

Small-scale Mining Decarbonisation Paradox: Why ASM Formalisation is the Linchpin of a Just Transition



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Abstract

The global imperative to decarbonise has catalysed an unprecedented demand for “critical minerals,” positioning the energy transition as a cornerstone of modern industrial policy. However, this transition is currently unfolding within a binary governance framework that privileges large-scale, corporate-led mining while systemically marginalising artisanal and small-scale mining (ASM). Despite employing over 40 million people and underpinning local economies in the Global South, ASM is frequently pathologised as a high-risk sector, leading to exclusionary ESG strategies and “de-risking” reflexes that drive miners further into informality.

This article interrogates the “Decarbonisation Paradox”: the reality that securing “clean” minerals for the Global North often inadvertently “outsources” environmental degradation and social inequity to the Global South. By synthesising current research on livelihood displacement, “Development Minerals,” and the gendered inequities of resource governance, I argue that the current trajectory of the Green Transition risks reinforcing a two-tiered global economy.

Drawing on evidence from unstable political settlements and the failed “rituals of inclusion” in mineral policy, this research contends that formalisation is not merely a development objective but a strategic necessity for global supply chain integrity. True sustainability requires moving beyond punitive “crackdowns” toward state-led, inclusive formalisation that provides technical assistance for mercury-free processing and legal security for miners. This study concludes that the global energy transition will remain structurally and ethically flawed until ASM is integrated as a formal, legitimate frontline of the green economy.

Keywords: Artisanal and Small-scale Mining (ASM); Green transition; Formalisation; Critical minerals; ESG; Just transition

Introduction

The Global North’s commitment to a low-carbon future is predicated on a massive, unprecedented scaling of mineral extraction. While the transition away from fossil fuels is non-negotiable for climate stability, the “Green Transition” is currently unfolding within a binary framework that privileges large-scale, corporate-led mining (LSM) while pathologising artisanal and small-scale mining (ASM). Despite employing an estimated 40-45 million people globally [1], ASM is frequently treated as a “risk” to be mitigated or an obstacle to be cleared, rather than a vital component of global resource governance.

This article argues that the current focus on “critical minerals” has inadvertently deepened the marginalisation of the ASM sector. The study contends that the exclusion of artisanal miners from formal green energy supply chains does not eliminate

environmental or social impacts; instead, it “outsources” these liabilities to the informal shadow economy. Without a radical shift toward state-led formalisation, the global energy transition will remain structurally flawed, failing the very Sustainable Development Goals (SDGs) it purports to uphold.

Expanding the Rhetoric: The Myth of “Clean” Supply Chains

Current international governance, exemplified by the *OECD Due Diligence Guidance* [2], seeks to sanitize mineral origins through rigorous auditing. However, this creates an “Exclusionary ESG” environment. When global markets demand “conflict-free” or “mercury-free” minerals without providing the infrastructure for formalisation, they trigger a “de-risking” reflex among

investors. This reflex incentivises the avoidance of ASM-heavy regions, effectively cutting off millions from legal markets [3,4].

The rhetoric of “clean” energy is further complicated by the “pendulum movement” of unstable political settlements [5]. In regions like Peru and Ghana, miners oscillate between brief periods of state tolerance and aggressive “crackdowns” that favour large concessions [4,5]. This instability prevents long-term environmental stewardship. For instance, while the *Minamata Convention* [6] mandates the reduction of mercury, informal miners cannot invest in retort technologies or mercury-free processing without the legal security of a mining licence. Consequently, the world’s demand for “clean” lithium or cobalt often displaces local labour into unregulated, mercury-intensive gold mining as a desperate survival strategy [7]. This sort of neglect has also been identified in the areas of development minerals.

The Development Mineral Gap and Livelihood Displacement

A critical oversight in the “critical minerals” discourse is the neglect of “Development Minerals”—materials like sand, clay, and gravel used for local domestic growth. As Kamlongera [8] demonstrates in Malawi, these resources are essential for local resilience but are ignored by global policymakers focused on export-oriented commodities.

