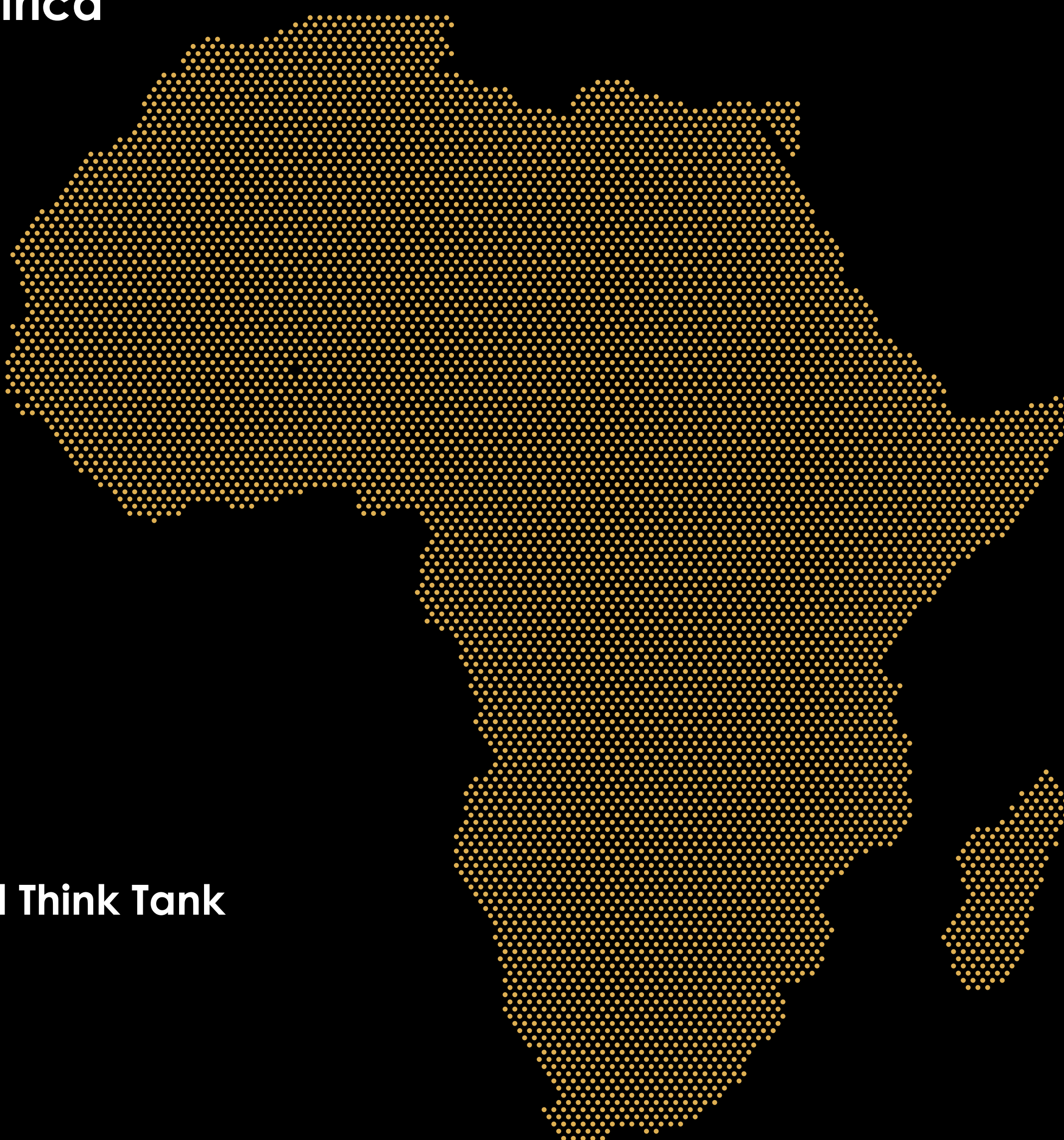
RAMP Africa

Reforming African Minerals to Prosper Africa



Oxford Global Think Tank

About this Report

This report is a flagship product of the Oxford Global Think Tank's focus on unleashing Africa's mineral wealth for the prosperity of its people, and on the concerning reality that a continent so richly endowed has so many of its citizens in poverty. The Oxford Global Think Tank (OGTT) is an independent, practitioner-led research initiative that convenes experts across policy, finance, technology, and industry to turn ambitious ideas into implementable solutions. Its mission is to lead rigorous research into the crucial problems that must be solved in order to bring lasting prosperity to the global south.

The report sets out a practical path to commodity-based industrialisation. It adds to the growing chorus of several reports released since early 2025 on the important topic of Africa's critical minerals, amid the global energy and industrial transition, and changing geopolitical dynamics. The report contributes a broader focus beyond critical minerals with detailed recommendations and Africa-tailored approaches.

It is corridor-anchored and market-integrated, detailing exact ways to go beyond beneficiation goals to genuine industrialisation on the continent. The OGTT approach also places this new industrialisation strategy squarely within the ongoing continental integration ambitions being implemented within the African Continental Free Trade Area (AfCFTA). It makes proposals that are financeable by design, highlighting innovative capital market instruments and blended structures that will crowd in patient capital at scale. Lastly, the report is replete with case studies from within Africa and around the world, and specifies the institutional architecture required to turn strategy into execution.

We recommend the report to leaders, policymakers, captains of industry, academia, development partners and all African citizens who are passionate about prosperity for all Africans.

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Foreword

This decade represents a pivotal moment for Africa, given the declining official development assistance and the anti-globalisation sentiments reshaping trade, investment, and technology flows. These shifts carry risks, but they also create a rare opportunity for Africa to lead on its own priorities. The continent's minerals are strategic inputs to today's and tomorrow's industries. They must be used to serve African industrialisation first, support regional value chains, and strengthen the continent's resilience in an increasingly uncertain world.

I am pleased to see the increasing attention this subject now receives from global leaders, industry, researchers, and citizens, although I must admit I have been surprised by the significant prominence that the topic of Africa's critical minerals has gained internationally this year. The Oxford Global Think Tank welcomes this attention and the momentum it generates, reflecting a growing understanding that prosperity will result from developing competitive firms, reliable infrastructure, and trusted institutions that transform resources into high-value products within Africa.

Our contribution is to broaden the perspective and elevate focus on execution. Much recent work concentrates narrowly on critical minerals or on a single stage of the value chain. This report adopts a wider approach, viewing all African minerals as a catalyst for mineral-driven industrialisation on the continent. It offers specific recommendations for connecting mines to midstream hubs and downstream manufacturing through corridor-based infrastructure, clean and dependable power, metrology, and certification. It also advocates rules to facilitate the swift movement of intermediate goods, services, and data across Africa's borders. Furthermore, it clarifies roles for national governments, regional economic communities, AfCFTA institutions, development finance, and the private sector, ensuring that responsibility for implementation remains clear and focused. The report is pragmatic. It proposes financeable structures that attract patient capital, from climate-aligned instruments for low-carbon processing to ring-fenced bonds for industrial parks backed by product offtake. It demonstrates how to regain pricing power through standards, transparency, and market platforms that improve price discovery, strengthen the integrity of contracts, and eliminate opaque transactions. It advances ideas that can only be realised through partnership, such as building African multinational champions in oil and gas value chains, strategic minerals, advanced materials, and shipping and logistics. These serve as vehicles for scale, technology, and disciplined governance. They also signal confidence that, with proper reform implementation, Africa can compete globally on quality, cost, and reliability.

Uniquely, the report links this industrial ambition to a framework for accountability, calling on leaders to show courage and conviction to take on this crucial and ambitious undertaking. Reforming Africa's minerals sector is vital for employment, fiscal stability, productivity, social harmony, and national security. If we lead with transparency and act with discipline, Africa will become the trusted and respected partner we all hope to see on the global stage. I commend this report to leaders, policymakers, investors, and citizens who share a clear belief: a resource-rich continent can and must create prosperity at home for all her people.

Arunma Oteh
Chairperson, Oxford Global Think Tank

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Executive Summary

Africa stands at a decisive inflection point. The continent holds a commanding position in the most valuable geology of the twenty-first century, yet only captures a marginal share of the wealth created in global mineral value chains. Decades of this status quo have led to the paradox of poverty amid plenty. This report highlights a central concern: Africa possesses substantial reserves and significant mine output of strategic minerals, but it accounts for a small fraction of global refining and an even smaller share in advanced materials and finished goods.

Nowhere is this more visible than in base and transition minerals. Africa possesses more than half of the known cobalt reserves and produces well over two-thirds of the mined cobalt; yet, less than five percent of cobalt chemical refining takes place on the continent. Similarly, the continent has abundant resources of manganese, graphite, chromite, bauxite, and iron ore, including the world's largest untapped high-grade iron ore deposit at Simandou, Guinea; however, its refining and manufacturing base remains limited. At the same time, Africa spends tens of billions of dollars each year importing refined products and industrial inputs, such as steel and petroleum, as well as fertilisers, even as it exports the raw materials that underpin those very supply chains. This pattern depresses fiscal resilience, keeps know-how offshore, and perpetuates a prosperity gap that persists through commodity booms and busts.

The stakes could not be more stark or urgent. In 2024, Africa produced approximately 28 million tonnes of crude steel, accounting for roughly 1.5 percent of global output, while importing a significant share of its requirements at a high foreign exchange cost. Countries with large upstream endowments still see value leakage in midstream processing.

In the Democratic Republic of Congo, the world's dominant cobalt producer, most of the output is exported as hydroxide and is priced at a discount to the metal, with attractive margins realised in foreign refineries that convert intermediates into battery-grade sulphates and downstream precursors. Guinea ships raw bauxite in very large volumes, while alumina and aluminium margins are likewise captured elsewhere. Mozambique exports graphite concentrates, only for anode material production to be conducted offshore. These examples, repeated across multiple commodities and countries, reflect a structural discount imposed by inadequate midstream capacity, high energy and logistics costs in producer countries, and fragmented policy regimes.

The global context heightens both risk and opportunity. The energy transition is reconfiguring demand toward battery materials, low-carbon steels, catalysts, and electronics inputs. European and North American governments, as well as multinationals, are actively seeking to diversify their supply chains for resilience and strategic autonomy. Concurrently, aid budgets are shrinking in several traditional partner countries that are becoming increasingly inward-facing, which narrows fiscal space for concessional support but also sharpens incentives for Africa to mobilise domestic capabilities and capital to finance sustainable value addition.

The window is open for a deliberate shift from extraction to genuine industrialisation, anchored in credible institutions, competitiveness, regional integration under the AfCFTA, and bankable projects that sequence upstream, midstream, and downstream steps.

From Diagnosis to Design

Barriers to value addition cohere into four interlocking constraints. First, regulatory weakness and institutional fragmentation undermine credible, long-horizon commitments. Different agencies often handle licensing, power, customs, taxation, and environmental regulation with overlapping mandates, opaque procedures, and limited technical expertise, which raises risk premiums and deters investment. Second, policy incoherence and instability erode predictability. Abrupt export bans, poorly timed fiscal shifts, and discretionary exemptions send mixed signals that disrupt production, leave inventories stranded, and heighten sovereign risk.

Tanzania's 2017 concentrates ban illustrates the costs of sudden measures that are not paired with enabling infrastructure, financing, and certification. Third, structural deficits in energy and logistics infrastructure inflate delivered costs for smelters, refineries, and chemical plants. Industrial power is often expensive and unreliable compared to competitors, while bulk rail and port capacity are constrained. Fourth, political economy dynamics of rent extraction and elite capture lock in a primary commodity model. Incumbent interests that profit from raw exports resist reforms that would diffuse rents through larger, more transparent industrial ecosystems.

Ajaokuta Steel in Nigeria exemplifies how governance failures can hinder the transformational potential of important national assets. Conceived as an integrated BF-BOF complex of continental significance, the plant reached near physical completion in the 1990s but never produced a tonne of steel. Two decades of opaque concessions, arbitration, split control between ore supply and steelmaking, and delayed rail links have converted capital expenditure into a stranded asset, while the country has continued to import iron and steel products at scale. The lesson is unambiguous: downstream capacity cannot be conjured by decree or headline projects. It requires disciplined governance, integrated supply chains, bankable power and logistics, performance-linked contracts, and transparent finance.

The chapter on macroeconomic frameworks outlines a toolkit to stabilise budgets, align incentives, and save for the future, while enabling investment in processing. It recommends credible fiscal rules with independent parameters, modelled on Chile's structural balance framework that delinks expenditure from volatile commodity prices and anchors multi-year budgeting. Royalty and tax regimes should be progressive, transparent, and designed to reduce incentives for transfer mispricing while preserving investment. Importantly, well-governed sovereign wealth funds with clear savings and stabilisation mandates, independent oversight, and regular public reporting can convert cyclical revenues into intergenerational assets. Public investment management and fiscal risk disclosure then translate savings into reliable infrastructure for beneficiation corridors, power, and water that sustainable and inclusive value addition requires.

A Continental Strategy for Industrialisation

National efforts alone are unlikely to deliver economies of scale. The report, therefore, advances a continental architecture that links mines, processing hubs, and markets across the continent. The 1.3 billion people-strong AfCFTA is the backbone capable of turning scale from aspiration into reality. It creates a single rules-based market for intermediate and finished goods, services, and data, enabling cross-border specialisation along corridors. Removing non-tariff barriers, harmonising technical standards for mineral grades, health and safety, and environmental performance, and operationalising continental payments through the Pan-African Payment and Settlement System (PAPSS) together reduce unit costs and compress delivery times. Regional Economic Communities, under this regime, become laboratories for aligned mining codes, model fiscal clauses, and corridor governance that can be scaled under AfCFTA annexes.

To drive coherence and continuity, the report proposes the establishment of an AU Commissioner for Commodities and Industrialisation. The Commissioner's mandate is to align policy across mining, energy, transport, trade, and finance, to coordinate Africa's mineral-driven industrialisation agenda. This role would embed the Africa Mining Vision in strategic and tactical decisions, providing the political centre of gravity required to turn the strategy into financed assets.

Pricing power must also shift. This report outlines how a Pan African Commodities Exchange could enhance transparency and pricing, as well as improve royalty assessment, by shifting most raw minerals transactions to an exchange platform that standardises grades and contracts. Drawing lessons from Mongolia's exchange experiment, the mechanism would reduce opaque discounts, crowd in competition among buyers, and provide public reference prices that support tax integrity and investment planning. The exchange would complement, not replace, long-term offtake contracts, and would require liquidity, quality assurance, harmonised rules, and robust logistics to be credible.

Financing and scaling true industrialisation require new corporate vehicles. The report calls for the creation of African multinational champions in three domains: oil and gas value chains, mining and strategic mineral processing, and shipping and logistics. These PPP-led groups would pool sovereign and private cargoes and offtake, list simultaneously on multiple African exchanges with a supplementary international line, and adopt independent governance with clear dividend and free float policies. Afreximbank and the AfDB would act as anchor financiers and guarantors, while PAPSS would reduce settlement frictions, and an Africa Currency Marketplace would enhance price discovery for cross-border foreign exchange needs.

The capital markets chapter introduces additional instruments tailored to support beneficiation and industrial development. First, resource-backed SDRs channelled as hybrid capital to the AfDB and Afreximbank could expand long-term lending without adding to sovereign debt stocks. Second, Diaspora Beneficiation Bonds, ring-fenced and overseen by a trustee, would mobilise patriotic savings into specific beneficiation projects, with options to convert part of the holdings into IPO shares of the new Africa-owned multinational champions. Third, certified green and transition bonds tied to low-carbon mineral processing would tap climate pools while signalling high environmental stewardship standards. Finally, regional sovereign wealth and stabilisation funds could pool a share of mineral revenues to invest directly in cross-border processing and corridor assets under professional governance.

Implementation Pathway and Quick Wins

The report deliberately complements long-term reforms with immediate actions that can change incentives and crowd in private investment within the short to medium term. Five quick win packages are prioritised. First, a new deal for artisanal and small-scale mining built on mobile first registration, digital wallets, geological extension services, safe processing parks, and a responsible buyer offtake window.

These steps formalise millions of smallholder miners, enhance safety and incomes, improve traceability, and create a pipeline of feedstock for domestic processors. Second, pilot Special Beneficiation Zones (SBZs) in each sub-region that offer plug-and-play land, bankable green power, pre-cleared permits, ISO compliant testing and metrology labs, and transparent procurement pipelines. Such Zones concentrate administrative capacity, compress timelines, and prove bankability. Third, fast-tracking an AfCFTA protocol on mining and mutual recognition of standards so that intermediate products cross borders at speed, supported by PAPSS for payments and electronic documentation. Fourth, a continental accelerator for supplier SMEs and mining tech that provides access to industrial testbeds, fast-track procurement, and blended finance tied to delivery. Fifth, an enforcement sprint to activate dormant provisions already on the statute books, backed by public dashboards that reveal performance, sanctions for non-compliance, and rapid correction.

A chapter is dedicated to sustainability as integral to competitiveness rather than an add-on. ESG compliance has become a market entry requirement through standards such as International Sustainability Standards Board (ISSB), Extractive Industries Transparency Initiative (EITI), Organisation for Economic Co-operation and Development (OECD) due diligence, European Union Carbon Border Adjustment Mechanism (EU CBAM), and the EU Battery Regulation.

Africa must move quickly to formalise millions of smallholder miners, enhance safety and incomes, improve traceability, and create a pipeline of feedstock for domestic processors.

Africa’s industrialisation should be anchored in clean power by connecting solar, wind, hydro, and geothermal resources to processing nodes through regional grids and park-based power purchase agreements. Hydrogen offers a pathway for low-carbon direct-reduced iron using electric arc furnaces, where renewable energy clusters can be secured, enabling African producers to supply markets that recognise low-carbon attributes. African recycling and circular economy strategies for e-waste and end-of-life batteries can foster domestic competence in the recovery of strategic materials and reduce the intensity of primary extraction.

While China, India, and the advanced countries usually boast of thousands of engineers per one million people, Africa has fewer than one hundred. Leadership, people, and knowledge are identified as the ultimate binding constraints to achieving beneficiation and industrialisation objectives. The report proposes programmes such as structured diaspora mentorship platforms, targeted secondments to operating smelters and refineries, visiting professorships in African engineering schools, and problem-solving clinics that connect plant dashboards to expert troubleshooters.

Regional centres of excellence and a pan African mining technology entity can finance cross-border research on digital twins, low-carbon comminution, and bioleaching, while shared pilot plants and reference datasets accelerate learning. Gender inclusion is treated as an economic imperative with concrete measures for safe facilities, financial access for women-led supplier SMEs, multi-year apprenticeship tracks in control rooms and laboratories, and transparent publication of gender disaggregated performance metrics.

Delivery depends on measurement and trust. The monitoring and evaluation chapter sets out indicators, publication standards, and institutional roles so that citizens, parliaments, investors, and operators can check performance against promises. Data standards, online publication of contracts, payments, and fund reports, and independent fiscal councils or similar bodies should establish credible feedback loops that enable course correction. Where risks arise, from data quality and skills gaps to political resistance and cyber threats, the report offers practical mitigation tactics grounded in African realities and international good practice.

Sequencing is essential. The report, therefore, lays out a path that starts with information and credibility, then builds hubs, and only then pushes deeper into advanced materials. Begin with mobile registration in Artisanal and Small-Scale Mining, open contracting for beneficiation zones and corridors, and publish royalty and price dashboards. Use early results to anchor pilot SBZs tied to corridors with bankable green power and shared facilities. Push harmonisation under AfCFTA to lock in common rules. Expand financing with Special Drawing Rights hybrids and diaspora bonds. As hubs reach scale, move into battery precursors, alloying, and advanced materials, where comparative advantage and offtake are credible. At each step, publish results promptly, correct quickly, and maintain the incentive rules based.

The core message is that Africa can drive mineral-led industrialisation through courageous leadership, coherent policies, and continental integration. The continent possesses all it takes to convert its enviable geological endowment into sustainable, intergenerational prosperity. African leaders are called to cease viewing industrialisation as a slogan, but rather as a practical, bankable route to jobs, fiscal depth, technological advancement, and prosperity for all citizens. The recommendations in this report give leaders, policymakers, investors, and citizens a platform to move decisively from analysis to execution over the short to medium term, and to sustain progress for decades to come.

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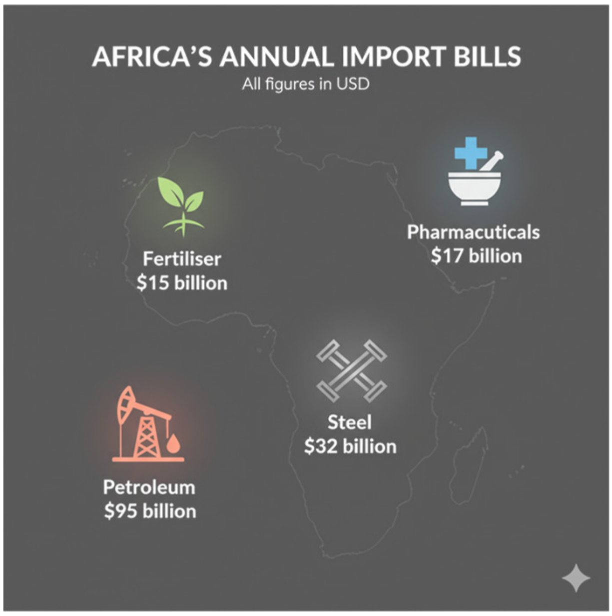
01 INTRODUCTION

1. Introduction

1.1 The Context

There is intense competition ongoing to secure crucial minerals supply in which Africa is too often treated as a raw geological terrain to be traversed at speed. As a case in point, the Lobito Corridor initiative, publicised for its ability to move minerals from interior deposits to Atlantic export points in hours rather than weeks[1], reflects this mindset oriented to extraction and outbound logistics. Similarly, the European Union has launched mineral partnerships under the Global Gateway initiative and the Critical Raw Materials Act[2] with the Democratic Republic of the Congo, Namibia, Rwanda, and Zambia, again focusing on access and security of raw materials supply. Venture-backed firms, such as KoBold Metals, are expanding exploration rights in the Democratic Republic of Congo's Manono deposit with similar aims. Without an African strategy anchored in ownership, market power, and an industrialisation mindset, the new rush will replicate the same result as earlier commodity booms.

Figure 1: Africa's average annual import bill



Sources: UNCTAD, 2024; Dangote Group, 2025; Afreximbank, 2023

Take steel as an example. In the modern world, almost no one goes a day without interacting with steel, termed "the world's most important engineering and construction material[3]". It is in the pots and pans in our kitchens, the chassis of our cars and buses, the girders of our bridges, and the beams that give form to the massive public infrastructure around us. It is the backbone of modern industry and the bedrock of industrialisation itself, as without continuous, large-scale steel production, the factories, cities, and transport networks that define modern civilisation cannot be maintained or expanded.

Yet, in 2024, Africa accounted for only 1.5 percent of global crude steel output, or roughly 28 million tonnes out of a world total of 1.885 billion tonnes – about 55 percent of which was produced by Egypt and South Africa. That is significantly less than what Brazil alone produced that year, and less than three percent of the tonnage churned out by the world's dominant producer, China. Africa reportedly imports about 60 percent of its steel needs, implying tens of billions of dollars are spent annually importing steel into the continent, with the burden especially heavy during price surges. South Africa, which already produces most of its steel requirements, spent $1.7 billion on steel imports in 2024[4]. These outflows erode foreign exchange reserves, suppress local manufacturing, and weaken resilience to shocks.

