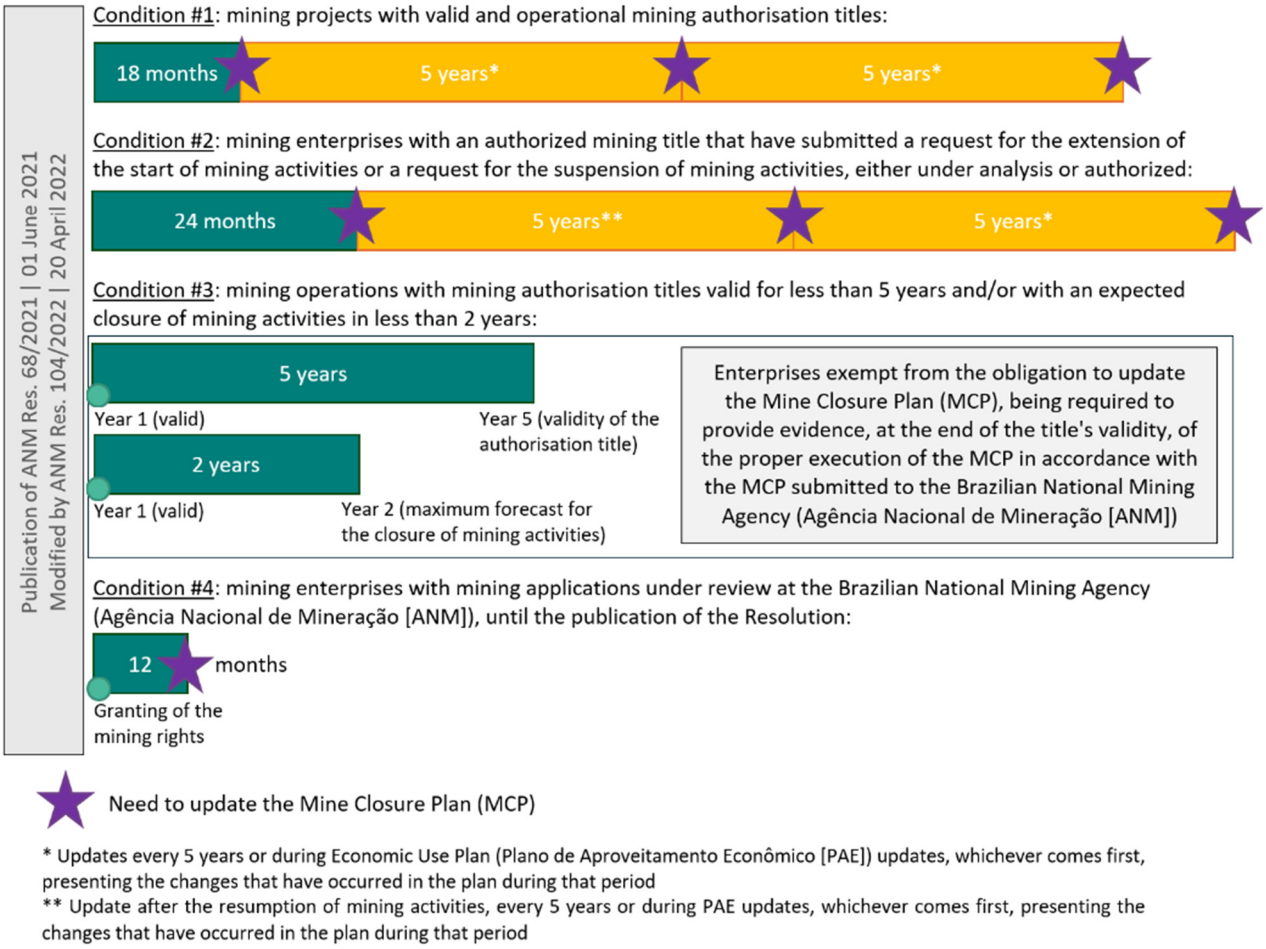


**Figure 4 Deadlines provided for by the Brazilian National Mining Agency [ANM] 2021 Resolution No. 68/2021 (figure composed by the authors based on the text of Resolution No. 68/2001)**

ANM's Resolution No. 68/2021 introduces as another innovative factor in its preliminary provisions (Chapter 1, Article 1): a series of concepts ranging from the mining exploitation title to the definition of temporary and remaining structures, which are extremely relevant for a correct understanding of the obligations outlined in the Resolution.