Furthermore, the expansion of LSM for the low-carbon transition often leads to “mineral exhaustion” and the displacement of local communities [7]. In such contexts, the “ritual of inclusion”

[9]—whereby women are nominally invited to governance meetings—fails to address deep-seated inequities. Research in Thailand and Ghana confirms that despite the rhetoric of SDG 5 (Gender Equality), women in ASM remain relegated to the most precarious roles with the least legal protection [10,11]. In order to significantly contribute to addressing this issue, it is imperative to note that strategic formalization can play a huge role [4].

Structural Path to Formalisation: Lessons from the Field

Formalisation must move beyond a “one-size-fits-all” legal stamp and be built “block by block” [4]. A credible 2026 global strategy (see table 1) requires:

- a) State-Led Reform over Crackdowns: As seen in Tanzania and Sierra Leone, sustainable progress occurs when the state moves from punitive “informality” to supportive policy reforms that treat ASM as a legitimate economic driver [12-14].
- b) Technological Sovereignty: Compliance with SDG 6 (Clean Water) [8] and the Minamata Convention [6] is only possible if formalisation includes the transfer of mercury-free processing technology at costs accessible to small-scale cooperatives.
- c) Holistic SDG Alignment: We must move past the “Nobody Cares” phenomenon described by Clifford [3]. If ASM is not integrated into the transition, the sector will continue to be a perceived threat to water supply and forest cover [15-18].

Table 1: Structural Path to Formalisation: Lessons from the Field.

Strategic Pillar	Core Principle	Key Insight from Field Evidence	Policy Implications	Relevant Frameworks / References	Findings and Risks if ignored
1. State-Led Reform (Not Crackdowns)	Formalisation must be incremental and supportive, not punitive.	Evidence from Tanzania and Sierra Leone shows sustainable progress occurs when governments shift from criminalisation to recognising ASM as a legitimate economic driver.	- Replace enforcement-heavy approaches with structured reform programmes. - Develop licensing pathways that are affordable and transparent. - Integrate ASM into national mineral development plans.	[11-13]	Continued informality, distrust of government, capital flight, and persistence of illegal trade networks.
2. Technological Sovereignty	Environmental compliance requires accessible technology transfer.	Compliance with SDG 6 (Clean Water) and the Minamata Convention is unattainable without affordable mercury-free processing technologies for cooperatives.	- Subsidise mercury-free technologies (e.g., gravimetric concentrators, borax methods). - Promote local fabrication and regional technology hubs. - Embed technology access into formalisation frameworks.	SDG 6 [6]; Minamata Convention [8]	Ongoing mercury pollution, water contamination, international trade restrictions, and exclusion from responsible mineral markets.
3. Holistic SDG Alignment	ASM must be integrated into national sustainability transitions.	The “Nobody Cares” phenomenon highlights institutional neglect. Without integration, ASM is framed as an environmental threat rather than a development opportunity.	- Align ASM with water, forestry, and climate policy. - Include ASM in national SDG reporting. - Reframe ASM as a partner in sustainable land and water management.	Clifford [3]; Environmental impact studies [15-18]	Persistent reputational damage, loss of forest cover, water degradation, and policy fragmentation.

Conclusion: Beyond the Green Wash

The “Green Transition” currently stands at a moral and strategic crossroads. The pursuit of a low-carbon grid cannot be considered “sustainable” if it relies on a two-tiered global economy: a regulated, high-tech Global North and an informal, mercury-soaked Global South. As research into COVID-19’s impact on mining communities highlighted, the informal sector is exceptionally resilient but dangerously vulnerable to global shocks [18,19].

To move forward, the international community must reject the “de-risking” model that excludes artisanal miners in favour of an “engagement” model that formalises them. This is not merely an act of charity; it is a geopolitical necessity. If 45 million miners remain outside the formal economy, the global mineral supply chain will remain susceptible to shadow markets, human rights abuses, and environmental degradation that no “green” certification can truly erase. The transition must be “Just,” or it will not be truly “Green” [20-23].

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