Meanwhile, Africa sits atop large iron ore deposits – the essential mineral for steelmaking – in countries such as Guinea, South Africa, Mauritania, Nigeria, and several others. Indeed, Simandou in Guinea is the world's largest untapped high-grade iron ore deposit[5]. Sparse primary steelmaking capacity, limited rolling facilities, and unreliable power keep output low and costs high.

Unsurprisingly, steel is not Africa's only dependency. Years of underinvestment in refining capacity mean that several African countries export crude oil and re-import refined petroleum products, such as petrol, diesel, and aviation fuel, at a significantly higher cost, amounting to as much as $90 billion annually, according to some estimates[6]. As a result, every bout of global oil price volatility squeezes budgets and drains reserves. Fertilisers tell a similar story. Natural gas and phosphate rock are readily available across the continent; however, continental production of nitrogen, phosphate, and potash products falls significantly short of demand. Import reliance increases costs for farmers and weakens food security when supply chains become more restrictive.

Africa's story with natural resources, especially minerals, is strikingly similar across the board. Although the continent possesses vast reserves of materials such as bauxite, cobalt, columbite, copper, diamonds, graphite, gold, lithium, platinum, rare earths, and tin, it still struggles to secure a meaningful place in the upper reaches of global value chains. This poor record in terms of value addition to its natural resources has seen Africa miss out on several cycles of oil booms, precious metal rushes, and other commodities upswings.

As the world transitions into the Fourth Industrial Revolution[7] – characterised by digitalisation, electrification, renewable energy infrastructure, and advanced manufacturing – the mineral stakes are changing. Africa's role in supplying the industrial inputs for this transition is undoubtedly even greater than ever before.

The continent's share of key minerals, which are critical to batteries, wind turbines, electric vehicles, and other clean-tech systems, will not only underwrite traditional steel-based industrialisation but could also become a cornerstone of the next wave of global technological transformation. Leaders and policymakers must recognise the significance of the moment and take steps to ensure that Africa does not miss this opportunity: utilising the continent's mineral wealth to accelerate sustainable development, create intergenerational wealth, and ultimately achieve full sovereignty. The need to act could not be more urgent.

First, the global order is changing as countries in the Global North are increasingly turning inward, scaling back on foreign assistance and development aid in favour of domestic priorities. In the UK, for example, the aid budget has already fallen to 0.5 percent of gross national income and is slated to drop further to 0.3 percent of Gross National Income (GNI) by 2027/28 – its lowest level in 30 years[8]. The UK Foreign, Commonwealth & Development Office budget shrank from £9.3 billion in 2024/25 to £6.19 billion in 2027/28, representing a £3 billion cut.

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The European Union has also trimmed its development spending: the Neighbourhood, Development and International Cooperation Instrument will see a €2 billion reduction between 2025 and 2027, and a broader 35 percent cut to EU development aid is under negotiation for 2028–2034[9]. In early 2025, the U.S. administration initiated a sweeping re-evaluation of its foreign assistance programmes, a move that signalled a potential dismantling or, at the very least, a significant restructuring of aid agencies like the United States Agency for International Development (USAID). This will be seismic, as the U.S. is estimated to provide approximately 40 percent of global humanitarian aid[10].

Critics of this policy shift warn that reducing foreign assistance now risks undermining long-term international development, global health, climate resilience, and even the West's strategic influence abroad, potentially creating future burdens that outweigh short-term savings. However, many of these decisions are motivated by very real domestic pressures: voters and policymakers are demanding stronger responses to economic instability, migration, public health crises, inflation, and geopolitical uncertainties. Africa can leverage its vast wealth of natural resources to take care of its own people, become independent, and eventually be in a position to provide aid to other regions of the world.

Second, the world is increasingly desperate to diversify global supply chains – for major products such as green energy technologies, vehicles, semiconductors, and robotics – away from China and Asia. Repeated disruptions during the COVID-19 pandemic highlighted the risks of concentrating supply chains in a single region, and tensions between China and the West have prompted an urgent reassessment of sourcing strategies.

Africa is uniquely positioned to become an attractive alternative. The continent offers lower labour costs, abundant natural resources, enviable time zones, proximity to major Western markets, and other comparative advantages for localised manufacturing. By investing in infrastructure, refining, and manufacturing capacity, African nations can provide secure, resilient production hubs for clean technology, pharmaceuticals, and other essential goods, filling a critical gap in the reshaped global supply landscape.

Third, and perhaps most urgent, the window is fast closing for Africa to determine whether its youth bulge becomes a demographic dividend or a time bomb. Failing to act now – by investing heavily in education, health, and industrialisation – means the swelling cohort of young people will inevitably slide into unemployment, under-employment, social decay, and instability, rather than driving productivity and prosperity. The young generation already entering the labour market represents a demographic opportunity, but only if policies and institutions are strengthened quickly to translate youthful energy into meaningful economic and social outcomes. This window is further narrowed by the rapid rate of technological change that threatens to develop substitutes capable of phasing out these very minerals that should underpin Africa's rapid industrialisation.

It is for all these reasons that the Oxford Global Think Tank (OGTT) is pleased to present this report, which we believe will amplify the current much-needed conversation on Africa's mineral resources. The report explores practical strategies for industrialisation – showcasing African success stories that can be scaled up, alongside international best practices – and offering concrete policy recommendations and financing frameworks for consideration. The timing could not be more critical: with global economic shifts, declining foreign aid, and rapidly evolving technological demand, Africa has a unique chance to convert its resource wealth into sustainable development, industrial power, and genuine sovereignty.

1.2 Africa's Strategic Minerals

Africa holds decisive positions in minerals that power the ongoing energy transition and productivity improvements of heavy industry. The region dominates cobalt mining, commands large shares of manganese and natural graphite resources, and holds significant reserves of iron ore and bauxite. Lithium resources are rising with new discoveries in countries such as Zimbabwe and Namibia, with further demand growth expected. Processing, however, remains concentrated outside the continent.

Table 1: Africa's share of major minerals

Mineral	Africa's share of reserves	Africa's share of mine output	Africa's share of refining
Platinum group metals	> 90%	~ 70%	~ 60%
Phosphate rock	> 70%	~ 35%	~ 15%
Manganese	> 60%	~ 75%	~ 1%
Cobalt	~ 55%	> 75%	< 5%
Chromite	> 50%	~ 45%	< 2%
Bauxite	> 30%	~ 25%	< 1%
Zircon	~ 30%	~ 25%	< 5%
Titanium minerals	~ 25%	~ 20%	~ 5%
Natural graphite	~ 20%	~ 15%	< 1%
Uranium	~ 18%	~ 15%	< 1%
Vanadium	~ 15%	~ 12%	< 1%
Fluorspar	~ 15%	~ 10%	~ 5%
Iron ore	~ 10%	~ 7%	~ 1%
Copper	~ 6%	~ 10%	~ 5%
Lithium	~ 5%	~ 6%	< 1%
Rare earth elements	~ 5%	~ 4%	< 1%
Soda ash	~ 5%	~ 5%	~ 5%
Nickel	~ 5%	~ 7%	~ 2%
Potash	~ 2%	~ 2%	~ 2%

Sources: Atlantic Council, 2024; U.S. Geological Survey, 2025; International Energy Agency, 2024; United Nations Economic Commission for Africa, 2024; UNCTAD / UNECA, 2024; ZeroCarbon Analytics, 2024

Case study 1: DRC's 2025 Temporary Cobalt Export Ban

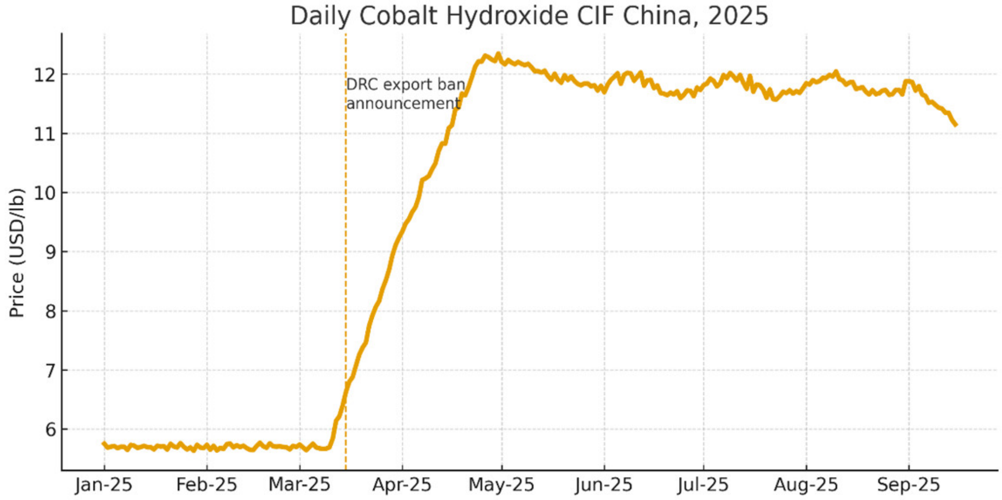
When the Democratic Republic of Congo announced an export ban on cobalt intermediates in mid-March 2025, the market repriced supply risk almost overnight. Cobalt hydroxide, which had traded near $5.60–$5.80 per pound through January and February, jumped as traders reassessed the availability of feedstock for Chinese refiners and the timing of alternative flows from Indonesia and elsewhere. Physical spot tightness was amplified by precautionary restocking along the battery supply chain, especially among cathode producers and trading houses with exposure to Chinese gigafactories.

Through late March and April, prices surged in a stepwise fashion as the policy signal translated into real disruptions to shipment schedules and blending strategies. The market printed a short-term high near $12 per pound by late April, reflecting higher premiums for prompt parcels and a widening spread between hydroxide payables and metal. Financing costs and freight bottlenecks added to the squeeze, while some buyers accepted higher payables to secure continuity of supply.

From May into the summer, prices eased into a volatile plateau as Chinese refiners re-optimised feed, some DRC material was rerouted under exemptions, and non-DRC supply incrementally filled the gap. By early September, prices were still well above pre-ban levels, but marginally softer as inventories normalised and forward visibility improved. The pattern highlights how concentrated upstream policy shocks can rapidly transmit through midstream processing to downstream battery manufacturing, with the most pronounced effects occurring within the first six to eight weeks after the announcement and a slower stabilisation thereafter.

Ahead of the 21 September 2025, export ban deadline, the DRC government announced that it was replacing the cobalt export ban with quotas from 16 October 2025. Miners will be allowed to ship up to 18,125 tonnes of cobalt for the rest of 2025, with annual caps of 96,600 tonnes in 2026 and 2027, according to the DRC's Authority for the Regulation and Control of Strategic Mineral Substances' Markets.

Figure 2: Impact of DRC Cobalt export ban



Sources: Benchmark Mineral Intelligence, 2025; International Energy Agency, 2023; S&P Global Commodity Insights, 2025; United States Geological Survey, 2024; World Bank, 2023.

1.3 Stuck in Extraction

Too little of Africa's geological wealth has translated into broad-based prosperity. As African countries export high volumes of raw ores and concentrates, their manufacturing bases remain shallow, their export baskets are persistently commodity-heavy, and fiscal buffers – if they exist at all – get thinner. The case of the Democratic Republic of the Congo perfectly illustrates this point. Despite being the world's leading source of mined cobalt, accounting for about three-quarters of global output in 2024[11], its entire national income was measured at just $70.75 billion; GDP per capita stood at roughly $647[12], far below the world average of about $13,673.

By contrast, Apple, whose iPhones, laptops, and accessories rely on cobalt-bearing lithium-ion cells, booked $391.0 billion in net sales in fiscal 2024[13] and carried a market capitalisation of roughly $3.56 trillion in September 2025[14], more than fifty times Congo's GDP. Similarly, Tesla reported $97.7 billion in revenue for 2024, with a market capitalisation of nearly $1.13 trillion[15].

Samsung Electronics reported KRW 300.9 trillion in 2024 revenue, equivalent to approximately $219 billion at current exchange rates, and had a market capitalisation of roughly $330 billion. Battery leaders in the EV supply chain also eclipse the producer country: the Chinese giant CATL posted approximately $50.3 billion in revenue for 2024, with a market capitalisation of nearly $210 billion, while BYD reported about $107.9 billion in revenue for 2024 and a market cap of roughly $133 billion. In short, the annual sales of each of these companies exceed the GDP of Congo, highlighting the stark and tangible nature of the prosperity gap.

Such instances are common. Guinea has become the world's leading bauxite exporter, shipping a record 48.6 million tonnes in the first quarter of 2025 and nearly 100 million tonnes in the first half, mainly as raw ore to China. Meanwhile, its GDP per capita was around $1,717 in 2024.

Mozambique exports natural graphite concentrate from Balama mines to international markets rather than processing it into anode materials on a large scale, with a GDP per capita of about $647 in 2024. South Africa, despite having the world’s largest chrome ore reserves, has seen its ore exports increase, while domestic ferrochrome production faces structural challenges. This demonstrates that, even for a relatively more advanced African economy, midstream value capture can be lost abroad when energy and policy conditions are weak.

Box 1: The Mineral Wealth Paradox

Despite holding approximately 30 percent of the world's mineral reserves[16], including critical inputs for the global energy transition, many African nations remain entrenched in poverty, underdevelopment, and institutional fragility. This phenomenon, often referred to as the "resource curse," occurs when resource-rich countries experience slower economic growth and weaker governance compared to their less resource-endowed counterparts. Factors contributing to this include revenue volatility, overreliance on extractive industries, and the erosion of institutional quality.

Environmental degradation and public health crises are also prevalent in regions rich in minerals. Research indicates that communities near mining operations are exposed to contaminated water sources, inadequate sanitation, and air pollution[17]. These conditions are exacerbated by in-migration, which strains existing infrastructure, and by the activities of extractive companies that may prioritise profit over environmental stewardship. Furthermore, the presence of valuable minerals has been linked to increased conflict, as various actors vie for control over these resources, leading to instability and further hindering development efforts.

1.4 The High Cost of the Status Quo

The dominant model, exporting raw or minimally processed minerals, keeps producers nations trapped in a low-value export position. Prices are volatile, terms of trade are unfavourable, and domestic firms face limited learning opportunities. Fiscal revenues swing with global cycles, which weakens public investment planning and resilience. Concentration in global refining amplifies these risks: a few countries control the majority of midstream processing capacity, which limits Africa's leverage on pricing and standards, and pushes jobs offshore. The result is a structural discount on Africa's geology and a persistent dependence on foreign midstream capacity that sets quality specifications, imposes "payables" formulas, and extracts margin in chemical refining and alloying stages outside the continent[18].

In the Congolese example, most output leaves as cobalt hydroxide, an intermediate that is priced as a percentage of the cobalt metal reference. In mid-2025, Fastmarkets reported hydroxide "payables" at 77 to 80 percent of the standard-grade metal price[19]. This means buyers price cobalt hydroxide as a discount to the cobalt metal benchmark, based solely on the contained cobalt. That automatic discount shifts value to offshore refiners that convert hydroxide into cobalt sulphate for batteries, a step dominated by China. The DRC supplies the bulk of mined cobalt, while China controls the majority of chemical refining capacity, which gives it price-setting power.

To illustrate: assuming cobalt metal is $30,000 per tonne, hydroxide payables are 80 percent, and the hydroxide grade is 25 percent cobalt, the gross invoice value per tonne of hydroxide is $0.25 \times 0.80 \times \$30,000 = \$6,000$. The net realised amount can be lower after deductions. The additional value created when hydroxide is converted into cobalt sulphate, then into precursors and cathode materials, accrues mainly to the refiner and downstream manufacturers outside the DRC. This implies that if Congo were to sustain annual production volumes around 200,000 tonnes, it could earn no more than $1.2 billion in the multi-trillion-dollar global markets for electric vehicles, smartphones, laptops, and other consumer electronics.

In South Africa, chrome ore exporters receive low hundreds of dollars per tonne. By contrast, high-carbon ferrochrome in Europe is priced around $1.04 to $1.52 per pound of contained chromium, equivalent to well over $1,000 per tonne of alloy. South Africa's chronic power shortages have eroded domestic smelting, pushed up ore shipments to China, and shifted alloy margins offshore, a classic midstream leakage problem.

Meanwhile, regarding knowledge transfer, the Balama mines in Mozambique export concentrate, while Syrah's downstream anode material facility operates in Louisiana, USA[20]. Most Mozambican contractors, therefore, provide civil works, transportation, and site services rather than high-value purification and coating, which are knowledge-intensive steps with steep learning curves. Similarly, UMS Africa Group is a Guinean shareholder in the SMB (Société Minière de Boke) consortium[21], with core activities in trucking, overland haulage, and logistics coordination. While these segments are important for jobs and local content, they sit far from alumina process engineering or aluminium smelting[22], which limits capability accumulation in higher-complexity steps.

These, among dozens of other examples across the continent, demonstrate how pricing formulas, benchmarking practices, and infrastructure bottlenecks steadily push margins and expertise into foreign midstream hubs.

02

THE STRATEGIC IMPERATIVE: COMMODITY-BASED INDUSTRIALISATION AS THE CORNERSTONE OF AFRICAN PROSPERITY

2. The Strategic Imperative: Commodity-Based Industrialisation as the Cornerstone of African Prosperity

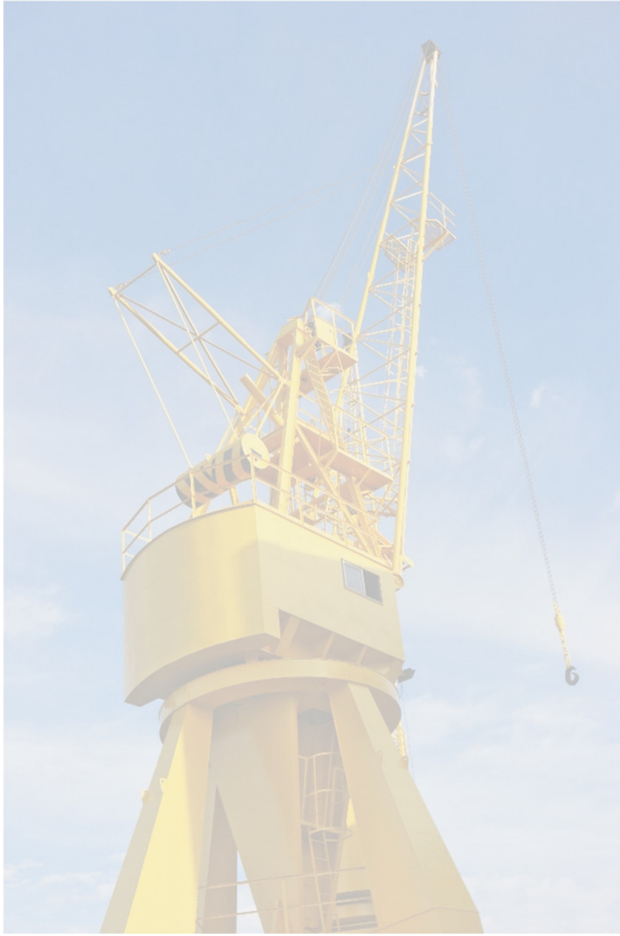
Africa's path to structural transformation depends on its ability to convert the continent's abundant mineral resources into engines of diversified industrial growth. This chapter explores the strategic logic of commodity-based industrialisation and demonstrates how moving beyond raw material exports can create jobs, fiscal stability, and technological learning across the continent. It assesses the economic multipliers of beneficiation, illustrates how different levels of value addition can be structured into regional production systems, and distils lessons from successful cases in Africa and abroad. Taken together, these insights show that resource-based industrialisation, when anchored in deliberate policy, can serve as the cornerstone of African prosperity.

The discussion unfolds in four parts. It begins by tracing how Africa's historical role as a supplier of unprocessed commodities has constrained its development trajectory, reinforcing dependence and vulnerability to global price cycles. It then outlines the tangible benefits of beneficiation in terms of employment, fiscal revenue, and linkages. The chapter examines the spectrum of opportunities available across mineral value chains and presents lessons from successful cases, such as South Africa's platinum group metals, Botswana's diamond cluster, and Australia's diversified processing hubs. The final section synthesises these experiences to highlight the institutional and policy foundations required to translate Africa's resource endowment into sustained industrial competitiveness.

Beneficiation, defined as the sequence of activities that increases the economic value of minerals after extraction through processing and manufacturing[23], has become a watered-down concept. Too often, companies and countries pay lip service to it, offering token gestures to local communities while preserving a model that treats Africa chiefly as an extraction ground for direct shipment of raw materials.

The decades-long status quo, in which multinational companies, none of which are African, organise and control African resources, has imposed heavy economic and social costs. It entrenches dependence, drains pricing power and skills, and leaves Africa exposed to commodity cycles without the buffers that come from domestic manufacturing depth. Major economies behave differently when they discover oil, gas, or critical minerals. In the United States, the European Union, and China, resources are treated as strategic inputs for their own industries first, with any surplus exported to partners chosen for geopolitical alignment – underscoring the link between resources, global competitiveness, and national security. For these global powers, the result is better-paying employment for their citizens, a deeper competitive advantage, and a durable fiscal capacity, as value is captured by domestic firms along the entire chain, from geology to finished goods.

The current geopolitical environment strengthens Africa's case for resource sovereignty and commodity-based industrialisation. Industrial policy has returned to the centre of strategy in the United States and Europe, not only in China, as government procurement underpins entire industrial ecosystems. The message for Africa is not to copy institutional forms, but to recognise that capable states de-risk priority industries and crowd in private investment. Many countries became industrialised by using protection where needed, negotiating technology transfer, and leveraging market size to attract manufacturing. China did this at scale over recent decades. India has applied similar tactics. The United States is deploying tariffs to accelerate the reshoring of manufacturing. Meanwhile, Africans own hundreds of millions of mobile phones, yet the continent manufactures almost no components despite hosting dominant quantities of the core minerals.



Commodity-based industrialisation is the corrective. It prioritises African factories and logistics platforms that use African resources to meet African demand first, then export surplus on terms that reinforce development goals. Beneficiation remains part of the toolbox, but it is repositioned as one step within an integrated industrial path.

2.1 The Economic Multiplier: Tangible Gains of Value Addition

When new steps in a value chain are unlocked, new roles emerge for engineers, technicians, logistics providers, and service firms, among others. For the government, this creates broader and more stable tax bases as activity shifts from a few mine sites to networks of plants and suppliers. Firms, on the other hand, learn by doing, improve quality, and adopt standards that open higher-value export markets. These effects compound over time. Clusters form around processing hubs, followed by finance and testing services, and local companies transition from low-complexity tasks to specialised inputs. The result is more resilient growth, better terms of trade, and a stronger platform for manufacturing-led industrialisation.

Job creation

China's dominance in midstream and downstream clean-tech manufacturing has generated millions of jobs, but it also reveals where Africa can compete. Africa controls large shares of key minerals and offers significantly lower labour costs than China. China holds about 93 percent of global battery manufacturing employment and the largest shares in several clean energy manufacturing segments, including EVs and solar PV, with around 4.6 million solar jobs in 2023 alone[24].