In Section 1 of Chapter 2, the various elements that must comprise the MCP are described with consideration of the different stages in which the mining enterprise may be, such as:

- enterprises in the phase of applying for the mining exploitation title or those which have already been granted approval for mining activities (Article 5)
- mines in closure due to exhaustion (Article 6)
- mines in closure before exhaustion (Article 7)
- mines in operation (Article 8).

Resolution No. 68/2021 stipulates that every mining enterprise must have a MCP developed and constituted according to Chapter 2 of the Resolution. However, it allows the exemption of some elements required in Section 1 of Chapter 2 for the MCP of small-scale enterprises, with mining and beneficiation operations of low complexity and low impact in the enterprise area. This legal provision is of great importance and consideration given the diverse size of Brazilian mining companies, both in terms of annual run of mine production and the types of minerals produced. Meeting all the requirements outlined to characterise the enterprise and the planning and rehabilitation actions for areas upon mine closure could be a challenging and extremely costly factor for smaller companies with the production of lower-value minerals.

It is important to highlight that Resolution ANM No. 68/2021, which will be detailed below, has brought many benefits to the mineral sector, such as greater regulatory clarity and the establishment of measures to be taken regarding Brazilian mines currently in operation that need to take actions aimed at their future closure. However, it is important to emphasise that to achieve the full effectiveness of the Resolution, all involved parties must be properly trained and prepared – both public agents, as enforcers of the law, and mining companies, which need to adapt their operations and processes to comply with the legislation.

# 3 International benchmark: the way Australia and Chile deal with their mine closure rules

International benchmark studies concerning mine closure regulation were carried out in relation to Australia and Chile. Due to their shared structural, institutional and economic characteristics, these countries present particularly relevant comparative frameworks for Brazil in the domain of mining regulation. Australia and Chile, like Brazil, own substantial mineral reserves. Besides this, they rely significantly on the mining sector as a driver of economic development. Their regulatory landscapes are shaped by decades of experience managing large-scale mining operations across diverse geographic and social contexts, which offer a range of lessons applicable to Brazil's evolving regulatory needs.

## 3.1 Mineral production data for Australia, Brazil and Chile between 2009 and 2022

Below is a summary of mineral production in Australia, Chile and Brazil between 2009 and 2022. The data was sourced from CEIC, an Austrian company specialised in providing macro-economic indicators, including figures related to global mining output by country.

In 2022 Australia saw a slight increase in mineral production compared to the previous year. Over the 14-year period, the country's average annual production was around 1,218 Mt. During this period the highest levels were recorded in 2019 (1,352 Mt), while the lowest value appeared in 2009 (794 Mt). The country produces a vast range of products including coal, iron, gold, lithium, uranium and bauxite ores.

Brazil experienced a decrease in mineral production in 2022 (483 Mt) compared to 2021 (504 Mt). Over the 14-year period, the country produced about 477 Mt on annual average. The data reached an all-time high of 506 Mt in 2018 and a record low of 351 Mt in 2009.

Chile recorded the production data of approximately 32.0[**] Mt in 2022, above the 30.6 Mt registered in 2021. The minerals production data present an average of 30.9 Mt between 2009 and 2022. The data touched an all-time high of 35.3 Mt in 2014 and a record low of 21.7 Mt in 2009. Chile is an important producer of copper, coal, manganese, iron ore, molybdenum, zinc, lead and gold.

Figure 5 shows the mineral production of each of the three countries between 2009 and 2022. The beginning of the analysed interval, 2009, is characterised the lowest production of the entire interval for the three countries. While peak production occurred in close years in the case of Brazil and Australia (2018 and 2019, respectively), the maximum production of Chile occurred a few years earlier, in 2014 (the intervals as limits of mineral production are highlighted in green in Figure 5).