Chinese manufacturing monthly average wages reached approximately $1,250 per year in 2024, whereas African benchmarks remain considerably lower; for example, Morocco's net minimum wage is around $330 per month in 2025, and Ethiopia's textile and garment median wages are approximately $55 per month for the period of 2024–2025[25]. In addition to the labour cost, policy tailwinds strengthen the case to reshore processing to Africa: the EU's Critical Raw Materials Act targets 40 percent of processing within the EU and caps dependence on any single third country at 65 percent[26], and the U.S. Inflation Reduction Act offers battery tax credits when critical minerals are extracted or processed in the U.S. or FTA partners[27]. Morocco is an FTA partner and is already attracting integrated battery investments, such as Gotion's planned gigafactory[28] and CNGR–Al Mada's precursor and recycling base[29]. At a continental level, the AfCFTA – a market of 1.3 billion people[30] – can support the scale of components and materials.

With its raw material endowments, cost advantages, and pro-diversification demand in the EU and the U.S., Africa must anchor midstream plants and attract a portion of these higher-value jobs to its industrial hubs.

Fiscal revenues

Processed exports command higher unit values. Domestic midstream and downstream activity broadens the tax base through corporate income tax, payroll taxes, VAT along supply chains, withholding on dividends, royalties, and state dividends where ownership applies. More stable value capture improves debt sustainability and buffers public investment. Sticking to the Morocco example on processed phosphates and fertilisers, OCP Group's downstream model feeds multiple fiscal channels.

In 2023, the group reported a profit before tax of MAD 16.4 billion (≈ approximately $1.9 billion) and recognised a corporate income tax expense of MAD 2.1 billion (≈ approximately $235 million). That is almost as much as the $270 million equivalent paid by the Dangote Group in 2024 corporate taxes in Nigeria, a national record.

Beyond taxes, the Moroccan state received MAD 9.2 billion (≈ approximately $1.0 billion) in net dividends for 2023, while VAT flows and phosphate exploitation fees are reflected in OCP's "State, VAT and other taxes" line items[31]. This is a textbook case of processed exports widening the fiscal base far beyond mine-gate royalties. In Zambia, some considerable copper smelting and refining now occur within its borders. With cathode production and ancillary processing onshore, fiscal receipts are generated through mineral royalties, corporate income tax, and VAT. First Quantum's 2023 tax transparency shows $98.7 million in taxes and $197.4 million in royalties paid to the Zambia Revenue Authority[32], including VAT offsets typical of processing supply chains, which expands the domestic tax net beyond mine royalties alone. The Zambia Extractive Industries Transparency Initiative (ZEITI) reporting confirms the centrality of these streams to the budget[33]. Tanzania's experience shows how tax design can steer value addition. In 2017, the government removed VAT refunds on "raw minerals," interpreted as exports not refined in-country. However, it re-introduced VAT refunds in 2020 to strike a better balance for exporters and encourage domestic processing[34].

Economic linkages

Smelting, refining, and advanced materials create dense webs of suppliers in energy, water, chemicals, transport, engineering services, testing, and maintenance. These linkages lower costs through proximity, foster learning-by-doing, and anchor capabilities that spill over into adjacent industries such as construction materials, machinery, and electronics. At the regional scale under the AfCFTA, specialised inputs, such as sulphuric acid for hydrometallurgy, calcined lime for smelting, caustic soda for alumina production, and anode and cathode precursors, can find customers across borders.

Additionally, several African examples demonstrate how processing draws in services and infrastructure. Morocco's Jorf Lasfar platform links imported sulphur and ammonia to sulphuric and phosphoric acid plants, fertiliser complexes, rail, laboratories, and heavy maintenance contractors[35]. Namibia's uranium belt around Erongo spurred desalinated water capacity and strengthened Walvis Bay logistics[36]. Zambia's copper smelting expanded local sulphuric acid supply for leaching, fertiliser producers, and metal cleaning, while engineering workshops and fabricators grew around the smelters[37]. Clusters in other parts of the world illustrate the same pattern.

Table 2: Fiscal channels from beneficiation

	Fiscal channel	Example country	Recent examples
1	Corporate income tax	Morocco (OCP)	CIT expense ≈ MAD 2.1bn in 2023
2	State dividends	Morocco (OCP)	Net dividends to state ≈ MAD 9.2bn in 2023
3	Royalties and overall take	Botswana (diamonds)	Government take targeting ~80%, De Beers indicates ~85% value returns to state
4	Mining tax weight	Namibia (diamonds)	About 55% of mining-sector tax revenue from diamonds
5	Taxes and royalties	Zambia (copper)	US$98.7m taxes and US$197.4m royalties paid in 2023
6	VAT policy signal	Tanzania (all minerals)	VAT refunds were removed in 2017, reintroduced in 2020 to balance incentives

Sources: OCP 2023 FS; IMF Botswana 2024; De Beers/official statements; NDTC Namibia 2023; First Quantum 2023 Tax Transparency; NRGI 2020; Reuters 2025

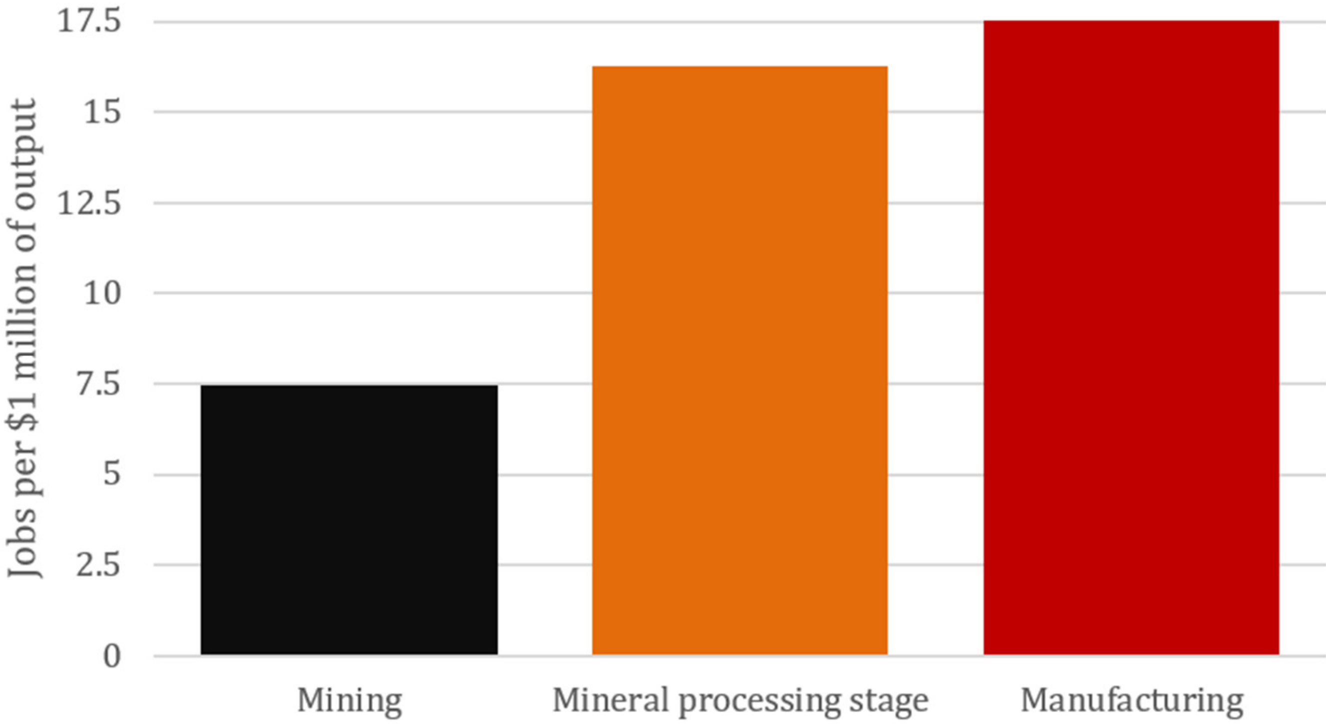
Finland's Kokkola Industrial Park[38] [39], for example, co-locates cobalt refining, chemical suppliers, storage, and port logistics, which shortens lead times for battery materials. Indonesia's nickel industrial parks integrate smelters with captive power, oxygen plants, lime kilns, and dedicated ports[40], which enables rapid learning across firms. Australia's Gladstone hub links alumina refineries to caustic soda supply, bauxite mines, and bulk export terminals, while Western Australia's lithium hydroxide plants are building supplier bases in reagents, utilities, and instrumentation[41].

Table 3: Linkages created by beneficiation: examples of inputs and supplier opportunities across Africa and globally

	Beneficiation step	Beneficiation step	Typical local supplier opportunities	African precedents	Global exempla
1	Coper electrorefining / SX-EW	Power, sulphuric acid, water, lime	Acid production, pump maintenance, lab testing, tankhouse consumables	Zambia copper belt acid plants and services	Chile SX-EW clusters in Antofagasta
2	Cobalt chemical refining	Acid, utilities, crystallisers, packaging	Reagents supply, filtration media, analytical services	DRC joint ventures with on-site impurity removal	Finland's Kokkola cobalt chemicals
3	Lithium hydroxide plant	Caustic soda, lime, power, water	Reagent blending, EPC services, automation and controls	Planned projects in Namibia and Zimbabwe	Western Australia Kwinana hydroxide
4	Graphite anode material	Acid, high-purity water, power, coating equipment	Purification services, coating, QA labs, packaging	Mozambique's Balama as upstream anchor	China's Heilongjiang and Shandong AAM bases
5	Ferrochrome smelter	Power, reductants, lime, refractories	Coke supply, refractory lining, crane services	South Africa's ferrochrome belt suppliers	India's Odisha smelter ecosystem
6	Alumina refinery	Bauxite, caustic soda, power, water	Caustic handling, residue management, instrumentation	Guinea projects under development	Australia's Gladstone alumina cluster

Every $1 million directed to manufacturing supports far more jobs than the same spend in mining alone. U.S. input–output estimates indicate roughly 18.3 jobs per $1 million in durable manufacturing and 14.7 in nondurables, compared with about 7.2 in mining, reflecting a minimum two-fold stronger backward and forward linkages in processing and fabrication. Africa-specific evidence from greenfield investment confirms the same ordering[42], with manufacturing consistently generating more jobs per million dollar invested than extractives, which reinforces the case for job growth through local beneficiation and industrial development.

Figure 3: Comparison of employment per $1 million invested Mining versus mineral processing versus manufacturing



Sources: UNCTAD, 2023; African Development Bank, 2024.

Note: Coefficients vary by country, year, and method. Bars use U.S. input–output multipliers for mining and manufacturing from EPI 2019. "Mineral processing" is proxied by the midpoint of durable and nondurable manufacturing. Africa-focused evidence in AfDB 2024 and UNCTAD 2023 supports the same ranking.

2.2 Pathways to Prosperity: Minerals and Levels of Value Addition

Value addition spans a ladder of activities. Early steps include ore sorting and concentration. Midstream activities comprise smelting, refining, and production of precursors, alloys, and active materials. Advanced stages include component manufacturing, from battery anodes and cathodes to steel long products and aluminium extrusions. Final goods include EV batteries, power electronics, construction materials, and high-tech manufacturing equipment, among others. Each rung demands higher quality standards, skills, energy reliability, and environmental controls; therefore, each delivers higher margins and stickier jobs. In North Africa, Egypt's power equipment and cable makers, led by Elsewedy Electric[43], demonstrate how metals-based intermediate goods can scale for regional markets, with sizable transformer and cable capacity that supports downstream electrification and transportation manufacturing.

In Central Africa, the DRC and Zambia, working with UNECA and partners, are developing a cross-border special economic zone focused on battery precursors and, over time, cells[44]. This builds directly on copper and cobalt reserves, and creates a pathway from ore to precursor cathode material and eventually to EV components. Gabon offers a parallel path in ferrous alloys: the Moanda Metallurgical Complex produces silicomanganese and electrolytic manganese metal, and the government has announced a 2029 ban on raw manganese ore exports to push more local processing[45]. Cameroon, through the $2 billion Minim-Martap mine[46], can complement these trends with high-grade bauxite and, if realised, alumina output that supplies an emerging regional aluminium chain.

Across in West Africa, Ghana can integrate its bauxite-to-aluminium ambition with an expanded role for Volta Aluminium Company Limited (VALCO) and new private rolling and extrusion investments, while also developing manganese upgrading and alloy potential as the country pursues a first domestic manganese processing plant[47]. Regional steelmakers, such as B5 Plus in Ghana, already supply long products and could upgrade into more sophisticated grades with reliable power and scrap logistics.

In East Africa, Tanzania can couple graphite and nickel resources with midstream processing. The Kabanga project includes a planned hydrometallurgical refinery in-country, which points to nickel sulphate and, later, cathode precursors.

Graphite projects at Mahenge and Nachu can supply high-grade concentrates and, with the right incentives, a pathway into anode-material processing[48]. Uganda's Sukulu complex shows how phosphate-based fertiliser and steel can co-locate around an integrated minerals platform[49]. Kenya's mineral sands at Kwale[50] illustrate an early-stage upgrading opportunity toward pigments and titanium metal if energy and scale conditions improve.

Over in Southern Africa, South Africa retains deep capabilities in ferroalloys, auto catalyst components, and automotive assembly, although power constraints have eroded parts of the ferrochrome base. A credible recovery plan would restore midstream strength and support advanced components, including battery pack assembly for regional Original Equipment Manufacturers (OEMs)[51]. Mozambique's Mozal smelter, near Maputo, is a proven midstream anchor that can feed extrusions and rolling mills in the region. Zimbabwe's new integrated $1.5 billion Manhize steelworks demonstrates how upstream ironmaking can seed a local long-products ecosystem. Madagascar's Ambatovy, which has created about 10,000 jobs[52], is a rare African example of mine-to-refinery nickel and cobalt, producing finished metal and fertiliser by-products, and shows what high-spec hydrometallurgy can deliver when logistics and power are solved. Namibia's raw materials and green hydrogen partnership with the EU targets local value addition in critical minerals and energy input for processing[53].

Table 4: Beneficiation rungs aligned to comparative advantage across Africa

Rung	Stage	Description	Requirements	Examples
Rung 1	Early steps (ore sorting and concentration)	Basic processing activities suitable for locations near the mine site	Proximity to the mine, modest power needs, rail to port integration	Manganese and iron ore concentration in West and Southern Africa
Rung 2	Midstream processing (smelting and alloys)	Intermediate value addition that requires more significant infrastructure	Reliable and stable power contracts, consistent process water supply, port access	Gabon's manganese alloys, Mozambique's aluminium smelting, Zambia's copper smelting
Rung 3	Advanced materials (refining and precursors)	Higher level processing that produces specialised materials for advanced industries	A skilled workforce, robust quality control systems, international certification	Morocco in batteries, DRC-Zambia SEZ for battery precursors, Madagascar refined nickel and cobalt
Rung 4	Final goods (integrated manufacturing)	The final stage of manufacturing that creates finished products for consumer or industrial markets	Fully integrated ecosystems with components, logistics and skills, plus scalable market access through agreements within the AfCFTA	Morocco's automotive cluster as a template for future EV era localisation

Sources: International Energy Agency, 2024; World Bank, 2023.

2.3 Lessons in Beneficiation

Countries that have moved beyond ore exports have done so through patient institution building, stable policies, and investment in science. Platinum-group metals (PGMs) are Africa's beneficiation outlier, being the only minerals for which Africa truly dominates the entire value chain. Africa, led by South Africa and Zimbabwe, built integrated PGM value chains from mine to refined metal over several decades. The core enablers were:

- ***Scale and ore quality in one district:*** The Bushveld Complex hosts the world's largest PGM endowment, enabling multi-mine throughput that justifies capital-intensive smelting, base-metal refining, and precious-metal refining in one geography. This clustering allows tolling and third-party feed that keep plants full and unit costs competitive. Implats' smelter and Base Metal Refinery[54], plus the Precious Metals Refinery at Springs, and Anglo American Platinum's Rustenburg Base Metal Refinery and precious-metal refining network, are long-standing anchors for regional concentrates and mattes.

- ***Policy pressure plus industry capability:*** South Africa's beneficiation strategy has, since 2011, singled out PGMs for deeper value addition, while Zimbabwe has used a 5 percent export tax on unbeneficiated platinum to push local smelting and base-metal refining investments[55]. These policy "nudges," coupled with existing metallurgical expertise, kept more processing steps in-region than for other critical minerals.

- ***Established end-use demand and technology partners:*** Decades of global autocatalyst demand supported steady refined output from southern Africa, with Johnson Matthey and other fabricators mapping demand needs to refined supply. Even with EV headwinds, hybrids and industrial uses have underpinned continuing deficits and sustained refining activity[56].

By contrast, Africa's low refining shares in cobalt, lithium and graphite reflect global concentration of midstream capacity in China, high energy and logistics costs, and fewer mature domestic offtake ecosystems. China processes roughly half to two-thirds of global lithium and cobalt and nearly 90 percent of rare earths, creating powerful scale economies and supplier networks that African projects struggle to match without very large, policy-backed hubs.

South Africa remains the system's hub, accounting for the largest share of global primary PGM supply, with integrated smelting and refining that also treat third-party material. The PGM chain directly supports large-scale employment and export earnings; government data show that more than 165,000 workers were employed in South African PGM operations in 2022[57], with plants and concentrators supplying domestic refineries. Energy and logistics constraints have hurt margins, but the processing base remains intact. On its part, Zimbabwe has expanded upstream and midstream capacity, including major smelter and base-metal refinery upgrades at Zimplats, with policy signals designed to localise more processing. These investments raise skills, procurement and fiscal take, and reduce reliance on exporting concentrates only[58].

Case study 2: Applying PGM lessons to other minerals

- **Build scale through hubs and tolling:** Co-locate mines with shared smelter/refinery hubs and allow toll treatment of third-party feed to reach bankable throughput, as done by Impala Refining Services and peers.
- **Use smart policy "carrots and sticks":** Couple beneficiation targets with pragmatic instruments such as limited export taxes on unprocessed material, duty-free import of plant equipment, and clear, time-bound milestones. Zimbabwe's platinum policy mix illustrates this approach.
- **Secure competitive utilities and logistics:** Refining is power- and reagent-intensive. Dedicated tariffs or industrial power solutions for strategic hubs, plus reliable rail and port access, are preconditions to move beyond concentrate.
- **Anchor offtake with global partners:** Long-term take-or-pay or processing agreements with established cathode, precursor, alloy or catalyst makers reduce market risk while skills partnerships transfer process know-how. Johnson Matthey's long-running market role around PGMs is instructive.
- **Sequence the chain:** Start with concentrate → matte → base-metal refinery before attempting full precious-metal or battery-chemical refining, aligning each step with credible offtakers and realistic capex. Mintek's process flow references and South Africa's strategy documents provide templates.
- **Plan for market transitions:** Hybrids have extended PGM demand, buying time for operational resets. Equivalent demand-side planning is needed for battery minerals, where Chinese midstream dominance sets the price and technology curve.

Africa's relative success in PGM beneficiation is the combined result of its geology, decades of metallurgical expertise, and targeted policies that have kept processing onshore. Replicating this for battery minerals, for example, will require deliberate hub-building, competitive energy, strong offtake partnerships, and sequenced policy that grows midstream scale rather than fragmenting it.

Two other mineral cases offer practical lessons for Africa, one from Botswana and the other from Australia.

Case study 3: Botswana, Polishing the Diamond Value Chain

Background: from exporter of rough stones to sales and midstream hub

Botswana built the world's most successful public–private diamond partnership through Debswana, a 50:50 joint venture between the Government of Botswana and De Beers. The country discovered Orapa in 1967 and brought Jwaneng into production in 1982. In 2011 the Government and De Beers agreed that rough-diamond aggregation and sight sales would move from London to Gaborone, and the first sights took place in November 2013. This shift anchored marketing, valuation and a share of cutting and polishing at home, rather than abroad.

The policy mix and institutions

Botswana coupled long-term mining licences and a stable fiscal regime with beneficiation conditions that required local value addition. Key instruments included creation of Diamond Trading Company Botswana (DTC Botswana) to sort and value rough from Debswana, a Diamond Hub within the Ministry of Minerals to coordinate skills, infrastructure and permits, and the Okavango Diamond Company (ODC) to market a government share of Debswana production via auctions. The state also invested in human capital and logistics in Gaborone to service sightholders, graders, bankers, insurers and secure transport.

What changed with relocation of sales to Gaborone

Relocation produced structural effects. Global Sightholder Sales shifted to Botswana, which brought regular inflows of international buyers for ten sights each year. Government marketing capacity rose through ODC, which initially sold about 25 percent of Debswana production by auction. Cutting and polishing headcount rose to roughly 3,750 jobs in 2014, then settled around 2,400 formal jobs by 2019 as firms consolidated and technology improved.

Quantified outcomes

- Fiscal capture and macro impact. De Beers states that after royalties, dividends and taxes, Botswana receives more than 80 percent of returns from Debswana. Diamonds have typically contributed about one quarter of GDP and around 80–90 percent of goods
- Local employment and services. Cutting and polishing created several thousand direct jobs at peak, with additional employment in security, grading, logistics, finance and hospitality around Gaborone's sight weeks.
- Supply security and mine life. Debswana invested about $2 billion in Jwaneng Cut-9, extending open-pit life to the mid-2030s, with plans for underground mining to at least 2050, supported by a 25-year licence extension to 2054 agreed in 2025.

Marketing power and the rising role of ODC

ODC has evolved from auction-only sales to a hybrid model. The 2023 heads of terms and the 2025 final agreements increased ODC's share from 25 percent to 30 percent up front, rising to 40 percent during the 10-year term, with an option to reach 50 percent in a further five-year extension. ODC reported US$1.1–1.2 billion in revenue in 2022, then paused sales in late 2023 during the global diamond glut. In 2025 ODC gained approval to add contract sales for roughly 40 percent of supply.

Case study 3: Botswana, Polishing the Diamond Value Chain [continued]

Linkages and learning

Relocation catalysed a services ecosystem in Gaborone, including grading labs, compliance, finance, secure logistics and training. Government skills studies emphasised on-the-job learning and targeted programmes in diamond valuation, polishing and equipment maintenance. While employment in factories fluctuated with the global cycle, Botswana built sticky capabilities in valuation, marketing and compliance that are harder to offshore.

Costs and constraints

Botswana's exposure to global diamond cycles remains high. Demand weakness in 2023–2024 cut Debswana sales by roughly 49 percent in H1 2024, while lab-grown diamonds pressure natural prices. Energy reliability and skills depth continue to matter for sustaining factory viability. The prospective Anglo American divestment of De Beers also raises strategic questions about long-term governance of the value chain.

The upgrade path: from sights to advanced cutting, tech and branding

Policy now targets deeper value capture through three tracks:

- ❑ Quality and technology. Support advanced inclusion-mapping, automated bruting and polishing, and niche large-stone expertise, including collaborations that emulate Lucara's large-stone model and downstream partnerships.

- ❑ Marketing diversification. Scale ODC's hybrid sales to reduce cyclicality and build market intelligence, while expanding citizen-owned trading through structured allocations.