[**] Although the comma is the decimal separator in Chile, just like in Brazil, this article adopts the full stop, as used in Australia.


**Figure 5 Mineral production for Australia, Brazil and Chile between 2010 and 2022 (data in metric tonnes). Adapted from CEIC (2025a, 2025b and 2025c, respectively)**

From an institutional perspective, all three countries operate under federal systems in which responsibilities over natural resources are distributed among national and subnational authorities. This governance structure imposes additional complexity on regulatory design and enforcement, making the experiences of Australia and Chile especially instructive for Brazil. In particular, the integration of environmental and social safeguards into mining legislation, including the development of detailed mine closure frameworks and financial assurance mechanisms, offers a valuable reference point for Brazil as it seeks to modernise its own systems and reduce the incidence of abandoned mining sites.

Furthermore, these countries are recognised participants in international debates on sustainable mining and climate policy. They have increasingly aligned their regulatory instruments with global standards on

environmental accountability, social licence to operate and carbon-related strategies. In this context, Brazil's comparison with Australia and Chile is not only appropriate from a technical and institutional standpoint but also strategic in ensuring regulatory compatibility with the expectations of global markets, investors, and multilateral environmental commitments.

### *3.1.1 Mining regulation in Australia*

Unlike Brazil, where mine closure legislation is of a federal nature and applies to all states in the nation, in Australia it varies according to the states. Three Australian states with large mining industries are New South Wales (NSW), Queensland (Qld) and Western Australia (WA).

In NSW, the most populous state of Australia, the mine closure planning and approval and the financial assurance are ruled by the *Mining Act* (Government of New South Wales [GNSW] 1992). Accordingly, prior to commencing activities, mining companies must submit a Rehabilitation Management Plan (RMP) that details the progressive rehabilitation strategies, final land use objectives and completion criteria (GNSW 2016). The RMP must be periodically updated and reviewed to reflect any kind of change. The progressive rehabilitation is ruled by the Mining Regulation (GNSW 2016), which determines the standard mining lease conditions mandate that disturbed land is progressively rehabilitated as mining progresses.

Qld is the second largest and third most populous of the Australian states. The *Environmental Protection Act* (Government of Queensland 1994) rules all the closure and progressive rehabilitation aspects. Mining projects must include a progressive rehabilitation and closure plan as part of their Environmental Authority. This plan, which must contain schedules for progressive rehabilitation, ensures that rehabilitation is integrated into the mine's lifecycle, with clear benchmarks and timelines. Financial assurances, which serve as a risk management tool, are required to cover potential rehabilitation liabilities. MCPs must be submitted and approved before the beginning of the mining operations.

In WA, the largest state of Australia, the *Mining Act* (Government of Western Australia [GWA] 1978) is the regulation which determines that the MCP must be submitted and approved before mining operations commence. Companies must pay a yearly levy into the Mining Rehabilitation Fund – a shared pool set aside for environmental restoration. This annual contribution is precisely figured out by looking at the type and sheer amount of land disturbed, applying specific rates per hectare depending on the different disturbance categories. This fund can be accessed by the state government to rehabilitate abandoned mines (GWA 2013).

### *3.1.2 Mining regulation in Chile*

Aspects regarding closure plan submission and approval, temporary suspension of an operations' post-closure obligations and sanctions for non-compliance are all ruled by the National Geology and Mining Service (Servicio Nacional de Geologia Y Minería) – SERNAGEOMIN. It is a Chilean government agency responsible for regulating the country's mining industry as well as to provide geological information and advice in technical issues, which is aimed at public and private interests (https://www.sernageomin.cl). The main law that regulates the closure of mining works and facilities is Law No. 20.551. It was enacted in October 2011 and published a month later. In July 2019 Law No. 21169 modified Law No. 20.551 and its most updated version is from June 2020. In general terms, mining operators must submit a closure plan to SERNAGEOMIN before operations begin.