- ❑ Broader clusters. Leverage diamond-driven services into regional jewellery manufacturing, precision tools, and high-value logistics, and use fiscal surpluses to crowd-in new minerals processing under a coherent industrial policy.

Key lessons

Sovereign control over resource marketing, combined with predictable rules and credible institutions, can shift bargaining power, attract private investment in midstream functions, and secure a larger domestic share of value. Botswana's experience shows that relocation of sales and targeted beneficiation can build skills and services that persist beyond individual factory cycles. The remaining task is to stabilise exposure to global cycles through diversified sales channels and to spread the model to other minerals.

Case Study 4: Australia, a mature model for mineral processing

Background: from bulk ore exporter to diversified processing hubs

Australia is a leading exporter of iron ore and bauxite, yet it has also built substantial midstream capacity in alumina, nickel, mineral sands, rare earths, and, more recently, battery chemicals. Five alumina refineries produced about 17.5 million tonnes in 2024, making Australia the second-largest alumina producer and the largest exporter. Primary aluminium output totalled about 1.58 million tonnes in 2024. New value chains are emerging in Western Australia around lithium hydroxide and rare earths cracking and leaching, with facilities at Kwinana, Kemerton, and Kalgoorlie now operating or ramping. These developments illustrate how a resources economy can extend into midstream processing at scale, while managing energy constraints and commodity cycles.

The policy mix and institutions

The Australian approach blends stable royalties and long-term tenures with strong public institutions and pre-competitive science. Three features stand out.

- Predictable regulation and cost transparency. The Productivity Commission's review of resources regulation stresses clarity of approvals, proportionate compliance, and coordination across jurisdictions. This predictability has reduced sovereign risk and supported large, capital-intensive processing assets.
- Public geoscience as a crowd-in tool. Geoscience Australia's Exploring for the Future programme, valued at A$225 million from 2016 to 2024, and its successor initiatives under Resourcing Australia's Prosperity, expand the national geoscience base, reduce exploration risk, and identify processing-relevant deposits.
- Targeted finance for midstream projects. The A$4 billion Critical Minerals Facility, administered by Export Finance Australia, plus NAIF earmarking A$500 million for critical minerals and related infrastructure, channels concessional finance into downstream capacity such as high-purity alumina and graphite. These sit within the national Critical Minerals Strategy 2023–2030 and are complemented by the CSIRO–ANSTO–GA Critical Minerals R&D Hub.

What processing looks like on the ground

- Alumina and aluminium, Gladstone and the south-west of WA. Integrated bauxite-to-alumina systems underpin a large export business. Industry submissions indicate five refineries with roughly 20 million tonnes per year of nameplate capacity, and over 100 million tonnes per year of bauxite mined nationally. Energy costs and decarbonisation are reshaping asset footprints, for example the curtailment of Alcoa's Kwinana refinery in 2024 while maintaining other refineries.
- Lithium chemicals, Kwinana and Kemerton. Australia has moved upstream from spodumene to conversion. Albemarle's Kemerton operated Train 1 through 2024 while re-phasing further trains, and Covalent's Kwinana project began production with a 50,000t per year lithium hydroxide target. Tianqi's Kwinana plant is designed for 24,000t per year per train. The build-out shows how policy stability and industrial land can seed new chemical value chains, even as prices cycle.

Case Study 4: Australia, a mature model for mineral processing [continued]

- Nickel and cobalt, Kwinana and Murrin Murrin. BHP Nickel West and Glencore's Murrin Murrin demonstrate mine-to-metal systems that produce LME-grade nickel and cobalt products, and in Nickel West's case, have long supplied battery precursors. Market shocks from Indonesian supply disruptions and lower prices have challenged mines; yet, processing know-how remains a strategic asset.
- Rare earths, Kalgoorlie cracking and leaching. Lynas commissioned Australia's first large rare earths cracking and leaching plant at Kalgoorlie, designed to supply mixed rare earth carbonate feed into downstream separation, supporting up to about 9,000 tonnes per year of NdPr equivalent finished product in the integrated system. This reduces single-country risk in a sensitive supply chain.
- Mineral sands upgrading, Capel synthetic rutile. Iluka's Capel plant upgrades ilmenite into synthetic rutile, with the SR2 kiln producing around 225,000 tonnes per year, and the SR1 kiln restarted to produce around 110,000 tonnes per year. This is a long-standing example of upstream minerals anchored to a domestic upgrading step that feeds global pigment producers.

Quantified outcomes and exposure to cycles

- Export earnings and processing depth. Resources and energy exports remain very large. The Office of the Chief Economist reports a moderation from pandemic peaks, with export earnings projected around A$372 billion for 2024 to 2025. Iron ore still dominates values, yet alumina, nickel products, mineral sands and emerging battery chemicals add diversity.
- Energy and operating costs. Processing assets are energy intensive. Operators have re-phased investments, for example Albemarle re-sequencing Kemerton trains, and Alcoa curtailing Kwinana. These adjustments highlight the importance of firm power, grid upgrades, and decarbonisation pathways for midstream competitiveness.
- Jobs and regional ecosystems. New plants support skilled employment in analytical labs, engineering services, EPC contractors, and logistics. Lynas Kalgoorlie created over a hundred direct jobs, and Alpha HPA's high-purity alumina project in Gladstone is backed by federal finance because of its spillovers into electronics, battery separators, and LED components.

Key lesson

- Stable rules attract capital, targeted finance closes gaps. Australia's predictable regulation and concessional finance de-risk new processing steps. Africa can adapt this by pairing stable fiscal terms with specialised funds for midstream assets, for example acid, calciner and hydroxide plants that bankable studies often overlook.
- Pre-competitive data multiplies private exploration and siting. Australia's geoscience programmes reduce uncertainty about resources, water and geotechnical conditions that matter for siting plants. Similar continental surveys would support African processing corridors.
- Clustering lowers cost and speeds learning. Industrial zones at Kwinana, Kemerton and Kalgoorlie show how co-location of utilities, reagents, labs and ports compresses learning times and reduces logistics costs, a model that can be replicated in African SEZs linked to ports and power pools.

The evidence presented in this chapter underscores that the countries that have prospered from their natural resources are those that moved deliberately into processing, manufacturing, and technology. Whether through the example of platinum value chains of South Africa, the diamond marketing reforms of Botswana, or Australia's steady expansion of its midstream base, progress came from aligning geology with policy, infrastructure, finance, and skills. They show that industrialisation driven by natural resources is not only possible but highly rewarding when built on credible institutions and long-term strategies.

For Africa, the strategic imperative is to capture more value within its borders. Beneficiation should not be seen as an isolated policy goal but as part of a broader vision of industrial transformation. This means connecting mineral corridors to energy and transport systems, strengthening fiscal regimes that reward domestic processing, and using regional markets under the AfCFTA to achieve scale. With the right blend of policy coherence, investment in infrastructure, and partnerships that balance risk and reward, Africa can move decisively from extraction to transformation and from vulnerability to shared prosperity.

03

BARRIERS TO VALUE ADDITION

3. Barriers to Value Addition

The seemingly elusive dream of leveraging Africa's immense mineral wealth to power its industrialisation and sustainable development can best be interpreted in the light of a known set of barriers and interlocking constraints. These obstacles reflect a configuration of institutions, policies, infrastructure and incentives that make midstream investments too risky or prohibitively expensive relative to global alternatives. This chapter focuses on the reasons why beneficiation and broader value addition have lagged across the continent. It organises the diagnosis in four interconnected categories.

First, regulatory and institutional weaknesses undermine credible commitments and policy coordination. Second, policy incoherence and instability deter long-horizon investment, with abrupt export bans a recurring and costly symptom. Third, structural infrastructure and energy deficits raise operating costs well above competitors and compromise reliability. Fourth, the political economy of elite capture sustains a pattern of raw exports that is easier to control and monetise in the short term, at the expense of longer-term industrialisation.

3.1 Weak Regulatory and Institutional Frameworks

Industrialisation requires capital-intensive plants, stable operating rules, and long-term offtake relationships. It hinges on a predictable, transparent, and effective governance framework, which is regrettably Africa's weakest point. According to the 2025 Chandler Good Government Index, Africa continues to have the lowest average governance score of all regions[59]. Between 2021 and 2025, only Tanzania and Rwanda moved up in the rankings. Investors in mineral processing require some predictability over long time horizons, often spanning decades, to commit the substantial capital needed for smelters, refineries, and manufacturing plants. Unfortunately, in many African countries, the institutional landscape governing the mineral sector is characterised by weakness, fragmentation, and a susceptibility to corruption, creating a formidable barrier to downstream investment. When licensing, taxation, power provision, and customs administration are fragmented or unpredictable, investors add risk premia to hurdle rates or refrain from investing altogether.

3.1.1 Fragmented Mandates and Jurisdictional Overlap

A key institutional challenge is the fragmented regulatory responsibility for the mineral value chain. Oversight is divided among several government bodies, including the ministries of mines, trade, industry, finance, and the environment. These agencies often work independently, with competing objectives and no unified strategy.

For example, the ministry of finance may prioritise maximising extractive output and export royalties, while the ministry of mines promotes local processing. The DRC's Mines Ministry has repeatedly banned the export of copper/cobalt concentrates to encourage local processing (2013; reimposed in May 2021; cobalt ban again from February to September 2025)[60], in pursuit of beneficiation objectives. At the same time, the fiscal authorities continue to issue broad, sometimes "indefinite" waivers, allowing producers to keep shipping concentrates – prioritising continued output and fiscal inflows when domestic processing capacity or market conditions made a hard ban impractical[61].

This jurisdictional overlap often leads to significant coordination failures. For instance, an investor seeking to establish a refinery may need permits and approvals from a dozen different agencies, each with its own opaque procedures and timelines, leading to delays and increased costs, which act as powerful disincentives.

3.1.2 Corruption and Governance Deficits

Corruption is corrosive and undermines trust and predictability, which are essential for long-term investment. In the context of mineral value addition, it appears in several forms. For example, the process of awarding licenses, permits, and contracts for downstream projects can be manipulated by corrupt networks, favouring politically connected firms over those with genuine technical and financial capacity. This not only results in inefficient outcomes but also discourages reputable international investors who are bound by strict anti-bribery regulations in their home countries[62].

Moreover, corruption diverts funds intended for developing the supportive infrastructure required for industrialisation. Revenues from mining royalties and taxes, which should be invested in power plants, roads, and skills development, are often lost to illicit financial flows or misallocated to projects that serve private interests[63]. Where firms expect to face rent-seeking during approvals or at customs, they may build these costs into bids or avoid midstream commitments that require fixed capital. Evidence from Transparency International's 2024 index shows that Sub-Saharan Africa records the lowest average score of any region, with 90 percent of countries below 50 out of 100[64].

Investors observe these metrics and adjust behaviour accordingly.

Governance deficits also compromise revenue mobilisation. Complex related-party sales and management-fee structures facilitate base erosion, and weak transfer pricing units struggle to challenge aggressive tax planning by multinational enterprises. The International Monetary Fund (IMF)[65] and the African Tax Administration Forum[66] document the difficulty that under-resourced administrations face in auditing mineral sales and service contracts, especially when prices and terms are set within corporate groups. Without credible revenue administration, governments cannot reliably fund essential services, such as power, water, roads, and skills development programmes. International assessments of governance capture these problems. The 2024 Ibrahim Index reveals persistent weaknesses in the rule of law and regulatory quality in several resource-rich states, with stagnation or decline in participation and rights dimensions that are crucial for accountability[67].

3.1.3 Inadequate Technical and Human Capital

Effective regulation requires capable institutions staffed by skilled professionals. Many African regulatory bodies suffer from a lack of technical and human capital, which hampers their ability to perform essential functions necessary for promoting value addition. For instance, negotiating complex mining development agreements that include strong, feasible, and legally enforceable provisions for local processing demands expertise in international law, project finance, mineral economics, environmental management, and industrial policy design and engineering. Without these skills, governments often consent to terms that favour rapid extraction over midstream and downstream development.

This same skills gap also extends to monitoring and enforcement. Local content laws, which mandate that mining companies procure a certain percentage of goods and services locally or invest in skills development, are often poorly enforced due to a lack of qualified auditors and inspectors. Additionally, governments may negotiate fiscal terms without robust models of price cycles, cost curves, and project cash flows. As a result, policies can overreach and then unravel.

3.2 Policy Incoherence and Instability

Sometimes, policymaking itself acts as a major deterrent to investing in mining and manufacturing. Value-added projects are very sensitive to sovereign risk. Investors need confidence that the fiscal, legal, and operational rules guiding their investment will stay stable or at least remain logically consistent throughout the project's duration.

Smelting and refining plants require certainty regarding feedstock supply, energy tariffs, water availability, logistics, and taxation over ten or more years. When governments implement unpredictable, erratic, or incoherent policies, they generate an atmosphere of uncertainty that renders long-term commitments unfeasible. This policy instability is especially harmful when it involves sudden interventions like export bans, which, although often motivated by good intentions, can backfire spectacularly if not carefully planned and phased.

Many African governments often pursue revenue maximisation, import substitution, and export promotion simultaneously, sending mixed signals. Incentives are granted through special deals rather than transparent frameworks, which undermines competition and accountability. According to a 2023 United Nations Trade and Development (UNCTAD) analysis of structural transformation under the AfCFTA, coherent rules-based policy environment is essential to attracting long-horizon industrial investment[68].

3.2.1 The Pitfalls of Abrupt Export Bans

Export bans can be politically appealing because they promise local processing and jobs. However, when implemented suddenly and without transitional support, they cause inventories to become stranded, reduce fiscal revenues, and lead to disputes. Mines cannot quickly redesign flowsheets, and new smelters need power, water, environmental permits, skilled operators, and willing customers to certify new products. Without these, a ban can decrease production while smelters remain in planning stages. Such measures also increase sovereign risk premiums and undermine investor confidence in the stability of the policy framework.

Case study 5: Tanzania's 2017 Mineral Concentrate Export Ban

Rationale: In March 2017, Tanzania prohibited the export of gold and copper concentrates in order to promote domestic smelting and address alleged under-declaration of mineral values and unpaid taxes[69]. The move followed presidential committees that investigated the contents of concentrates and the economic impact of exporting unprocessed material.

Immediate impact: The ban halted shipments from major mines. Acacia Mining announced the cessation of concentrate exports from its Bulyanhulu and Buzwagi mines. The company's share price fell 13 percent and operations were curtailed[70]. Government revenues also dipped as production slowed and disputes escalated, including arbitration filings.

Resolution and lessons: Following protracted negotiations, Barrick and the Government reached an agreement on a framework that established Twiga Minerals as a joint venture and resolved disputes, enabling shipments to resume under new terms, including a settlement payment and revised sharing of economic benefits[71]. The episode left a reputational scar. The central lesson is that export restrictions without a phased plan, enabling infrastructure and financing, can delay value addition rather than accelerate it. Successful strategies pair time-bound trade measures with credible roadmaps for power, logistics, skills, and certification, and they utilise performance-based incentives rather than blanket prohibitions.

3.3 Critical Infrastructure and Energy Deficits

Africa's well-known infrastructure gap is valued at $130 to $170 billion annually in needed investments. Only about $80 billion is usually financed, causing significant yearly deficits in energy, transport, water, and ICT, which restrict productivity, trade, and growth. Processing is energy-heavy and depends heavily on logistics. Smelters, refineries, and chemical plants need stable baseload power at competitive tariffs, high-quality water, dependable roads and rail, and ports capable of handling bulk inputs and outputs. In many African countries, the cost and reliability of these services still fall short of global standards. Plant managers mitigate issues with self-generation and large stockpiles of consumables, raising capital and operating expenses. These structural gaps are documented by multiple sources and are a key reason why many projects remain uncompetitive on a delivered-market basis[72].

3.3.1 The Energy Constraint

Africa's energy deficit is structural and material for industry: the continent accounts for about six percent of global energy use and only roughly three percent of global electricity consumption despite hosting nearly one-fifth of the world's population. In absolute terms, Africa consumed approximately 937 TWh of electricity in 2023, compared to about 9,443 TWh in China, about 1,957 TWh in India, and about 725 TWh in Brazil[73], underscoring the scale gap that shapes industrial competitiveness.

Against this backdrop, industrial power prices and reliability are crucial for electro-intensive processes. The 2022 Africa Energy Outlook[74] documents wide differentials in generation costs and grid performance across the continent, with persistent load-shedding and transmission constraints. Cross-subsidised tariffs can shift the burden to factories and push effective industrial rates higher, prompting firms to install diesel or gas generators that typically raise unit costs further.

Studies drawing on Enterprise Surveys[75] suggest that frequent outages are prevalent across Sub-Saharan Africa, resulting in material losses in sales, and that generator power can cost many times the price of grid power. These conditions are hard to reconcile with quality-sensitive output such as battery-grade chemicals or continuous casting, which require steady voltage, tight process control, and high utilisation. Without massive public and private investment in power generation and transmission, African minerals will continue to be exported to jurisdictions like China, which can leverage economies of scale and access to low-cost energy to process them competitively.

3.3.2 Logistical Bottlenecks

Efficient transportation infrastructure is the circulatory system of a value-adding industrial economy. Value addition requires the smooth movement of goods at multiple stages: transporting raw ore from the mine to a processing plant, moving intermediate products between facilities, and finally, shipping finished goods to domestic or international markets. In many parts of Africa, this system is severely constrained by underdeveloped road networks, inefficient and congested ports, and a lack of integrated rail systems.

These logistical bottlenecks impose significant costs and delays, eroding the potential competitive advantage of local processing. A mining company might find that the cost of transporting bulk commodities overland from a remote mine to a coastal port for export is significantly lower than transporting that same material to a hypothetical in-country refinery and then moving the refined product back to the port. Poor infrastructure also creates vulnerabilities in the supply chain. A single damaged bridge or a congested port can halt a production line for weeks, adding a layer of operational risk that investors are unwilling to bear.

Logistics performance affects both cost and reliability. The 2023 Logistics Performance Index[76] reports that many African corridors lag behind the global median in terms of customs efficiency, infrastructure, and timeliness. Underinvestment in rail for bulk freight results in ore and concentrate being transported onto congested roads. Port dwell times remain high due to limited berths, slow cargo handling, and documentation delays. For midstream investors, this translates into higher working capital and missed delivery windows.

3.4 The Political Economy of Elite Capture

Institutional weakness and infrastructure deficits are critical technical barriers, but they do not fully explain the persistence of a raw material export model. The structure of the economy is not merely a product of technical constraints but is actively shaped by political interests. In many resource-rich nations, powerful domestic and international actors have a strong vested interest in maintaining the status quo. This phenomenon, known as elite capture, creates a political economy where the incentives are aligned against the complex, long-term project of industrialisation and in favour of the simpler, more easily controllable system of raw commodity extraction and trade.

3.4.1 Vested Interests and Rent-Seeking

Extractive activity typically creates a class of domestic and international actors who profit from the status quo. For example, traders and logistics providers make margins on export volumes, international refiners benefit from captive feedstock, and within governments, discretionary exemptions and opaque procurement create opportunities for rent extraction.

3.4.2 Resistance to Economic Diversification

The political logic of elite capture helps explain why many resource-dependent states fail to pursue genuine economic diversification. Diversification threatens the status quo. Successful processing clusters nurture new participants in engineering services, logistics, equipment maintenance, and testing. These businesses require predictable rules and transparent procurement processes. Incumbent elites may view such shifts as a threat. That creates inertia against reforms such as competitive power tariffs for industry, transparent capacity allocations on railways, or publication of mineral agreements.

One case study encapsulates all of these barriers – Ajaokuta Steel in Nigeria.

Case study 6: Ajaokuta Steel

The Ajaokuta Potential

Ajaokuta was built as an integrated Blast Furnace–Basic Oxygen Furnace (BF–BOF) steelworks with an installed first-phase capacity of 1.3 metric tonnes per year (Mt/yr), engineered to scale to 2.6 and ultimately ~5.2 Mt/yr; enough to anchor domestic flat and long-product value chains (with rolling mills across regions in Jos, Katsina, Osogbo; linkages into autos, construction, machinery industries). The site typically includes coke ovens, sinter/pellet plants, one or more BFs, BOF converters, casting and rolling mills, plus on-site power, oxygen, and lime – designed to run as a single, high-throughput complex. With a population of 233 million[77] (2024) and a stubbornly shallow industrial base, Nigeria still spends heavily importing iron/steel products (2024 COMTRADE: $226 million for "iron & steel" plus $755 million for "articles of iron or steel"[78]), underscoring the unrealised role Ajaokuta could have played in import-substitution and downstream jobs.

The Policy Zigzags

- Soviet start, stalled completion (1979–1994): Built by Tyazhpromexport (TPE), the plant reportedly reached ~98 percent physical completion by 1994, yet never poured a tonne of steel.
- Concession to Solgas (2003) → collapse (2004): The Obasanjo government granted a concession to Solgas in 2003; within a year, Solgas sought termination for lack of financing, an early sign of weak due diligence and contract discipline.
- Concession to Global Steel/GINL (2004) → revocation (2008): A broader suite of steel assets (Ajaokuta + NIOMCO Itakpe) went to Global Steel/Global Infrastructure. The government later revoked in 2008, alleging material breach/asset stripping, triggering years of international arbitration.
- "Modified" deal (2016–2017): Nigeria negotiated an out-of-court settlement: Ajaokuta back to government; NIOMCO re-concessioned to Global Steel, an awkward split that left the ore-supply/steel-making chain institutionally divided.
- Costly arbitration settlement (2022): Abuja paid $496 million to settle Global Steel's multi-billion-dollar claim, a direct fiscal hit from governance lapses in the concession cycle.
- Belated enabling rail (2020) but still no steel: The Itakpe–Ajaokuta–Warri standard-gauge line finally opened in 2020 – three decades late – removing one bottleneck but not the contractual/operational ones.
- Fresh revival pushes (2024–2025): MoU with a Russian consortium (incl. TPE) in Sept 2024; in 2025, Abuja opened talks with major Chinese steel firms, signs of renewed intent, but still contingent on credible governance and bankable execution.

The barriers

- Weak promoter screening & opaque concessions: The Solgas award (2003) collapsed within a year because the firm could not raise finance; later, the Global Steel concession drew official accusations of asset-stripping/material breach before being revoked, both episodes reflect poor vetting, contractual asymmetries and politicised decision-making.
- Institutional fragmentation & exclusion of the right agencies: Nigeria's Bureau of Public Enterprises (BPE) later protested that it was not properly involved in parts of the steel-asset deals, a classic process failure that weakens accountability and increases litigation risk.
- Arbitration overhang & fiscal leakage: Years of arbitration culminated in the $496 million payout in 2022[79];

Case study 6: Ajaokuta Steel [continued]

- Parliament launched 2024 Senate investigations into how and why that settlement happened, money and time that could have gone into commissioning furnaces or rebuilding supply chains.
- Policy flip-flops that broke the chain: The 2016–17 "modified" arrangement split ore supply (NIOMCO) from steelmaking (Ajaokuta) across different control structures, misaligning incentives exactly when the plant needed integrated ramp-up.
- Chronic project discontinuity: The long gap between physical completion (1994) and any coherent commissioning plan meant equipment degradation, skills loss, and a mounting rehab bill, an archetype of how governance failure converts capex into stranded assets.
- Narratives of graft around the complex: Investigations and analysis by reputable Nigerian outlets repeatedly tie Ajaokuta's standstill to bureaucratic corruption, poor contract management, and politicised decision-making[80], not just "bad luck."
- No upstream–midstream lock-in: With Itakpe (ore), rail, and Ajaokuta (BF-BOF) never aligned under a credible operating regime, the blast furnace has never been lit, so Nigeria never captured the learning, standards, and supplier-development effects that come from running an integrated works.
- Persistent import dependence: Even as domestic demand grew, Nigeria kept importing basic steel and fabricated items, leaking FX and forfeiting downstream jobs that an operational Ajaokuta could have supported.

Current status and what would need to change

Status (Sept 2025): MoU with Russian partners is on paper; Chinese engagements are exploratory; the rail link now exists, but credible governance (clean RFPs, transparent financing, integrated NIOMCO–Ajaokuta operating model, and enforceable performance milestones) will decide whether this is another zigzag or the long-deferred commissioning.

Current status and what would need to change

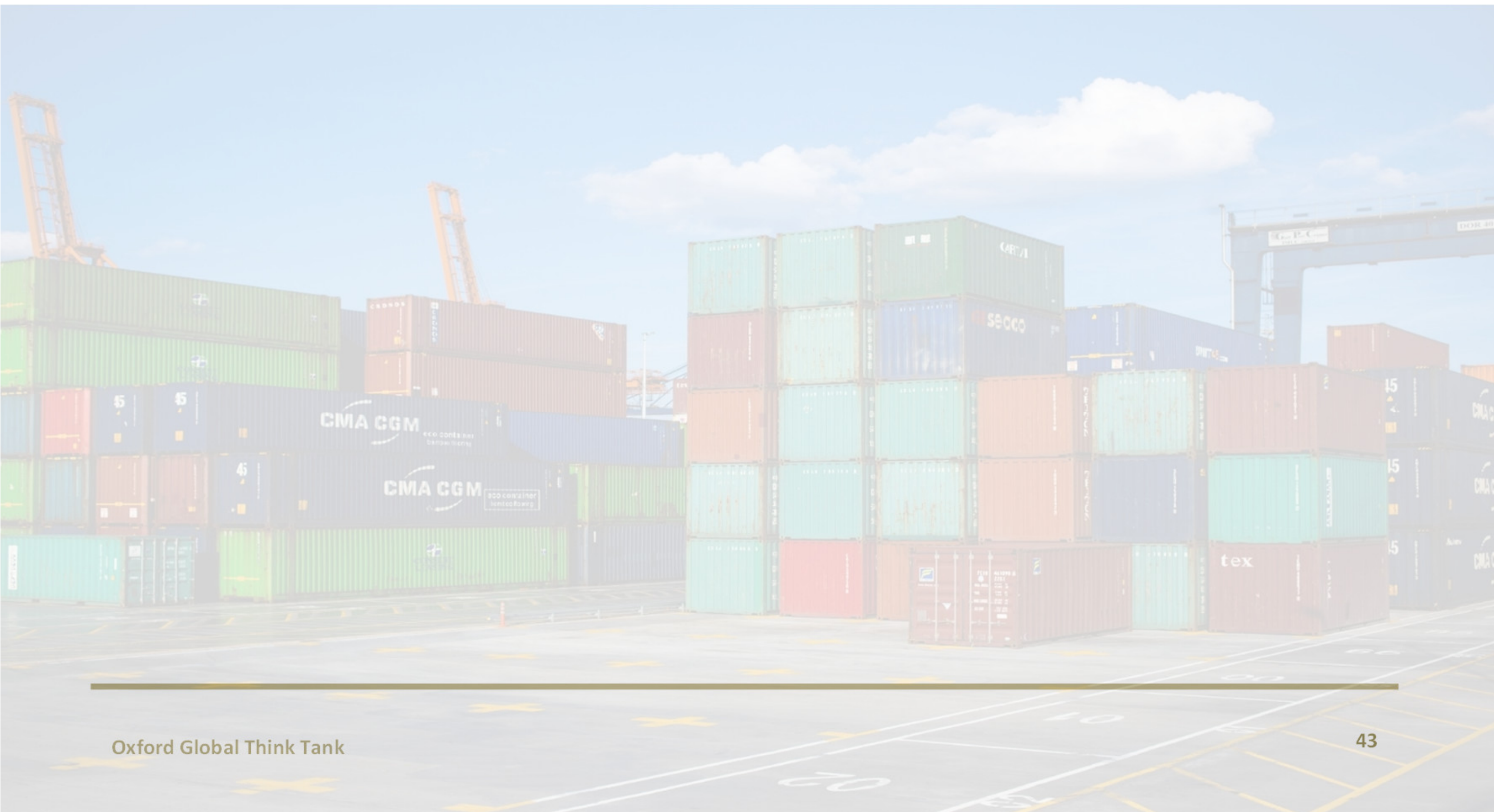
- Reconstitute Ajaokuta–NIOMCO as one operating chain under a time-bound, KPI-linked concession (ore → hot metal → flat/long products).
- Full transparency on any settlement legacies and new capex; publish contracts and milestone-based disbursements.
- Independent technical operator with proven BF–BOF ramp-ups; escrowed offtake contracts to anchor finance.
- A dedicated industrial power solution and logistics SLA to keep the furnace and mills continuous (the 2020 rail is necessary, but not sufficient).

3.5 Overcoming the Barriers: A Path to Structural Reform

Countries that have made progress share common features. They:

- focus on a small number of minerals where they enjoy genuine advantages;
- build institutional credibility before imposing ambitious obligations;
- invest in dedicated power and logistics for industrial hubs;
- sequence regulations and incentives to match the maturation of suppliers; and
- negotiate firmly but predictably with private partners, aligning commercial incentives with public objectives.

Indeed, progress requires a holistic strategy. Governments should prioritise a small number of mineral hubs, deliver competitive energy and logistics, build human capital, and strengthen revenue administration. Policies must be coherent, transparent, and predictable. Export restrictions cannot substitute for infrastructure and skills. Partnerships with private actors should align commercial incentives with public objectives through clear, enforceable agreements. Regional integration under the AfCFTA can expand markets and reduce costs for intermediate goods that underpin the processing sector. With patience and discipline, countries can transition from exporting raw materials to capturing the top echelons of global value chains, thereby fostering a more diversified, resilient, and inclusive economy.



04

MACROECONOMIC AND FISCAL FRAMEWORKS

4. Macroeconomic and Fiscal Frameworks

This chapter will analyse how African countries can design and implement macroeconomic and fiscal frameworks that translate finite mineral wealth into sustainable development and intergenerational equity. The policy goal here is to build institutions that stabilise the budget when prices fall, save during upswings or booms, and invest well at home.

Three challenges confront this agenda. First, commodity prices move sharply. Revenues rise and fall faster than public spending can adjust, which invites procyclical policies and debt stress if rules are weak[81]. Second, poor revenue management undermines the promise of minerals. Fiscal systems try to raise more revenue without deterring investment or shifting value abroad through transfer pricing and thin capitalisation[82]. Third, as previously seen, the risk of Dutch disease is a genuine concern. Booms can appreciate the real exchange rate, crowd out tradable sectors, and delay diversification unless fiscal and monetary policies lean against the cycle and public investment strengthens productivity[83].

The remainder of the chapter will outline how transparent fiscal rules, well-calibrated royalty and tax regimes, and targeted yet disciplined incentives can anchor stability and promote value addition. Thereafter, it examines sovereign wealth funds as the primary vehicles for stabilisation and savings, drawing lessons from Norway and Alaska, and sketches a continental approach for Africa. It also integrates these elements into a macro-fiscal toolkit for Africa, including debt anchors, public investment management, and risk disclosure.

Table 5: Fiscal rules for resource-rich countries

Rule type	Operational target	Strengths	Risks and mitigation
Structural balance rule	Balance at long-run commodity price and potential output	Countercyclical, credible if expert panels are independent	Model uncertainty; require transparent methods and external oversight
Expenditure growth rule	Real growth of primary spending linked to trend non-resource revenue	Simple, limits procyclicality and volatility	Can ignore sustainability; add debt anchor and medium-term framework
Non-resource primary balance rule	Balance net of resource revenues	Focus on underlying fiscal effort	Requires strong revenue administration; pair with stabilisation fund
Debt anchor	Ceiling on gross public debt over the cycle	Guards sustainability and market access	Can be procyclical alone; combine with operational rule

4.1 Designing Stable and Transparent Fiscal Regimes

4.1.1 Fiscal Rules as an Anchor for Stability

Fiscal rules help resource-rich countries address revenue cyclicality. They provide ex ante guidance on how much to spend and save when prices move. The most effective rules comprise three key elements: an operational target that the budget can effectively address, a long-term sustainability anchor, and an escape clause with clear triggers and a defined path back to the rule[84].

A structural balance rule is the leading option for commodity producers. It delinks expenditure plans from current prices by estimating structural revenues at a long-run reference price and potential output. Chile's experience illustrates this approach.

Table 6: Main mining fiscal instruments and practical considerations

Instrument	What it does	Strengths	Practical risks
Ad valorem royalty	Levy on gross value	Early revenue, simple to administer	Regressive at low prices; consider sliding scales
Specific royalty	Levy per physical unit	Stable where grades are uniform	Sensitive to mis-measurement and quality differences
Corporate income tax	Levy on taxable profits	Broad-based, familiar	Subject to profit shifting; needs transfer pricing rules
Resource rent tax / additional profits tax	Tax on cash flow above hurdle rate	Progressive, targets rents	Complex to audit; requires robust administration
Windfall levy	Extra charge above a trigger price	Captures surge rents	Must be formula-based to avoid arbitrariness
Withholding taxes	On interest, services, or dividends	Anti-avoidance complement	Risk of double taxation; align with treaties
Bonuses and fees	Entry or production fees	Upfront value for the state	Small revenue share, can distort bidding if poorly designed

4.1.2 Balancing Incentives and Revenue in Royalty and Tax Regimes

Mining fiscal regimes must raise public revenue efficiently while keeping investment viable through the cycle. Instruments used to achieve this objective include ad valorem royalties, specific unit royalties, profit-based taxes, rent capture mechanisms such as resource rent taxes, windfall levies, and production sharing in some sub-sectors. No single tool predominates. The choice depends on geological context, cost curves, state capacity, and the tolerance for risk sharing.

Ad valorem royalties provide early and robust revenue across the price cycle[85]. They are simple to administer and harder to avoid, which suits lower-capacity settings. The trade-off is that royalties raise average costs and can push high-cost marginal projects out of the market when prices fall. Profit-based instruments, such as additional profit taxes or resource rent taxes, are more efficient on paper. They collect a larger share once costs are recovered and profitability is high, thus increasing progressivity. They need strong cost auditing and transfer pricing controls. Hybrid regimes combine a moderate royalty with a profit-based layer and a corporate income tax, often with an accelerated depreciation schedule that encourages investment while keeping the base broad[86].

Case study 7: Chile's structural balance rule

Chile adopted a structural budget balance rule in 2001 to break the link between volatile copper revenues and public spending. The rule targets the budget balance measured at a long-run copper price and at trend GDP, not at the prevailing cycle. The government chose the numerical target, initially a surplus of one percent of GDP, then adjusted it over time as debt and social priorities evolved. The intent was simple: save windfalls during booms and allow the budget to support activity when prices or output fall.

Independent parameters, not political guesses.
Two independent expert panels underpin the calculus: one estimates the long-term copper price, the other estimates trend GDP. The Ministry of Finance convenes the panels, publishes their membership and outputs, and uses the results to compute structural revenues. This design reduces incentives to inflate the reference price or growth rate in order to spend more today. Panel methods focus on long-run fundamentals, including cost curves and global demand for the copper panel, and potential output for the GDP panel. Chile publicly reports the parameter updates during the budget cycle.

From rule to institutions: funds and reporting.
The 2006 Fiscal Responsibility Law translated the rule into institutional plumbing. It created two sovereign funds: the Economic and Social Stabilization Fund for cyclical smoothing and the Pension Reserve Fund to meet future pension obligations. The law also established a Financial Committee to advise on portfolio mandates and risk. The Ministry of Finance and its budget office, DIPRES, publish monthly, quarterly, and annual reports on the funds and on structural versus actual balances. Open reporting and a clear legal base make the framework durable across political cycles.

Governance upgrades.
Chile strengthened oversight by creating an independent fiscal council with a statutory basis in 2019. The council reviews macro-fiscal assumptions and compliance with the rule and advises on the convergence path when deviations occur. Independent scrutiny of the parameters and of the reconciliation between structural and headline outcomes increases credibility with markets and citizens.

Operational mechanics.
Each year, government prepares the budget on a multi-year path consistent with the structural target. If actual revenues exceed structural revenues at the reference copper price and trend GDP, the excess is saved, primarily through the stabilisation fund. If actual revenues fall short, the framework allows drawdowns or temporary borrowing within a stated convergence plan back to the target. The indicator nets out the cyclical impact of three variables: the level of economic activity, the copper price, and the molybdenum price. This yields a counterfactual balance that answers a simple question: what would revenue be at normal prices and output.

Known challenges.
Three risks recur. First, model and parameter risk: long-run copper prices and potential output are difficult to estimate, so ex post revisions can be material. Second, political pressure to relax the target in good times or to stretch escape clauses can emerge, which argues for transparent convergence plans and external monitoring.

Case study 7: Chile's structural balance rule [continued]

Third, communication complexity: structural concepts are technical, so ministries must publish the formulas, the parameters, and a transparent reconciliation that shows how the structural balance differs from the headline balance. Chile's practice of publishing panel outputs, sensitivity tests, and detailed budget annexes mitigates these risks.

Key lessons for Africa

Chile demonstrates that a resource producer can run a disciplined, countercyclical budget without relying on discretionary judgement each year. The combination of rules, sovereign funds, and independent checks improves resilience, supports market credibility, and protects investment quality. The approach is adaptable. Countries can swap copper for their own key commodity in the parameter set, calibrate the numerical target to their debt anchor, and sequence institutions as capacity grows. The core principle is stable: spend in line with permanent income, save windfalls, and publish the arithmetic so everyone can see the rule at work.

4.1.3 Promoting Value Addition through Fiscal Policy

Fiscal policy can encourage domestic processing where it is economically sound. First, investment allowances or accelerated depreciation for processing plants reduce the cost of capital. Second, refundable tax credits tied to measurable outcomes such as energy efficiency, local procurement, or R&D create performance-based incentives. Third, targeted import duty relief on equipment avoids double taxation along the chain. Used together, these instruments lower upfront costs, reward verifiable results, and keep supply chains affordable, creating conditions in which projects can proceed on a commercial footing[90].

Yet incentives do not substitute for fundamentals. Processing is capital-intensive and energy-hungry. Without reliable power, logistics, and skills, incentives leak with little value added. In practice, design should be transparent, time-bound, and subject to evaluation. Publish the implied tax expenditure annually. Sunset clauses and output-based criteria help avoid permanent subsidies. Policymakers should endeavour to link incentives to environmental and social standards so that value addition does not degrade assets needed for long-term competitiveness[91].

Finally, because scale and market access often determine feasibility, continental policy matters.

Zero tariffs on processed mineral products traded within Africa, together with aligned standards, will reduce scale barriers for new plants.

Fiscal regimes should also allow cost recovery for cross-border processing and recognise regional value chains in transfer pricing rules to avoid double taxation.

4.2 Sovereign Wealth Funds: Safeguarding Mineral Wealth for Future Generations

4.2.1 The Rationale for Sovereign Wealth Funds in Resource-Rich Nations

Sovereign wealth funds serve two linked purposes. A stabilisation function smooths public expenditure when prices fall. A savings function preserves wealth for future generations when non-renewable resources deplete. Both functions rely on a rules-based link between the budget and the fund and governance that protects the fund from short-term political pressure[92].

A credible fund has four design elements. First, a clear legal basis that defines objectives, roles, and the relationship with the treasury and central bank. Second, deposit and withdrawal rules that tie flows to the fiscal framework. For a structural balance rule, deposits occur when actual revenues exceed structural revenues, and withdrawals fund the budget when actual revenues fall short. Third, an investment mandate that matches the objective. Stabilisation portfolios need high liquidity and low risk. Savings portfolios can take more market risk and invest across global equities and bonds. Fourth, transparency and accountability. Regular public reports on performance, fees, benchmarks, and governance build trust and reduce the risk of misuse[93].

The fund cannot fix a weak budget process. Sound public financial management is a precondition. The treasury should integrate the fund into the medium-term fiscal framework and debt management strategy, and the central bank should coordinate liquidity to avoid large swings in the money market when the fund buys or sells foreign exchange.

Case study 8: Lessons from Norway and Alaska

Norway's Government Pension Fund Global.
Norway separates resource revenue management from day-to-day politics through a clear fiscal rule and strong institutions. All net petroleum cash flows go into the fund, and the non-oil budget deficit is financed by a rules-based transfer equal to the fund's expected long-run real return, set at three percent since 2017. As at 30 June 2025, the fund stood at NOK 19.6 trillion (about $2 trillion), invested globally under a transparent benchmark and ethical guidelines overseen by Norges Bank Investment Management. The framework insulates the budget from oil price swings and links spending to permanent income rather than current revenues. During stress episodes, it has allowed countercyclical support while keeping a credible anchor. In 2009, for example, Norway temporarily let the structural non-oil deficit rise above the guideline to cushion the global crisis, then set a path back to the rule. The rule also guided pandemic-era support, with plans to converge as conditions normalised. Regular publication of holdings, voting, exclusions, benchmarks, and reconciliations between structural and actual balances has sustained public and market confidence.

The key lesson for Africa is design rather than scale.
Norway's single, comprehensible rule, independent asset management, and rigorous disclosure are transferable. Countries with smaller funds can adapt the model by sizing liquidity tranches to domestic needs and by setting prudent, rules-based drawdowns that respect sustainability.

Alaska Permanent Fund.
The U.S. state of Alaska channels a share of mineral revenues into a permanent fund with a dual objective. One part serves as a savings vehicle invested across global markets. Another part, through a Percent-of-Market-Value statute, guides a predictable five percent annual draw to support the state budget and citizen dividends. As of July 2025, the fund's total value was about $81.7 billion. In recent years, the rules-based draw has provided more than half of the state's general-fund revenue, which has been critical during oil downturns. The dividend programme builds public buy-in by distributing a portion of earnings directly to residents, while an in-state investment programme supports selected Alaska-based projects under the same risk-return standards applied elsewhere. Governance relies on a professional corporation with a public board, audited reporting, and clear separation between principal and spendable earnings, which protects the savings core while enabling stabilisation and broad-based sharing of benefits.

4.2.2 A Continental Approach to Sovereign Wealth Management

- Establish an African SWF Forum under the auspices of the African Union, supported by the AfDB. The forum would develop a voluntary code that builds on the Santiago Principle94 with Africa-specific modules on transparency, domestic investment safeguards, and currency risk. Peer review would encourage compliance and allow ministers to benchmark performance.
- Create a co-investment platform for regional projects managed by the AfDB or in partnership with Afreximbank. Many national funds are too small to access high-quality, large-ticket opportunities alone. Pooling can finance cross-border power, rail, ports, and data infrastructure that lower costs for manufacturing. The platform would apply commercial standards, use independent investment committees, and co-invest alongside private partners to preserve discipline95.
- Third, promote knowledge sharing on portfolio construction, risk, and reporting. Training programmes and secondments to experienced managers can raise capacity. Public dashboards that publish fund size, strategy, returns, and draw rules will build trust at home.

Table 7 - Snapshot: African Sovereign Wealth Funds

Country	Fund (year of establishment)	Latest reported size	Official mandates
Angola	Fundo Soberano de Angola (FSDEA) (2012)	≈ $3.9bn	Intergenerational savings, economic diversification, and co-investment in infrastructure and social projects.
Botswana	Pula Fund (1994)	BWP 38.46bn at Dec 2024	Long-term investment of foreign reserves for savings and stabilisation.
Djibouti	Fonds Souverain de Djibouti (FSD) (2020)	> $1bn reported Mar 2025; status contested after reports of dissolution in May 2025	Strategic co-investment to diversify the economy and build long-term wealth.
Egypt	The Sovereign Fund of Egypt (TSFE) (2018)	~ $12bn (Aug 2024)	Monetise and optimise state assets, crowd in private capital, co-invest in strategic sectors.
Equatorial Guinea	Fund for Future Generations (2002)	~ $100m; funded by 0.5 percent of oil revenues	Intergenerational savings managed by BEAC.
Ethiopia	Ethiopian Investment Holdings (EIH) (2022)	$45bn to	Strategic holding of state assets, co-investment, and FDI attraction.
Gabon	Fonds Gabonais d'Investissements Stratégiques (FGIS) (2012)	> CFAF 1,000bn portfolio at end-2024	Diversification beyond oil, strategic domestic investments, ESG focus.
Ghana	Ghana Petroleum Funds: Stabilisation & Heritage (2011)	$1.456bn at 31 Dec 2024	Stabilisation during shocks and intergenerational savings from petroleum receipts.
Libya	Libyan Investment Authority (2006)	$68–70bn	Preserve oil wealth for future generations; savings and stabilisation within UN restrictions.
Morocco	Mohammed VI Investment Fund (M6FI) (2021); Ithmar Capital (2011)	M6FI ~ $1.6bn capital; Ithmar ~ $1.84bn	Strategic and green investment, PPP co-investment, sector development.
Namibia	Welwitschia Sovereign Wealth Fund (2022)	Initial endowment N$262m; latest AUM not disclosed	Dual-window stabilisation and savings from natural-resource revenues.
Nigeria	Nigeria Sovereign Investment Authority (2011)	₦4.35 trillion (~ $3bn) net assets at Dec 2024	Three ring-fenced mandates: Stabilisation Fund, Future Generations Fund, Nigeria Infrastructure Fund.
Rwanda	Agaciro Development Fund (2012)	~ $250m by 2021; latest not disclosed	National savings for resilience and intergenerational equity; socio-economic development.
Senegal	FONSIS (2012)	$1.23bn (2025 profile)	Sovereign development fund to catalyse private investment in strategic sectors.
Zimbabwe	Mutapa Investment Fund (2014; renamed 2023)	Size not officially audited; government communications cite ~ $16bn in state assets transferred	Consolidate and professionalise SOE assets, support development and fiscal stabilisation.

Sources: funds' websites

Note: Sizes reflect latest publicly available figures. Some entities (for example, strategic holding or development funds) report the book value of state assets rather than liquid financial AUM, so figures are not perfectly comparable.

4.2.3 Earmarking Revenues for Strategic Development Goals

Earmarking can tie mineral revenues to long-term priorities such as education, health, and strategic infrastructure. The case for earmarking is strong when baseline spending on these priorities is too low or volatile, and when citizens need evidence that resources are being allocated to shared goals. The case against earmarking is that rigid tags can fragment budgets, complicate planning, and protect inefficient programmes from scrutiny.

A middle course works best. Countries can allocate a share of structural resource revenues to multi-year funds with explicit objectives and performance indicators, integrated within the budget and subject to parliamentary approval. For example, part of the savings portfolio's expected return can finance a Skills and Science Fund that invests in Science, Technology, Engineering, and Mathematics (STEM) education, research partnerships, and vocational training. Disbursements should be output-based and audited. Another share can service debt for well-prepared infrastructure projects that pass rigorous cost-benefit tests. The rule should specify that when prices fall below structural levels, earmarked flows adjust proportionally to preserve overall stability[96].