The closure plan must include strategies for dismantling infrastructure, undertaking environmental restoration, ensuring chemical and physical stability, mitigating environmental risks and conducting community engagement. Like Brazilian ANM Resolution No. 68, the closure plan in Chile must be updated every five years, or earlier if there are substantial operational or environmental changes. In the event of the suspension of operations for more than six months, the mining company must submit a temporary closure plan.

Details of the mining regulatory regulations for mine closures in Australia and Chile are set out in Tables 2 and 3, respectively. It is important to note that both Australian and Chilean mine closure laws consider financial guarantees and environmental aspects. However, as this paper is not aimed at these subjects, they were not deeply considered in the study.

**Table 2 International benchmark: mine closure regulation in Australia**

| Aspect | Regulatory framework (article + text) | Detailed requirements | Detailed description |
|---|---|---|---|
| 1. Closure planning and approval (NSW) | *Mining Act 1992*: mining leases include conditions that require companies to demonstrate how land will be progressively rehabilitated across the life of the mine (Government of New South Wales 1992) | Companies must develop and submit a RMP detailing progressive rehabilitation strategies, final land use objectives and completion criteria | Mining companies are obligated to plan for land rehabilitation from the outset. The RMP ensures that land disturbed by mining is returned to a safe, stable and sustainable state, aligning with approved post-mining land uses. Regular updates and reviews of the RMP are mandated to reflect any changes in mining operations or environmental conditions |
| 2. Progressive rehabilitation (NSW) | *Mining Regulation 2016*: standard mining lease conditions mandate that disturbed land be progressively rehabilitated as mining progresses (Government of New South Wales 2016) | Companies are required to rehabilitate land as soon as reasonably practicable after disturbance, aiming to achieve approved for the final land use | Progressive rehabilitation minimises environmental impacts by restoring land incrementally during the mining process. This approach reduces the scale of rehabilitation required at closure and facilitates earlier detection and resolution of potential issues |
| 3. Closure planning and approval (Qld) | *Environmental Protection Act 1994*: mining projects must include a progressive rehabilitation and closure plan (PRCP) as part of their Environmental Authority application (Government of Queensland 1994) | The PRCP outlines rehabilitation milestones, final land use objectives and criteria for relinquishment of responsibilities | PRCP ensures that rehabilitation is integrated into the mine's lifecycle, with clear benchmarks and timelines. This proactive planning promotes environmental sustainability and provides transparency to stakeholders regarding rehabilitation commitments |
| 4. Progressive Rehabilitation (Qld) | *Environmental Protection Act 1994*: PRCPs must include schedules for progressive rehabilitation | Companies are obligated to rehabilitate land progressively, aligning with the timelines and milestones set out in the PRCP | Progressive rehabilitation reduces the environmental footprint of mining operations and facilitates the return of land to beneficial uses. It also allows for adaptive management, enabling companies to respond to unforeseen challenges during the rehabilitation process |
| 5. Closure planning and approval (WA) | *Mining Act 1978*: the MCP must be submitted and approved before mining operations commence (Government of Western Australia 1978) | The MCP should detail closure objectives, rehabilitation strategies, monitoring programs and stakeholder consultation processes | In WA the MCP is integral to mining approvals, ensuring that closure considerations are embedded in project planning. The Department of Energy, Mines, Industry Regulation and Safety assesses the MCP to confirm that it meets regulatory standards and community expectations |
| 6. Progressive rehabilitation (WA) | *Mining Act 1978*: MCPs must include provisions for progressive rehabilitation | Companies are expected to rehabilitate disturbed land progressively, in accordance with the strategies outlined in the MCP | Progressive rehabilitation promotes environmental stewardship by ensuring that land is restored in a timely manner, reducing the cumulative impact of mining and facilitating earlier ecosystem recovery |