4.3 A Macro-Fiscal Toolkit for Resource-Rich African Economies

We recommend here a toolkit that links fiscal policy to monetary and exchange rate policy, public investment management, debt strategy, and transparency.

- *Non-resource primary balance and sterilisation:* Track the non-resource primary balance to gauge the underlying fiscal stance. During booms, save abroad, ideally in fellow African markets, to reduce real appreciation pressures and to protect competitiveness. Coordinate with the central bank to sterilise liquidity where needed, mindful of costs. Use the exchange rate regime and credible inflation targets to anchor expectations. Avoid large, procyclical jumps in public expenditure and transfers that are hard to reverse.
- *Public investment management:* Efficient investment converts resource wealth into productive national assets. Strengthen project appraisal, selection, budgeting, and execution. Adopt a public investment management assessment and implement reforms in a sequenced manner: pipelines linked to national plans, an independent review of major projects, standardised cost-benefit methods, and post-completion audits. Transparent procurement and maintenance budgets protect value for money[97].
- *Debt management and sustainability:* Set a prudent debt anchor and keep borrowing on a path consistent with long-term revenues. Resource-backed loans demand caution. If used, they should be transparent, competitively priced, and limited in size relative to future structural revenues. Hedging can reduce price risk for critical projects, but policymakers must understand basis risk and margin calls before committing.

- *Fiscal risks and state-owned enterprises:* Disclose guarantees, public-private partnership liabilities, and state-owned enterprise exposures. Publish a fiscal risk statement that includes stress tests for price, production, and exchange rate shocks. Where national mining or energy companies operate, institute hard budget constraints, independent boards, and transparent dividend policies.
- *Local content and productivity:* Local content rules should target capabilities that raise productivity rather than impose rigid quotas. Use fiscal incentives to support training, supplier development, and technology adoption where spillovers are demonstrable. Avoid import bans or export restrictions that undermine investment unless part of a well-designed, time-bound strategy anchored in regional markets.
- *Regional integration:* Processing plants need scale, reliable inputs, and routes to market. The AfCFTA reduces tariff and non-tariff barriers on intermediate and finished goods. It supports common standards, payments, and digital trade. This integration allows one country to mine ore, another to process, and a third to manufacture components within a single market. Fiscal rules and funds then stabilise the macro environment, while regional infrastructure lowers delivered costs. The combination makes investment in manufacturing bankable at scale[98].

African countries can turn mineral wealth into sustained prosperity with the right macro-fiscal rules supported by well-managed SWFs and strong institutions. Structural or expenditure-based rules stabilise the budget and set the pace of spending. Progressive royalty and tax regimes raise fair revenue while preserving investment. Well-governed sovereign wealth funds save for the future and smooth shocks. Public investment systems convert savings into productive assets, while transparent reporting and fiscal risk management protect credibility.

Citizens must see the benefits. Publishing contracts, payments, fund reports, and performance dashboards can build trust. Where countries opt for dividends or earmarked spending on education and health, rules should be clear, affordable, and consistent with the broader framework.
Lastly, integration matters. A continental market for goods, services, and capital reduces unit costs and increases the number of viable processing projects. Regional corridors and harmonised standards enable firms to specialise and scale. With these elements in place, African nations can protect stability today and deliver value for future generations.

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African countries can turn mineral wealth into sustained prosperity with the right macro-fiscal rules supported by well-managed SWFs and strong institutions.

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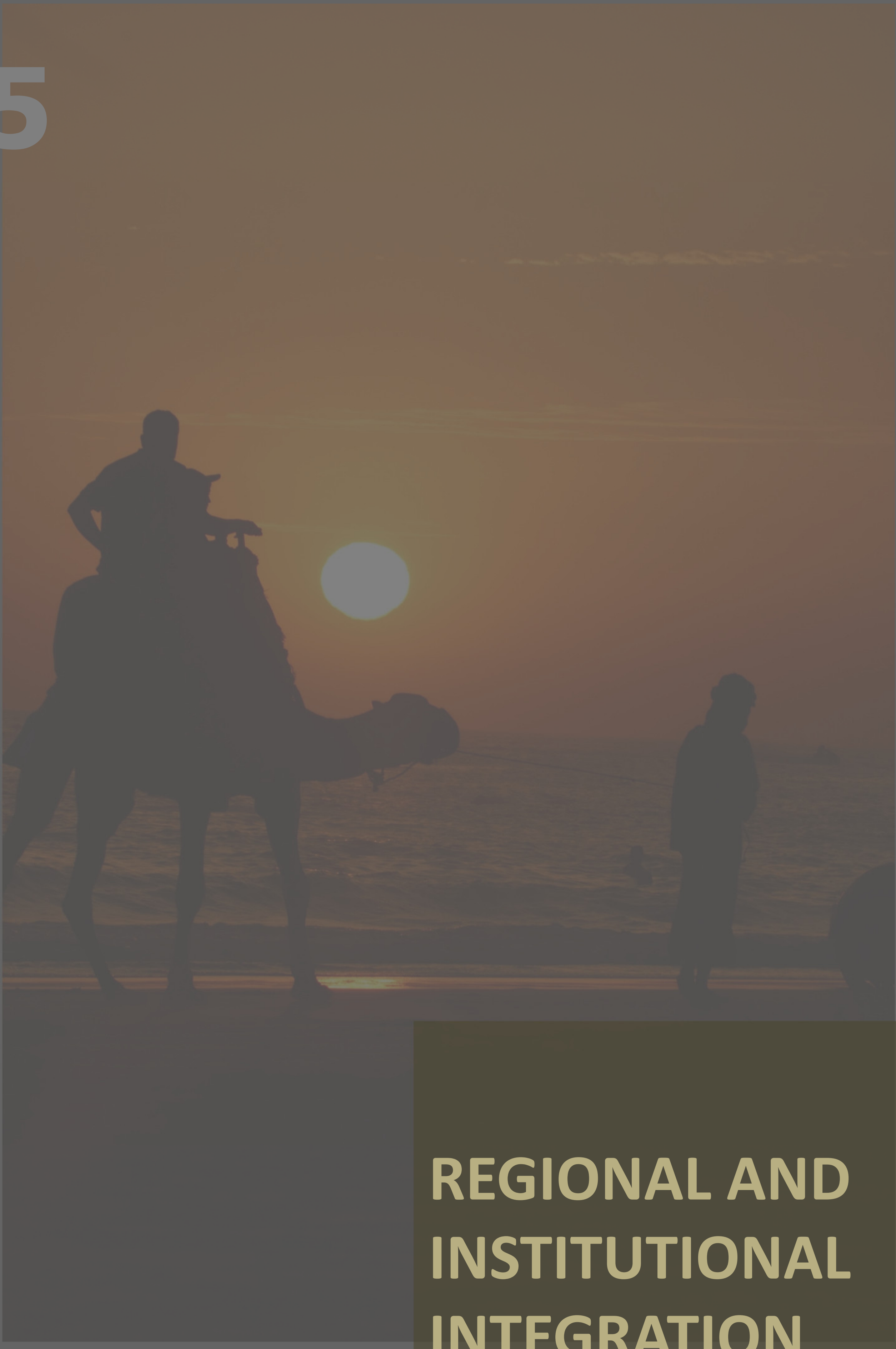


05

REGIONAL AND INSTITUTIONAL INTEGRATION

5. Regional and Institutional Integration

Resource-based industrialisation in Africa cannot succeed through isolated national efforts. The capital needed for processing plants, the logistics to supply them, and the markets they serve all surpass the capacity of most individual economies. The path to sustainable value addition is regional: integrated corridors linking mines to processing hubs and ports, a single continental market that encourages intra-African specialisation, and continental institutions that align incentives, share risks, and negotiate with global partners from a position of strength.

This champter explains why cross-border transport and economic corridors are essential for mineral value chains and how they can be organized to lower costs and reduce risks for private investments. It also reviews policy integration under the African Continental Free Trade Area (AfCFTA), including the role of recently approved protocols and the need for a tailored mining framework across the common area. Additionally, it suggests a continental governance structure to implement the Africa Mining Vision, including practical institutional reforms to ensure coordination at the highest levels of the African Union (AU). Acknowledging that working within the AU can seem slow and bureaucratic, sovereign states are encouraged to adopt a collaborative approach with their peers – form of coalition of the willing – to implement any of the recommendations in this report that requires regional integration.

Box 2: Background on AfCFTA

In January 2012, African leaders adopted the decision to establish a continental free trade area as a pillar of Agenda 2063 and endorsed the Action Plan for Boosting Intra-African Trade. Negotiations were formally launched at the AU Summit in Johannesburg in June 2015. The Agreement was signed in Kigali on 21 March 2018. After the twenty-second ratification threshold was reached on 29 April 2019, the Agreement entered into force on 30 May 2019.

The operational phase was launched on 7 July 2019, and trading under AfCFTA rules formally began on 1 January 2021. In October 2022 the Secretariat launched the Guided Trade Initiative to pilot shipments using AfCFTA preferences and systems. In February 2024 the AU adopted the Protocol on Digital Trade to underpin cross-border e-commerce, payments and data flows.

Size of the market.

- The AfCFTA links a continental market of roughly 1.3 billion people with a combined GDP of about $3.4 trillion, making it the largest free trade area by number of participating countries.

Current implementation status.

- Phase I set the core architecture for trade in goods, trade in services, and dispute settlement. Phase II adds competition policy, investment, intellectual property rights, and women and youth in trade. Phase III brings digital trade, which is critical for seamless documentation, e-invoicing and interoperable payment systems that lower the cost and time of cross-border transactions.
- Fifty-four of 55 member states have signed the Agreement. Ratifications have continued to climb, reaching about 49 state parties by mid-2025, while practical implementation is advancing through the Guided Trade Initiative and the roll-out of phase-two and phase-three protocols. Trading under AfCFTA preferences has begun among a growing group of participants, although full uptake remains uneven as countries complete schedules, customs connectivity and domestic adjustments.

Why the AfCFTA matters for mineral-based industrialisation in Africa.

Few individual African markets can support large chemical, metallurgical or fabrication plants on their own. The AfCFTA creates the scale by allowing firms to locate processing where power is cheaper, feedstock is nearest, water and logistics are dependable, then sell across the continent without tariff penalties. It also enables regional specialisation: one country can mine ore, another can refine or smelt, a third can manufacture components, all within a single continental value chain. The Guided Trade Initiative and the Digital Trade Protocol reduce the friction that historically killed margins through paperwork, delays and currency costs.

Regional integration will convert Africa's fragmented endowments into integrated value chains, diversifying political and route risk, deepening supplier and buyer pools, and making long-term investment bankable at a cost of capital that individual countries struggle to secure on their own. Without that integrated market, most projects will remain sub-scale, over-exposed to single borders and ports, and priced out by logistics and compliance costs.

Sources: AfCFTA Secretariat, 2022, 2024, 2025; African Union, 2012, 2015, 2018, 2019, 2024; World Bank, 2020.

5.1 Developing Cross-Border Corridors for Mineral Value Chains

Well-designed corridors will drive the structural integrity of mineral-based industrialisation in Africa. These corridors will move bulk ore to concentrators, carry concentrates to smelters and refineries, and deliver finished metals to regional manufacturers and global markets. For landlocked producers, they convert geological endowment into tradable value by linking mines to coastal gateways. For coastal states, they enable clustering of energy-intensive processing near ports with reliable power and water. For investors, they lower unit costs through scale, reduce uncertainty through predictable timetables, and create options for multi-user, multi-commodity flows that improve bankability.

Corridor reform focuses on reducing border frictions that increase logistics costs and de-risking private investment. A multi-country, rules-based corridor with credible sponsors lowers asset-specific political risk, supports take-or-pay contracts, and increases the likelihood of timely completion. Support from regional bodies and development finance institutions makes a significant difference because they can provide long-term debt, partial risk and credit guarantees, and influence to coordinate permits, land access, and standards across borders.

Other corridors on the continent to inspire possibilities include:

- *Nacala Logistics Corridor:* Mozambique–Malawi rail and port system. The 912 km rail-port system connects inland Malawi and western Mozambique to the deep-water port at Nacala, supported by project finance from international partners. It transports bulk commodities on a large scale and carries general cargo in both directions, which is important for beneficiation because inputs such as reagents, spare parts, and fuel can reach inland processors on reliable schedules, while concentrates or refined metals move out efficiently. Operators describe Nacala Logistics as the first railway company active in Malawi, serving cross-border flows across Mozambique and into Zambia.
- *Maputo Corridor:* South Africa–Mozambique minerals gateway. The Maputo route is a prime example of regional market integration for minerals. The Port of Maputo recorded record volumes in 2023, with ores such as chrome, ferrochrome, and magnetite, among others, making up the majority of the throughput. This cross-border rail, road, and port network provides inland producers with an alternative to South Africa's congested ports, reducing delivered costs and stabilising export schedules, which enhances the bankability of smelting and refining investments in the region.
- *Walvis Bay–Ndola–Lubumbashi Corridor:* Namibia to the Copperbelt. The Walvis Bay Corridor Group manages a public-private facilitation model connecting Namibia to Zambia and the DRC. This is further supported by a network of well-maintained paved roads that extend across Namibia into Angola, Botswana, South Africa, and Zimbabwe. Official and port sources indicate increasing Copperbelt exports via Walvis Bay and a balanced return of sulphur into Zambia for acid production in copper processing. This two-way flow reduces logistics deadweight and supports uninterrupted plant operations, which are essential for profitable beneficiation.

Case study 9: The Lobito Corridor, a route for Central African minerals

The Lobito Corridor connects the copper belt of the Democratic Republic of the Congo and Zambia to the Atlantic Ocean through Angola. The main route is the Benguela Railway, which runs from the DRC border at Luau through Lobito, and includes feeder links from Kolwezi and Zambia's Copperbelt. The corridor offers an alternative to congested eastern routes, shortens transit times to Atlantic markets, and provides options that reduce route-specific risk for producers of copper, cobalt, and other critical minerals.

Financing and delivery depend on layered partnerships. The Government of Angola has concessioned operations on the Lobito Atlantic Railway to a private consortium for investment and service upgrades. Meanwhile, the United States, the European Union, and their partners have identified the corridor as a flagship under the Partnership for Global Infrastructure and Investment.

Development banks are preparing support for infrastructure and regulatory upgrades, with the African Development Bank signalling its intention to catalyse private capital along the route. The World Bank's analytical work highlights the productivity gains from logistics reforms that are needed to maximise benefits.

The corridor illustrates how infrastructure integration directly supports value chains. Adding a west-facing outlet diversifies export risk, supports competitive tariffs through route competition, and encourages investment in local processing by improving the reliability of inbound consumables and outbound finished products. It also creates a platform for common customs procedures, digitised documentation, and aligned axle-load standards, which amplify the physical gains from track and terminal investments.

5.2 Harmonising Policy through the AfCFTA

The AfCFTA establishes the legal and institutional framework for a continental market, enabling raw materials to cross borders for processing, processed goods to circulate tariff-free among participating states, and services, capital, and data to support value chains on a large scale. The AfCFTA Agreement aims to progressively eliminate tariffs and non-tariff barriers on intra-African trade, as outlined in schedules negotiated by the State Parties. Eliminating tariffs on processed mineral products traded within Africa would encourage firms to site their processing facilities where energy is cheaper or where clusters of skills exist, and then sell across the market without penalty. The largest gains will come from disciplined removal of non-tariff barriers, including redundant licensing, discretionary inspections, and duplicative conformity assessment, which often persist after tariff reductions.

In February 2023, the AU Assembly adopted Phase II protocols on Competition Policy, Investment and Intellectual Property Rights[99]. In February 2024, it adopted the Protocol on Digital Trade, with annexes approved in 2025 that operationalise rules on data flows, online consumer protection, and other enablers of cross-border digital commerce[100]. These instruments matter for minerals. Competition rules can deter anti-competitive conduct along transport and handling chains. Investment provisions can give comfort to strategic investors in processing plants. Digital trade rules support e-documentation, digital letters of credit, and platform-enabled trading in concentrates or refined products.

Harmonised standards for mineral grades, environmental safeguards and labour protections are needed to avoid a race to the bottom and to meet buyer requirements in regional and global automotive and electronics supply chains. The Africa Mining Vision sets the normative direction[101], while the OECD Due Diligence Guidance and related tools provide practical frameworks for responsible sourcing that African regulators can reference, adapt and enforce.

Regional Economic Communities (RECs) are the laboratories where harmonisation becomes real. The Southern African Development Community (SADC) Protocol on Mining, signed in 1997 and in force since 2000, established cooperation on policy and standards , a basis that can be updated and extended to cover modern issues such as tailings safety, acid mine drainage, and carbon intensity reporting. REC-level technical committees can pilot aligned mining codes and fiscal regimes that lower uncertainty for cross-border projects, then scale successful models under the AfCFTA umbrella.

5.3 Forging a Continental Architecture for Mineral Governance

Africa needs continental institutions that turn vision into investment. The Africa Mining Vision (AMV) provides the north star: transparent, equitable and optimal exploitation of mineral resources to underpin broad-based growth and structural transformation. What is missing is a stronger operating system that coordinates corridors, aligns fiscal regimes, pools risk, and builds bargaining power in global markets.

5.3.1 Existing frameworks and tools

The AMV Action Plan and the African Minerals Development Centre provide policy templates, diagnostic tools, and capacity-building programmes. Complementary strategies, such as the AU Green Minerals Strategy, focus attention on the energy transition and the industrial opportunities that flow from it. Financially, Africa's development banks are expanding their instruments to support cross-border infrastructure. The African Development Bank and the World Bank can bring long-tenor lending and guarantee structures to corridors, while Afreximbank has scaled trade finance, launched the Africa Trade Gateway[103], and is operationalising the Pan-African Payment and Settlement System[104] (PAPSS) to reduce frictions in cross-border settlement. PAPSS is especially relevant for regional mineral trade because it enables faster payments and settlements in local currencies with central bank backing.

Parallel efforts in capital markets also matter. The African Exchanges Linkage Project connects 10 exchanges across 17 countries for order routing and market data sharing, a foundation for dual listings of regional champions and for mobilising domestic savings into long-term assets. Derivatives markets on the Johannesburg Stock Exchange show that risk can be managed locally through rand-settled metals contracts referencing global benchmarks, a practical bridge for an eventual African commodities platform that offers both physical and financial products.

5.3.2 Institutional reform proposal: a continental framework for mining governance

A coherent AU-level framework should set baseline rules for contracts, fiscal terms, environmental and social safeguards, and dispute resolution. It should codify a corridor-first approach, in which new processing plants are located on cross-border backbones with open-access rules. It should establish model clauses for take-or-pay rail agreements, port throughput commitments, and power wheeling, which can be adopted by RECs and states with minimal tailoring. It should align royalty calculations with transparent reference prices and require the publication of anonymised transaction data to support market integrity. Finally, it should embed responsible sourcing by referencing recognised standards for due diligence and traceability.

A more significant factor is collective bargaining power. Africa supplies a significant share of the world's cobalt and manganese, and has substantial potential for copper, lithium, and rare earth resources. Countries have previously discussed closer coordination for battery minerals. A structured organisation for strategic minerals, carefully designed to comply with competition rules and promote investment rather than restrict it, could pool market intelligence, coordinate infrastructure sequencing, and align sustainability standards, thereby strengthening Africa's hand in offtake negotiations for energy transition supply chains.

Innovation Box 1: An AU Commissioner for Commodities and Industrialisation

Mandate: Establish an AU Commissioner with a singular focus on resource-based industrialisation and regional value chains. The office would coordinate policy across mining, energy, transport, trade and finance to turn corridor plans and processing strategies into financed assets.

Responsibilities: First, drive harmonisation of mining rules within the AfCFTA by convening ministers and regulators to agree on model codes and fiscal benchmarks. Second, promote regional value chains by mapping cross-border complementarities, matching energy-abundant locations with processing needs, and sequencing investments along corridors. Third, negotiate with consortia and development banks on a pipeline basis to secure anchor finance for rolling programmes rather than one-off projects. Fourth, house an analytical secretariat for a minerals coordination body, maintaining price dashboards, environmental benchmarks, and forward supply-demand curves. Fifth, enforce transparency by publishing standardised data on royalty bases, export volumes, and corridor performance.

Justification: African institutions have many mandates but limited bandwidth. This role would provide political visibility and technical continuity to an agenda that spans multiple ministries and countries. It would embed the Africa Mining Vision in day-to-day financing and regulatory decisions, link PAPSS and the capital markets agenda to real projects, and build a professional cadre that thinks at a continental scale on these matters.

Table 8: Division of labour in a mining-driven continental industrialisation drive

Function	National governments	RECs	AfCFTA institutions	Continental DFIs and Afreximbank
Mining codes and licences	Adopt model clauses and publish contracts	Harmonise codes and standards	Embed in AfCFTA annexes where relevant	Provide TA tied to finance
Corridors	Grant concessions, land and permits	Align axle loads, transit guarantees	Support customs and data standards	Finance and guarantee multi-user assets
Responsible sourcing	Enforce ESIAs and mine site audits	Develop REC-level audit pools	Reference due diligence standards	Fund traceability and disclosure systems
Payments and FX	Enable PAPSS access and FX windows	Coordinate cross-border settlement rules	Recognise digital trade standards	Scale PAPSS, pilot currency marketplace

Africa's opportunity is clear. The world is retooling for electrification and low-carbon industry, which requires massive volumes of metals and minerals. The risk is equally clear. Without integration, Africa will continue to repeat the pattern of exporting bulk commodities while importing finished goods. The path to a different outcome rests on three pillars.

First, build corridors that efficiently move ore, concentrates, and refined products across borders. Where One-Stop Border Posts (OSBPs) and digital systems have been implemented, significant gains in time and cost have been observed. The lesson is to make such reforms standard along every priority route and to lock in multi-user rules that attract private shippers and processors.

Second, use the AfCFTA to turn geography into a single market. Tariff-free trade in processed minerals, common standards that meet global buyer requirements, rules that encourage responsible sourcing, and digital trade provisions that bring documentation and payments online will allow firms to specialise across borders. The recent adoption of protocols on competition, investment and digital trade provides the legal spine for this work.

Third, empower continental institutions to execute. A Commissioner for Commodities and Industrialisation would align ministries, financiers and regulators around a rolling programme of corridor and processing investments. Afreximbank's PAPSS reduces settlement frictions, while the African Exchanges Linkage Project and deeper local bond markets mobilise long-term capital. Development banks can derisk complex assets through guarantees and concessional tranches.

06

FINANCING AFRICA'S MINERAL-BASED INDUSTRIALISATION

6. Financing Africa's Mineral-based Industrialisation

Africa's ambition to industrialise through its mineral wealth will strongly depend on its ability to mobilise vast volumes of affordable, long-term finance. Transforming ore into refined materials and finished products requires the construction and modernisation of rail lines, ports, power systems, and water networks that knit industrial value chains together. These assets are expensive to build, take years to complete, and demand capital that can absorb construction and ramp-up risk. The success or failure of Africa's mineral-based industrialisation will therefore depend on how effectively the continent mobilises and sequences its diverse sources of capital to match risk, scale, and timing.

A coherent financing architecture must integrate three powerful engines of capital: banks that fund construction and working capital, development finance institutions (DFIs) that extend tenors and provide de-risking instruments, and capital markets that transform these exposures into long-term, tradable securities. When orchestrated together, these layers reduce the overall cost of capital, allocate risks to those best equipped to bear them, and create a sustainable pipeline for financing successive industrialisation projects.

This chapter provides an overview of recent examples across the continent, showing the breadth of instruments already being deployed. In Guinea, the $15 billion financing package for the Simandou iron-ore development blends equity from Rio Tinto and Chinese partners with state participation and milestone-linked debt. In South Africa, the AfDB's 25-year corporate loan to Transnet provides the flexibility needed to restore the national logistics grid. Along the Atlantic, the revival of the Lobito Corridor is drawing billions of dollars in U.S., European, and African capital to connect mines to export terminals. Together, these projects illustrate the range of financing solutions available to advance Africa's mineral-based industrialisation, from greenfield builds to brownfield recoveries and regional beneficiation corridors.

6.1 Banks: Bridging Scale and Sophistication

African banks are modest in global scale but significant in domestic impact. The combined Tier 1 capital of the continent's top 100 banks stood at about $126 billion in September 2025, up slightly from $120 billion a year earlier. By contrast, the five largest global banks – led by Industrial and Commercial Bank of China, China Construction Bank, JPMorgan Chase, Bank of America, and Agricultural Bank of China – together hold well over $1.2 trillion in Tier 1 capital[105]. This highlights the limited absolute firepower of African lenders. Yet within these constraints, Africa's banking industry has grown into a sophisticated network capable of financing complex, multi-billion-dollar projects across the continent.

> "African banks have shown they can underwrite big industrial tickets."

Standard Bank Group remains the largest African lender with $13.2 billion in Tier 1 capital, followed by National Bank of Egypt with $7.3 billion USD and Attijariwafa Bank with $6.2 billion USD. South African and North African banks continue to dominate the top of the table, along with Nigerian lenders with a significant pan-African footprint[106]. Despite their smaller size, these banks have repeatedly shown that they can structure and underwrite large industrial deals by blending long-tenor project loans with working-capital facilities, supplier credit, guarantees, and trade instruments.

These banks have shown they can underwrite big industrial tickets, combining long-tenor project loans with working-capital lines, supplier credit, guarantees, and trade instruments. In practice, this takes the form of syndicated term loans for plant and equipment, revolving facilities tied to receivables and inventory, letters of credit for machinery imports, and performance bonds that unlock public procurement. When banks pair these with leasing for machinery, factoring for cash-flow smoothing, and risk-sharing from DFIs, manufacturers can fund both the concrete and the cadence of production. Crucially, banks also underwrite and place local-currency bonds for national champions, which reduces foreign exchange exposure and builds a domestic investor base for industry.

In practice, this capability is visible in syndicated term loans for plant and equipment, revolving facilities tied to receivables and inventory, letters of credit for machinery imports, and performance bonds that unlock public procurement. When these instruments are combined with leasing for machinery, factoring to smooth cash flows, and risk-sharing from development finance institutions, manufacturers gain access to both the concrete and the cadence of production finance.

Many of these banks also underwrite and place local-currency bonds for national champions, reducing foreign-exchange exposure and cultivating a domestic investor base for industrial growth.

Nigerian banks have demonstrated this strength through syndicated financing for Dangote Group's cement capacity expansions and the broader Lekki Industrial Platform. The group benefited from $3.3 billion financing for its petrochemical complex, funded through a club loan led by Standard Chartered Bank and Guaranty Trust Bank, joined by Access Bank, Zenith Bank, Ecobank Nigeria, First Bank, UBA, First City Monument Bank, and South Africa's Standard Bank and FirstRand[107]. It was a textbook multi-bank construction facility that proved African balance sheets could stand alongside international lenders on a multi-year, multi-billion-dollar project.

In South Africa, lenders such as Standard Bank, Nedbank, and Absa have financed auto-component manufacturers that supply global original-equipment makers, upgraded steel mini-mills and smelters, and supported renewable-energy manufacturing, including wind-tower and turbine-blade plants in special economic zones[108]. In Morocco, Attijariwafa Bank, Banque Populaire, and Bank of Africa financed suppliers clustered around Renault's Tangier[109] and Stellantis's Kenitra plants, extending capital-expenditure loans for presses and moulds, supplier-invoice discounting, and export working capital as local firms moved into wire harnesses, seats, and interior plastics. The same institutions financed industrial-park developers at Tangier Med and Midparc through project-finance structures secured by long-term tenant leases, lowering entry costs for small and mid-sized manufacturers. In fertilisers, Moroccan banks co-financed OCP Group's downstream investments at Jorf Lasfar[110], showing that domestic lenders can fund both heavy industry and its ecosystem of suppliers.

6.2 Development Finance Institutions: Scaling Capital Mobilisation

Development finance institutions occupy a crucial middle ground between the public and private sectors. While their collective balance sheets are small compared to global commercial lenders, their ability to extend long maturities, absorb political and construction risk, and crowd in private finance gives them an outsized influence on development worldwide. They can similarly scale their impact in financing Africa's industrialisation agenda. Through creative structuring and syndication, DFIs are mastering the art of multiplying every dollar they lend.

A good example is the $1.5 billion Tema Port expansion in Ghana. The project followed a proven blueprint in which a private operator assumed the construction risk while the IFC anchored the financing. The IFC provided a $195 million A-loan from its own balance sheet, which gave commercial banks the confidence to commit a further $470 million B-loan under the IFC's umbrella[111]. This A/B loan model has become a template for complex industrial and corridor projects, allowing regional banks to participate in large transactions without taking on ultra-long tenors. Once the asset stabilises, these exposures can be refinanced or securitised, freeing capital for new lending.

Beyond individual deals, DFIs are scaling their impact by building programmatic platforms that channel institutional capital into portfolios of infrastructure and industrial projects. The IFC's Managed Co-Lending Portfolio Program (MCPP) allows global investors to take an automatic share of every new IFC loan, creating a "blind pool" that has mobilised around $16 billion for emerging markets. The privately managed ILX Fund complements this approach by investing directly in DFI B-loans, providing a ready-made source of liquidity for senior debt originated by institutions such as the AfDB and IFC[112]. Together, these mechanisms transform project-by-project finance into a pipeline of scalable, portfolio-based assets.

To recycle their own capital, DFIs increasingly employ advanced risk-transfer tools. The AfDB's pioneering "Room2Run" transaction transferred credit risk on a $1 billion portfolio through synthetic securitisation, freeing balance-sheet capacity for new operations. The International Development Bank (IDB) Invest and others have since replicated similar transactions. Another model is the creation of Infrastructure Asset-Backed Securities (IABS), pioneered by Singapore's Bayfront, which purchases infrastructure loans and issues them as securities to investors. By having institutions such as GuarantCo guarantee mezzanine tranches, these securities achieve high ratings and attract deep-pocketed private buyers, as seen in recent oversubscribed issues.

Blended finance remains one of the most powerful tools in the DFI arsenal. The Dutch development bank FMO demonstrated this with its $1.1 billion SDG Loan Fund, which pooled 100 loans into a single vehicle where FMO retained the first-loss tranche. This structure, partially backed by a foundation guarantee, delivered a high-grade instrument that mobilised private capital at a ratio of nine to one. Similarly, guarantee facilities can leverage several times more private lending than direct DFI loans by lowering regulatory risk weights for banks and insurers. Institutions such as The Currency Exchange Fund (TCX)[113] complement these efforts by providing local-currency hedging instruments, mitigating one of the greatest deterrents to long-term investment in African projects.

Through these approaches, DFIs are proving that financial innovation can be as important as capital size. Their capacity to design layered structures, share risk intelligently, and connect African projects with global investors is helping to build a bridge between development priorities and market discipline. As these models are replicated and scaled, Africa's DFIs will remain the essential link in transforming mineral wealth into bankable industrial ecosystems.

6.3 Capital Markets: Affordable Long Term Capital for Industrialisation

Capital markets are indispensable to Africa's industrialisation journey, yet they remain small and fragmented relative to global peers. Across the continent, 31 stock exchanges together host listed companies with a combined market capitalisation of between $1.7 to $2.0 trillion, less than two percent of global listed equity value. The Johannesburg Stock Exchange (JSE) accounts for more than 80 percent of this total and ranks among the top twenty exchanges worldwide by market capitalisation. On the debt side, the story is similar: Africa's entire bond market remains under $1 trillion, representing less than one percent of the global total[114]. The limited scale of these markets constrains the flow of long-term capital to the industries that must power mineral-based industrialisation.

Developing deep and sophisticated capital markets in Africa should be a top priority for governments and policymakers. Governments have a central role to play in deepening domestic debt markets and using them as reliable platforms for financing industrial and infrastructure projects. When sovereigns issue bonds across the maturity spectrum – from short-term bills to 10-, 15-, and 20-year notes – they establish a benchmark yield curve that provides pricing reference points for other issuers. This process not only enhances transparency and market predictability but also lowers borrowing costs for sub-sovereign entities, industrial corridor special-purpose vehicles (SPVs), and corporates. Over time, these issuers can price their securities as a spread over sovereign yields, enabling the emergence of a structured and predictable domestic debt market. Once infrastructure assets stabilise and generate steady cash flows, banks can refinance shorter-term construction loans into longer-term, investor-held securities, freeing up balance-sheet capacity for new projects.

Deep domestic bond markets also allow governments to finance infrastructure in local currency, reducing exposure to exchange-rate volatility and preserving macroeconomic stability. The example of Nigeria's FMDQ Group demonstrates what is possible when market infrastructure evolves in tandem with policy intent. As of October 2024, FMDQ reported total debt market listings of over $60 billion (NGN88 trillion), comprising sovereign, sub-sovereign, and corporate issuances[115]. The FMDQ's platforms have hosted innovative instruments such as the NGN 130 billion Federal Government Roads Ijarah Sukuk, which channels long-term domestic savings into infrastructure assets[116]. The exchange has also listed private funds like the Nigeria Infrastructure Debt Fund (NIDF) managed by Chapel Hill Denham, which enables institutional and retail investors to participate in infrastructure as an asset class[117]. Together, these developments illustrate how a well-functioning domestic debt market can provide governments and corporates with access to stable, long-term funding that aligns with the lifespan of industrial assets.

South Africa offers the prime example of depth and scale in domestic capital mobilisation in Africa. With an outstanding bond volume of about $329 billion across nearly 3,000 issuances, its debt market is the most developed on the continent[118]. The long-dated sovereign curve, developed through regular issuance by the National Treasury, has enabled a wide range of corporates, municipalities, and utilities to issue local currency debt at competitive spreads. The predictability of the South African bond market has also nurtured one of the deepest pools of domestic institutional investors in the Global South, comprising pension funds, insurers, and asset managers capable of supporting long-term industrial projects.

Equity markets complement this by supplying risk-bearing capital, governance discipline, and follow-on financing capacity. Several African multinationals maintain dual-listings on the continent and in other parts of the world to enjoy access to both domestic and cross-border capital markets. Egypt's Orascom Construction Plc, for instance, maintains its listing on the Egyptian Exchange (EGX) – while currently holding a primary listing on the Abu Dhabi Securities Exchange (ADX)[119].

This dual structure allows it to mobilise capital from both domestic and international investors for its infrastructure and industrial projects. Similarly, Dangote Cement Plc in Nigeria has leveraged its listing on the Nigerian Exchange (NGX) to issue both short-dated commercial paper and longer-term bonds, ensuring a diversified funding mix for expansion and working-capital needs[120]. In South Africa, mining majors such as Anglo American and Anglo American Platinum rely on the JSE for equity liquidity and for domestic note programmes that provide flexible financing options through accelerated bookbuilds and follow-on issues[121].

Governments should focus on fostering credible capital markets regulation, extending sovereign yield curves and deepening domestic investor pools. This will enable corporates to more easily issue long-term bonds and exchanges to provide transparent listing and trading infrastructure. This will lead to greater investor confidence, higher governance standards, greater local ownership in productive sectors and wealth creation, and a more robust financial ecosystem.

While Africa's capital markets are still characterised by limited depth, liquidity, and regional fragmentation, the direction is encouraging. With sustained reforms to improve market infrastructure, harmonise regulations across borders, and promote local institutional and retail participation, these markets can evolve into powerful engines for financing industrial transformation. Ultimately, deep and liquid domestic capital markets will be central to Africa's ability to finance mineral-based industrialisation in local currency, at scale, and on its own terms.

Table 9: State of African Stock Markets

#	Stock exchange	Founded	Country (2024 GDP, current prices - IMF)	Domestic Market Cap (as of end March 2025)	Number of Listed Companies	Market Cap as % of GDP
1	Johannesburg Stock Exchange (JSE)	1887	South Africa ($ 410 bn)	$ 1,019 bn	278	**268%**
2	Nigerian Exchange (NGX)	1961	Nigeria ($ 188 bn)	$ 57.8 bn	167	**31%**
3	Bourse de Casablanca (CSE)	1929	Morocco ($ 166 bn)	$ 82.5 bn	77	**50%**
4	The Egyptian Exchange (EGX)	1883	Egypt ($ 347 bn)	$ 44.3 bn	246	**13%**
5	Botswana Stock Exchange (BSE)	1989	Botswana ($ 19.4 bn)	$ 53 bn	31	**272%**
6	Nairobi Securities Exchange (NSE)	1954	Kenya ($ 132 bn)	$ 15.4 bn	61	**12%**
7	BRVM (WAEMU, HQ in Abidjan) *	1998	Côte d'Ivoire proxy GDP $ 95 bn)	$ 16.2 bn	47	**17%**
8	Stock Exchange of M auritius (SEM)	1988	Mauritius ($ 15.5 bn)	$ 9.5 bn	100	**61%**
9	Dar es Salaam SE (DSE)	1998	Tanzania ($ 96 bn)	$ 7.4 bn	28	**8%**
10	Ghana Stock Exchange (GSE)	1990	Ghana ($ 88)	$ 7.6 bn	36	**9%**
	Aggregate for all 31 operational exchanges in Africa		Africa (GDP - $ 2,830 billion)	$ 1,600 bn	1640	**57%**

Sources: IMF, World Federation of Exchanges, African Securities Exchanges Association (ASEA)

*Note: * WAEMU: West African Economic and Monetary Union (the BRVM serves Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo)*

Innovation Box 2: The Case for Three New African Multinational Corporations

Africa must build and nurture its own giants

- Global extractive and logistics industries are dominated by a handful of very large, multinational groups. In mining, the largest names include BHP (an Australian multinational headquartered in Melbourne), Rio Tinto (a dual-listed British–Australian group with major listings and management centres in both London and Australia), Vale (Brazil), Glencore (headquartered in Switzerland with major UK listings and offices), and Anglo American, a company founded in South Africa in 1917 that is today a UK-controlled and listed multinational with deep historical roots in southern Africa.
- In oil and gas, the sector's integrated leaders include ExxonMobil and Chevron (United States), Shell (the long-running Anglo-Dutch group that consolidated under Shell plc and now has a UK registration), TotalEnergies (France), Saudi Aramco (Saudi Arabia), Petrobras (Brazil) and the large Chinese national groups such as Sinopec and CNPC.
- In container shipping the foremost carriers are MSC (Mediterranean Shipping Company, headquartered in Geneva, Switzerland), A.P. Møller-Maersk (Denmark), CMA CGM (France), COSCO (China) and Hapag-Lloyd (Germany).
- Africa has comparatively few indigenous groups with the scale and global networks to match these players. If the continent is to reclaim economic sovereignty over its natural resources and retain more of the value chain, it needs home-grown multinational champions – in mining (including large-scale processing and manufacturing), in oil and gas (from upstream to downstream) and in shipping, ports and logistics – that are African-owned, African-managed and built to compete globally.

Surmounting the high barriers to entry

The barriers include high upfront capital, technology and operational know-how, large talent pipelines, access to low-cost long-tenor finance, and the need for global commercial networks. Africa can clear these hurdles with continental leadership and a shared commitment to build scale. Several levers are available:

- Resource advantage: Locate value-addition at the source. Secure feedstock through long-term mineral and crude allocation agreements tied to local processing milestones and performance covenants. The resources are on African soil, which allows structured offtake to backstop financing.
- Pooling and consolidation: Aggregate sovereign and private cargoes and offtake into long-term contracts to underwrite capacity. Pooling government cargo alone can underpin multi-year charters for an African shipping champion, for example.
- Digital and market infrastructure: Use PAPSS for cross-border settlement and its Africa Currency Marketplace to reduce FX frictions along regional supply chains.
- Industrial partnerships: Bring in strategic investors for technology transfer and operational discipline. Use performance-based management contracts and profit-share arrangements that reward efficiency and uptime.
- List for scale: Dual and triple list on African exchanges at inception and add one international line to broaden the investor base and analyst coverage. Link follow-on raises to delivery milestones.
- Talent and governance: Build deep technical cadres through secondments with global operators, and lock in governance through independent boards, audit and risk committees, and clear dividend and free-float policies.

Innovation Box 2: The Case for Three New African Multinational Corporations [continued]

Roles for the Major Actors

1. African Union

- Mandate and treaty backbone: Create an AU-sponsored special-purpose vehicle with a continental mandate to sponsor three PPP-led multinationals, one in each target area. Embed AfCFTA-consistent rules on competition, cabotage, and open-access infrastructure, and coordinate Regional Economic Communities on permissive licensing and cross-border movement.
- Regulatory harmonisation: Champion a common disclosure and listing template to enable simultaneous multi-exchange IPOs and secondary offerings.
- Cargo and offtake pooling: Convene member states to commit a share of public cargoes and mineral offtake to long-term framework contracts that support vessels, pipelines, and plants.

2. Afreximbank

- Anchor equity and guarantees: Invest through FEDA as an early equity anchor, and provide credit-enhancement, trade finance, and receivables-backed structures for offtake. FEDA already deploys equity into industrial and logistics platforms and has capital ready for scale.
- Payments and FX rails: Deploy PAPSS for coupon, dividend, and trade-settlement flows, and fully operationalise the Africa Currency Marketplace so issuers and suppliers can match local-currency needs directly.
- Diaspora mobilisation: Structure a "Beneficiation Bond" programme for the diaspora with transparent use-of-proceeds and an option to convert part of holdings into IPO shares.

3. AfDB

- Project development and risk-mitigation: Use the Africa Investment Forum to move projects to bankability, crowd in commercial capital, and attach partial risk and partial credit guarantees. The AIF has recorded tens of billions of dollars in investment interest and serves as a proven platform to accelerate the financial close.
- SDR-hybrid leverage and corridor finance: Leverage allocated SDRs to expand long-tenor capacity and continue financing strategic corridors such as the Lobito route that connect mines to ports and processors.
- Co-developer capacity: Work alongside Africa50 to de-risk early development, standardise documentation, and enforce environmental and social safeguards at scale.

4. National governments

- Contribute assets and rights: Inject brownfield assets, rights of way, and long-term concessions rather than only cash. Align fiscal regimes across borders for predictable royalty and tax frameworks.
- Market-making policies: Commit sovereign cargo, simplify border procedures, and enforce open-access rules for rail, pipelines, and terminals.
- Safeguards and discipline: Ring-fence the companies from political cycles through independent boards, clear dividend policies, and transparent procurement.

5. Strategic private investors

- Technology and operating systems: Provide process technology, fleet and yard management, maintenance, and digital tracking platforms.
- Capital and capex discipline: Co-invest as significant minorities with clear performance-linked returns. In shipping, the scale of investment is material, with ultra-large container vessels costing about 250 to 270 million US dollars each, which underlines the case for pooled commitments.
- Market access: Bring global customer relationships, structured offtake, and risk-management tools to secure margins.

6. Citizens and the diaspora

- Ownership at scale: Subscribe to IPOs and follow-on issues across African exchanges and participate in diaspora bonds that fund named assets with quarterly reporting and trustee oversight. Nigeria's five-year $300 million diaspora bond priced at 5.625 percent remains a practical template.
- Accountability through markets: Public listing enforces disclosure and performance. Broadened share ownership fosters support for long-term strategies and mitigates political risk.

Innovation Box 2: The Case for Three New African Multinational Corporations [continued]

The operating blueprint: three PPP-led champions

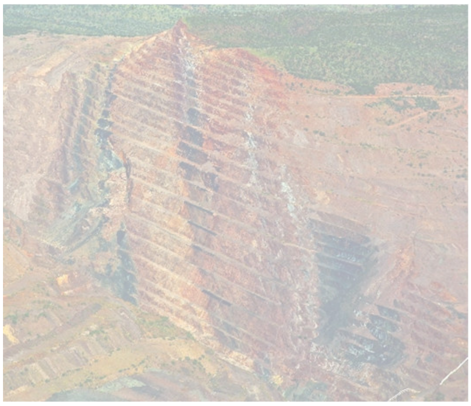
- Oil and gas upstream, midstream, and downstream: Nurture existing companies to refine African crude and natural gas into petroleum and energy products on the continent. Use long-term crude allocation from producing states, structured offtake to neighbours, and ECA-backed equipment finance.
- Mining and strategic minerals processing: Develop battery precursor, alumina, and specialty metals plants that sit near mines and corridors. Tie offtake to regional OEMs and global traders, and use green or transition-labelled bonds for eligible assets.
- Shipping and logistics integrator: Combine stakes in ports, rail links, coastal shipping, and digital platforms to lower delivered costs within Africa and to world markets. Pool government cargo and large private flows into take-or-pay charters to underwrite vessels and rail capacity. Build on existing African operators and expand reach; currently, no African carrier is among the global top container lines, which leaves value on the table.

Ownership and governance model

- Shareholder mix: Negotiate among AU-sponsored SPV, Afreximbank, AfDB Group, participating national governments, private strategic investors, and a sizeable dedicated public float open to citizens, communities, and the diaspora. List simultaneously in Johannesburg, Lagos, Cairo, and Nairobi, and add a non-African exchange to further broaden the investor pool. Lock in free-float and dividend thresholds, adopt leading disclosure standards, and seat independent audit and risk committees from day one.
- Why this design works: The AU sets mandate and regional discipline, the multilaterals anchor equity and de-risk tenor, governments contribute assets and permits, strategic investors import technology and operating excellence, and the public float builds accountability and popular support. PAPSS lowers settlement friction for cross-border trade and coupons, while AIF and Africa50 accelerate bankability and financial close. Together, these elements assemble the scale and staying power required to compete with Shell, Rio Tinto, or Maersk on African terms.

6.4 Reclaiming Pricing Power: A Pan African Commodities Exchange

To secure access to deep pools of equity and fixed-income capital, a Pan-African Commodities Exchange (ACE) is necessary to shift price discovery for key minerals to African soil, starting with cobalt, lithium, bauxite, and manganese. This exchange will design products that reflect African logistics, assay standards, and delivery points. The JSE already hosts metals derivatives and serves as a proof of concept for clearing and risk management in this space. The independent ACE can build on that base and add spot, forward, and warehouse receipt-backed instruments for transition minerals.