**Table 3 International benchmark: mine closure regulation in Chile**

| Aspect | Regulatory framework (article + text) | Detailed requirements | Detailed description |
|---|---|---|---|
| 1. Closure plan submission and approval | *Law No. 20,551*: every mining project owner must submit a closure plan to the Service before the start of mining operations (Republic of Chile 2020) | Mining operators must submit a closure plan to National Geology and Mining Service (SERNAGEOMIN) before operations begin. Approval is a prerequisite to commencing mining activities | Ensures closure planning is integrated from the outset. The plan must include comprehensive technical, environmental, and safety strategies. SERNAGEOMIN is responsible for approval and technical assessment |
| 2. Closure plan content requirements | *Law No. 20,551*: the closure plan must contain the necessary measures to protect the environment, health, and safety of people. \| Law No. 19,300: Mining projects that include exploitation or beneficiation processes shall be subject to the environmental impact assessment system (Republic of Chile 2024) | The closure plan must include strategies for dismantling infrastructure, undertaking environmental restoration, ensuring chemical and physical stability, mitigating environmental risks and conducting community engagement | Restoration must include soil remediation, revegetation with native flora, water body recovery, and risk prevention strategies such as containment of acid mine drainage. Post-closure monitoring plans and cost evaluations are also mandatory |
| 3. Closure plan updates | *Law No. 20,551*: the closure plan must be reviewed and, if appropriate, updated every five years | Closure plans must be updated every five years or earlier if there are substantial operational or environmental changes | Ensures the closure plan reflects the mine's current conditions. Revised financial assurances must be submitted if closure costs change |
| 4. Temporary suspension of operations | *Law No. 20,551*: the owner must present a temporary closure plan when operations are paralysed for more than six months | Companies must submit a temporary closure plan if operations are suspended for more than six months | The plan must ensure environmental protection and infrastructure maintenance during inactivity. The maximum suspension period is two years, extendable with approval |
| 5. Post-closure obligations | *Law No. 20,551*: the owner must keep the area closed for the period determined by the Service, ensuring compliance with the measures adopted | Post-closure monitoring and contributions to a maintenance fund are required | Obligations include verifying the effectiveness of environmental measures like water quality and vegetation. Funds are non-refundable and finance long-term site care |
| 6. Sanctions for non-compliance | *Law No. 20,551*: violations of the provisions of this law will be punished with fines of up to 1,000 monthly tax units | Non-compliance may lead to substantial fines and government-led closure using financial guarantees | Enforcement targets both legal entities and individuals. Ensures closure is completed even in cases of financial default |

# 4 Conclusion

Brazilian National Mining Agency (ANM) Resolution No. 68/2021 represents an important regulatory milestone in the context of mine closure in Brazil, significantly modernising and expanding the scope of the previous normative framework, such as NRM No. 20/2001. Its creation responds not only to the need for technical and legal updates in light of the evolution of mining practices but also to the growing social and environmental demand for more responsible and sustainable mining.

The new regulation introduces fundamental concepts, establishes clear deadlines for the development and updating of the MCP, and integrates the closure planning throughout the entire lifecycle of the mining enterprise rather than just during its final phase. This systemic approach ensures that the closure of mining activities is not treated as an isolated event but as part of a continuous and planned process.

Another highlight is the regulatory predictability provided by Resolution No. 68/2021, which facilitates planning by companies and enhances the oversight capabilities of the ANM. Furthermore, the flexibility of provisions for small-scale enterprises with less complex operations and lower impacts demonstrates sensitivity to the diverse production profiles in Brazil's mining sector, reducing the risks of technical and economic feasibility issues for small miners.

On the international front, research on the regulatory standards of countries like Australia and Chile reveals that nations such as Australia, for example, have advanced with progressive rehabilitation requirements from the beginning of operations. Chile, in turn, clearly integrates environmental aspects into closure planning, with obligations for post-closure monitoring and strict sanctions.

Therefore Resolution No. 68/2021 brings Brazil closer to international best practices but its effectiveness depends on several key factors: (i) continuous technical training of the public and private agents involved; (ii) effective and transparent monitoring by the ANM; and (iii) the maturation of the organisational culture within companies to view mine closure as a long-term commitment to the territory and society. The consolidation of this regulation can thus not only mitigate the environmental and social liabilities arising from mining activities but also contribute to the development of a more sustainable and ethical image for Brazil's mining sector on the global stage.

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