Case study 10: Mongolia Mining Products Exchange, a model for local pricing

Mongolia introduced a Mining Products Exchange through legislation in 2022, and trading began in 2023. The Mongolian Stock Exchange (MSE) was granted a licence to operate the new exchange, establishing a formal platform for coal, iron ore, fluorspar, copper concentrates, and other mining products to be sold via spot and forward electronic auctions, with full transparency in bidding and published prices.

In 2023, Mongolia exported a record 70 million tonnes of coal, a substantial portion of which was already being sold through the Mining Products Exchange. By early 2024, the exchange had hundreds of registered buyers and suppliers. In addition to coal, iron ore and concentrate have also been listed for exchange trading since September 2023. Mongolrosvetmet and Darkhan Metallurgical Plant together sold approximately 680,000 tonnes of iron ore/ concentrate, valued at MNT 7.5 trillion (~$2.2 billion), through the exchange.

The shift to exchange-based trading has begun to change pricing dynamics. Prior to exchange trading, Mongolia’s coal exports were often sold under “mine-mouth” contracts for $70 to $80 per tonne. Post exchange introduction observed coal prices have ranged from $140 to $190 per tonne, indicating a significant upward adjustment in price realisation.

Pricing Power and Royalty Reform

- The Mining Products Exchange has become a reference price source for mineral royalties. As of September 2025, Mongolia reformed its royalty calculation system: exporters are now required to sell at least 25 percent of their annual mineral output on the domestic exchange, and the average prices realized there will serve as the basis for royalty taxes, replacing reliance on international benchmark indices.
- This reform seeks to align royalty obligations more closely with actual market prices received by firms, reduce disputes over benchmark pricing, and strengthen the exchange’s role as a pricing authority. By anchoring royalty calculations to domestic exchange prices, Mongolia is shifting price discovery from off-exchange contracts to the exchange itself, thereby giving the country more leverage over how mineral export prices are determined, limiting external price manipulations, and improving fiscal transparency.

Implications for Pricing Power

By creating a domestic exchange and using exchange-based transaction prices to calculate royalties, Mongolia is partially re-localising the price discovery process. This provides policymakers and fiscal authorities with greater visibility and control over actual export pricing, reducing their dependence on opaque international benchmark indices that can distort national revenue assessments.

Case study 10: Mongolia Mining Products Exchange, a model for local pricing [continued]

The exchange mechanism also allows Mongolia to:

- Capture a higher share of value by reducing mispricing and hidden discounts on mine-mouth transactions.
- Expose export contracts to more competitive bidding, which can pressure exporters and intermediaries to achieve better prices.
- Provide publicly observable price signals for investors, producers, and regulators, which can reduce corruption and under-the-table deals.
- Strengthen Mongolia's negotiation position in international contracts, by demonstrating transparent price performance and a credible domestic price reference system.

These reforms, however, are not without challenges: they require sufficient liquidity and participation on the exchange, consistent quality grading, stable regulatory rules, and adequate infrastructure (especially export logistics) to ensure that domestic exchange prices are credible and enforceable. Early uptake in Mongolia – where only about 20 to 25 percent of export volumes have been brought onto the exchange so far – suggests that building full pricing power will take time, alongside reforms in logistics, contract renegotiation, and compliance enforcement.

Key lessons for Africa

Mongolia's Mining Products Exchange is a promising model for harnessing domestic pricing mechanisms, fiscal reform, and market transparency. Its success depends on scaling exchange liquidity, refining regulatory implementation, and ensuring that exchange-based pricing becomes the benchmark for export and royalty regimes.

6.5 Other Innovative Financial Instruments

6.5.1 Resource-backed SDRs and hybrid capital

Africa should leverage the new IMF-approved channel that enables member countries to utilise their Special Drawing Rights (SDRs) as hybrid capital for multilateral development banks (MDBs). According to the AfDB, with $1 of SDRs, MDBs can unlock at least $4 in new lending for development projects. African governments should pool these SDRs and route them to specially-dedicated AfDB and Afreximbank hybrid instruments. Both of these African multilaterals can create mineral-linked cash flow accounts structured at the project level to mitigate currency and convertibility risks associated with infrastructure related to industrialisation. By adopting this innovative financing model, African governments can mobilise substantial resources for infrastructure development without incurring additional sovereign debt. This will not only support the continent's industrialisation agenda but also strengthen the financial resilience of its economies.

To effectively harness the potential of the African diaspora, governments should consider issuing ring-fenced Diaspora Beneficiation Bonds. These bonds would link returns directly to the cash flows generated by specific value addition projects, such as mineral processing plants or industrial parks.

6.5.2 Diaspora Beneficiation Bonds

By registering these bonds with major securities regulators across the continent, governments can enhance transparency and build trust among potential investors. Employing independent trustees, establishing escrow accounts, and providing robust periodic reporting would further ensure accountability and investor confidence. Offering both hard currency and local currency tranches, along with digital subscription channels, can reduce friction costs and broaden access to a wider pool of investors.

A notable example of leveraging diaspora resources for development is Ethiopia's issuance of the Millennium Corporate Bond in 2008. This bond was designed to finance the Grand Ethiopian Renaissance Dam and was marketed primarily to the Ethiopian diaspora. While the bond faced challenges, it demonstrated the potential of engaging the diaspora in financing large-scale infrastructure projects. Similarly, Nigeria's 2017 diaspora bond raised US$300 million and was oversubscribed by 130 percent[122], partly due to its international listing and the regulatory protections it offered to investors. Both examples highlight the feasibility and potential benefits of diaspora bonds when structured effectively. By adopting a similar approach, African countries can mobilise diaspora capital to finance beneficiation projects, thereby fostering industrialisation and economic development across the continent.

Table 10: Illustrative structure of a Diaspora Beneficiation Bond

Issuer	**Afreximbank SPV, for and on behalf of named beneficiation projects**
Target investor base	African diaspora, African pension funds, African mutual funds
Currency	US Dollar tranche and select local currency tranches
Tenor	10 to 15 years, amortising from year 4
Security	Pledge over project offtake receivables, escrowed in PAPSS linked accounts
Reporting	Quarterly project cash flow and impact dashboard, audited annually
Incentives	Option to convert a portion to IPO shares at a determined percentage discount at listing

6.5.3 Green and climate bonds for transition minerals

Governments should consider issuing certified green bonds specifically designed to finance sustainable industrialisation, including mining operations, beneficiation plants, and recycling facilities. By aligning these projects with internationally recognised green standards, such as the Climate Bonds Standard, these bonds can attract both climate-focused funds and private investors seeking sustainable investment opportunities. The African Development Bank's Sustainable Bond Program exemplifies such initiatives, issuing green bonds to finance projects that contribute to environmental sustainability and climate resilience[123]. Another example is Zambia's Copperbelt Energy Corporation, which successfully issued a $150 million, 15-year green bond in December 2024 to finance the development of solar energy projects[124], demonstrating the viability of green financing in Africa's resource sector.

The issuance of green bonds for transition minerals can be further enhanced by listing these bonds on African exchanges, ensuring transparency and accessibility for a broader range of investors. Proceeds from these bonds should be earmarked exclusively for projects that meet stringent environmental criteria, with third-party verification to ensure compliance. Incorporating features such as anchor subscriptions from climate funds and digital subscription platforms is essential.

Financing mineral-based industrialisation is not simply about raising large sums of money but, more importantly, about sequencing and aligning diverse forms of capital so that each plays to its strength. Banks remain the frontline financiers of plant construction, supplier credit, and working capital.

The challenge now is to make this architecture truly pan-African. That means harmonising financial regulations, deepening domestic bond markets, strengthening regional payment and settlement systems, and encouraging African exchanges to list industrial and infrastructure vehicles in multiple jurisdictions. It also means building credible pipelines of bankable projects and nurturing African multinationals capable of competing globally. If these elements come together, Africa can reclaim control over its mineral endowments, capture more value within its borders, and finance an industrial transformation on its own terms.

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> **Financing mineral-based industrialisation is not simply about raising large sums of money but, more importantly, about sequencing and aligning diverse forms of capital so that each plays to its strength. Banks remain the frontline financiers of plant construction, supplier credit, and working capital. Development finance institutions provide the maturity, risk cover, and catalytic instruments that draw in private co-investors. Capital markets transform project finance into scalable securities, allowing pension funds, insurers, and citizens to invest in the continent's industrial future.**
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07

TECHNOLOGY AND INNOVATION ECOSYSTEMS

7. Technology and Innovation Ecosystems

Technology and innovation must sit at the centre of mineral-led development in Africa. They shape how resources are discovered, how ore is extracted and processed, how environmental risks are managed, and how value is captured locally through beneficiation and services. Africa will not move beyond primary extraction at scale without deliberate investment in digital capabilities, data infrastructure, and innovation systems that connect mines, suppliers, researchers, and investors into functioning ecosystems.

The suite of Fourth Industrial Revolution technologies is already changing mining worldwide. Digital twins allow operators to simulate and optimise mine-to-market systems before making costly changes[125]. The internet of things connects fleets, plants, and power systems, generating real-time data to reduce downtime and defects. Drones, autonomy, and remote operations increase safety while raising utilisation[126]. Advanced analytics and artificial intelligence support decisions on grade control, maintenance, energy management, and logistics. These tools lower unit costs and reduce environmental footprints when combined with clear standards and skilled teams[127].

This chapter proceeds in four parts. First, we examine the digital transformation of mining operations and then turn to the homegrown innovation ecosystem that Africa requires to adapt and scale these tools. The chapter also proposes a pan-African approach to research and development, with shared facilities and standards. Lastly, we outline strategic global partnerships for skills, technology transfer, and investment – including priority actions for policymakers and industry leaders.

Table 11: Key mining technologies and applications

Technology	Primary mining applications	Operational benefits
Digital twins	Mine-to-market system simulation, debottlenecking, throughput and energy optimisation	Scenario testing without production risk, better capex targeting, lower unit costs
Industrial IoT	Asset health monitoring, process control, energy management	Less unplanned downtime, longer asset life, tighter process variation
Drones	Surveying, stockpile volumetrics, compliance monitoring, environmental surveillance	Faster data acquisition, lower cost per survey, improved safety
Autonomous vehicles and drills	Haulage, loading, development drilling, production drilling	Higher utilisation, fewer stoppages after blasts, improved safety outcomes
Advanced analytics and AI	Grade control, predictive maintenance, reconciliation, fuel and power optimisation	Higher recovery, lower maintenance spend, reduced energy intensity
Remote operations centres	Integrated supervision of fleets, plants, and logistics	Standardised performance, deeper talent pools, safer working conditions

7. Technology and Innovation Ecosystems

Technology and innovation must sit at the centre of mineral-led development in Africa. They shape how resources are discovered, how ore is extracted and processed, how environmental risks are managed, and how value is captured locally through beneficiation and services. Africa will not move beyond primary extraction at scale without deliberate investment in digital capabilities, data infrastructure, and innovation systems that connect mines, suppliers, researchers, and investors into functioning ecosystems.

The suite of Fourth Industrial Revolution technologies is already changing mining worldwide. Digital twins allow operators to simulate and optimise mine-to-market systems before making costly changes[125].

The internet of things connects fleets, plants, and power systems, generating real-time data to reduce downtime and defects. Drones, autonomy, and remote operations increase safety while raising utilisation[126]. Advanced analytics and artificial intelligence support decisions on grade control, maintenance, energy management, and logistics. These tools lower unit costs and reduce environmental footprints when combined with clear standards and skilled teams[127].

This chapter proceeds in four parts. First, we examine the digital transformation of mining operations and then turn to the homegrown innovation ecosystem that Africa requires to adapt and scale these tools. The chapter also proposes a pan-African approach to research and development, with shared facilities and standards. Lastly, we outline strategic global partnerships for skills, technology transfer, and investment – including priority actions for policymakers and industry leaders.

Table 11: Key mining technologies and applications

Technology	Primary mining applications	Operational benefits
Digital twins	Mine-to-market system simulation, debottlenecking, throughput and energy optimisation	Scenario testing without production risk, better capex targeting, lower unit costs
Industrial IoT	Asset health monitoring, process control, energy management	Less unplanned downtime, longer asset life, tighter process variation
Drones	Surveying, stockpile volumetrics, compliance monitoring, environmental surveillance	Faster data acquisition, lower cost per survey, improved safety
Autonomous vehicles and drills	Haulage, loading, development drilling, production drilling	Higher utilisation, fewer stoppages after blasts, improved safety outcomes
Advanced analytics and AI	Grade control, predictive maintenance, reconciliation, fuel and power optimisation	Higher recovery, lower maintenance spend, reduced energy intensity
Remote operations centres	Integrated supervision of fleets, plants, and logistics	Standardised performance, deeper talent pools, safer working conditions

7.1 The Digital Transformation of Mining Operations

7.1.1 Enhancing Efficiency and Safety

Digital-twin mines: A digital twin is a virtual replica of a physical asset or process that is continuously updated with live data[128]. In mining, twins can represent the entire value chain from pit or stope to port. Practitioners use them to test scenarios, diagnose bottlenecks, optimise throughput, and plan capital with lower risk. Properly built twins combine sensor data, physics-based models, and financial metrics, which allows managers to evaluate trade-offs between tonnes, recovery, cost, and emissions before acting. Industry assessments report significant value from digital twins and simulation when embedded in operating rhythms[129].

Internet of Things (IoT): Sensor-equipped fleets, conveyors, crushers, and substations now stream data into mine control rooms. Condition monitoring and predictive maintenance can reduce unplanned downtime and extend asset life. Process control loops use the same data to stabilise plant performance[130]. Evidence from manufacturing and process industries shows consistent productivity gains from industrial IoT adoption[131], and the same logic applies in mining where bottlenecks and equipment failures often drive cost variance.

Drones and automation: Uncrewed aerial vehicles have transformed surveying and stockpile management[132]. Photogrammetry and lidar deliver three-dimensional models in hours rather than days, with fewer safety risks to staff[133]. Underground and open-pit operations deploy autonomous or teleoperated vehicles to cut exposure to geotechnical hazards and to raise equipment utilisation. Remote operations centres integrate these technologies into a coherent production system that separates people from risk and standardises performance.

Case study 11: Mali's Syama Mine

Resolute Mining's Syama operation in Mali is widely cited as the first purpose-built, fully autonomous underground gold mine. The company partnered with equipment and technology providers to implement a fibre-connected, automated sublevel cave with remotely supervised loaders, trucks, and drills. Public sources indicate that the programme aimed to cut mining costs by about 30 percent and reduce the all-in sustaining cost by roughly $135 per ounce, with equipment operating up to 22 hours per day. The case demonstrates the link between connectivity, autonomy, and predictable productivity.

The Syama experience offers three concrete lessons. First, automation must be built on reliable connectivity and robust data architecture. Second, benefits are largest when mine design anticipates autonomy from the outset, rather than retrofitting later. Third, transparency about outcomes matters for public trust. Publishing cost, safety, and environmental indicators makes it easier for governments and communities to assess whether technology delivers shared value

7.2 Fostering Homegrown Innovation Ecosystems

7.2.1 Cultivating a Mining-tech Startup Culture

Africa needs a pipeline of local firms that solve operational problems with software, sensors, and services adapted to local geology and infrastructure. Incubators and accelerators that specialise in mining technology can provide seed funding, access to field testing, and mentorship from experienced operators. Governments can co-fund first-of-a-kind pilots through challenge grants that procure solutions to defined mine-site problems, for example, mill analytics to improve recovery or low-cost power management for remote operations. Procurement policies can include innovation-friendly clauses that reserve a small share of spend for qualified startups.

Policy should also focus on skills development. Short, modular programmes in data engineering, instrumentation, and mine automation can be provided through polytechnics and universities in collaboration with industry placements. Co-designing curricula with global mining schools helps ensure training aligns with the equipment platforms actually used on site. Regional professional networks can certify competencies that are recognised across borders, enabling talent to relocate to where projects are expanding.

Box 3: African Tech Hub Scene

Established hubs already support high-growth founders across the continent. Many are sector-agnostic but have programmes that can be applied to mining technology.

Pan-African platforms

- Founders Factory Africa (Johannesburg and Nairobi): venture studio and accelerator combining capital, product, growth, and corporate partnerships.
- The Baobab Network (pan-African): early-stage accelerator providing hands-on support, expert mentors, and seed funding.
- Startupbootcamp AfriTech (multi-country): corporate-backed accelerator running themed programmes and pilot pipelines with large companies.
- Endeavor Africa (multiple markets): scale-up support for high-impact entrepreneurs through mentorship, market access, and investor networks.
- Plug and Play Africa (Johannesburg and partners): corporate innovation platform linking startups with industry pilot opportunities.
- Flat6Labs (Cairo and Tunis): leading North African accelerator with seed programmes and investor networks.

West Africa

- MEST Africa (Accra): training, seed investment, and venture-building for technology startups.
- Co-Creation Hub, including iHub (Lagos): incubation, research labs, and open innovation programmes with corporates and governments.
- ARM Labs Lagos Techstars Accelerator (Lagos): global accelerator franchise focused on early-stage companies.
- Wennovation Hub (Nigeria): multi-city incubator offering mentorship, investor linkages, and pilot opportunities.

East Africa

- iHub (Nairobi): flagship community and innovation space now within the CcHub family.
- Nailab (Nairobi): entrepreneurship support and accelerator programmes.
- GrowthAfrica Accelerator (regional): scale-up advisory and investor readiness across East Africa.
- Norrsken Kigali House (Rwanda): high-capacity startup campus hosting accelerators and venture programmes.

Southern Africa

- Savant (Cape Town): deep-tech and hardware-focused incubator and investor with engineering commercialisation expertise relevant to mining technologies.
- Grindstone (Cape Town and Johannesburg): growth accelerator for scale-ups with structured mentorship and market access.
- Tshimologong Digital Innovation Precinct (Johannesburg): university-anchored hub with labs for digital, AI, and hardware prototyping.
- The Innovation Hub, including mLab (Pretoria): incubation and skills programmes with links to advanced manufacturing and climate solutions.

North Africa

- AUC Venture Lab (Cairo): accelerator at the American University in Cairo with strong links to industry and investors.
- UM6P Startgate (Ben Guerir, Morocco): university-anchored venture ecosystem connected to industrial R&D and advanced testing facilities.
- Flat6Labs (Cairo and Tunis): seed programmes and investor networks that serve a regional pipeline.

How these platforms can advance mining technology

- Challenge-driven pilots: design cohorts around mine-site problem statements, for example ore sorting, mill optimisation, dust suppression, or energy management.
- Access to industrial testbeds: link accelerators to mines, smelters, and laboratories so founders can validate solutions against real data and safety requirements.
- Specialist talent and standards: co-develop short courses in instrumentation, data engineering, and robotics with credentialing recognised across borders.
- Finance pathways: blend seed capital with supply-chain finance and offtake-linked contracts so startups can scale hardware and services.
- Procurement reform: create fast-track vendor onboarding and sandbox procurement rules for regulated mine sites.
- Regional scaling: use AfCFTA rules and REC corridors to expand pilots across countries, building continental suppliers for digital and green mining.

7.2.2 The Power of Open Data

Exploration risk decreases when investors can access clean, well-documented geoscience data. Open geological portals reduce information asymmetries and lower entry costs for junior miners and local entrepreneurs. Botswana's Geoscience Portal provides layered datasets for prospectors, researchers, and service companies, while several African governments have launched online mineral rights cadastres to clarify titles and reduce discretionary decision-making. Good practice includes comprehensive metadata, standard data formats, and clear licensing. The World Bank recommends robust institutional arrangements for mineral rights cadastres and transparent online services that shorten processing times.

7.2.3 Sustainable Extraction through Biotechnology

Biomining employs microorganisms to extract metals from low-grade ores, concentrates, and mine wastes. The method can reduce reliance on aggressive chemicals and often operates at lower temperatures than traditional processing, thereby lowering energy consumption. Recent reviews highlight advances in microbial consortia, reactor design, and modelling that broaden applications for copper, nickel, cobalt, and rare earth elements. Bioleaching shows particular promise for reprocessing tailings and for deposits with complex mineralogy that are resistant to conventional methods.

7.3 A Pan-African Strategy for Research and Development

7.3.1 The Case for R&D Cooperation

Individual national research budgets seldom align with the scale of challenges in modern mining. Fragmented projects replicate efforts and struggle to keep pace with frontier technologies. A coordinated, continent-wide strategy can pool resources, establish common research goals, and distribute the benefits. The African Union's Science, Technology and Innovation Strategy for Africa 2024, together with the Africa Mining Vision, offers a policy foundation for such coordination. Development partners can support a shared pipeline of projects that benefit multiple jurisdictions.

7.3.2 A Continental Mining Technology Entity

A practical option is to establish a pan-African mining technology institution or a pooled innovation fund with three functions.

- Finance competitive, cross-border research programmes focused on high-impact themes, such as digital twins for process optimisation, low-carbon comminution, or bioleaching of complex ores.
- Manage regional centres of excellence that contain shared facilities like test adits, pilot plants, and high-performance computing for geometallurgy.
- Publish open standards and reference datasets, including synthetic ore bodies for algorithm benchmarking.

The entity could be co-sponsored by the African Union, AfDB, and regional bodies, with governance that balances state and industry representation.

7.4 Building Strategic Global Partnerships

7.4.1 Collaborating with Global Centres of Excellence

Africa can progress more rapidly by partnering with leading mining universities and research institutes in Australia, Canada, Chile, and other regions. Structured programmes might include joint doctoral projects on mine automation or biohydrometallurgy, visiting professorships at African universities, and shared curricula for mine digitalisation. Collaborations with global miners that already operate digital twins of value chains can speed up learning by exposing African teams to established toolchains and workflows. These partnerships should focus on mutual knowledge exchange and developing curricula that reflect African operating conditions.

Box 4: The African Venture Capital Scene

Over the past five years, African VC experienced a sharp upward cycle, followed by a correction and then stabilisation. Equity funding reached a peak in 2021, with African tech startups raising approximately $5.2 billion in equity and $6.0 billion including debt, across 681 rounds, according to Partech's audited dataset. However, this was less than one percent of the record $671 billion raised by startups that year. Activity increased again in 2022 in total dollars once venture debt was included, reaching $6.5 billion across 764 deals, even as equity slowed. Global monetary tightening and risk-off sentiment then led to a notable retrenchment in 2023, with total funding (equity plus debt) declining to $3.5 billion across 547 deals.

In 2024, conditions stabilised: Partech recorded a total of $3.2 billion in funding, comprising $2.2 billion in equity and $1.0 billion in debt.

AVCA's venture lens, which employs a different inclusion methodology and captures a broader range of deals, reported 487 venture transactions in 2024, including 427 equity deals valued at $2.6 billion and 60 venture-debt deals amounting to $1.0 billion. Collectively, the datasets indicate a relatively flat 2024 with renewed late-year momentum and a clear role for debt in bridging growth finance.

Dealmaking highlights and the rise of venture debt.

Deal activity has been driven by fintech, mobility, energy access, e-commerce enablement, and health. Illustrative transactions include:

Box 4: The African Venture Capital Scene [continued]

Pan-African platforms

- Moove, a Nigerian revenue-based vehicle financing startup, raised a $100 million Series B in March 2024 at a $750 million valuation, backed by Uber and Mubadala, as revenue-based vehicle financing expands across markets.
- Sun King, an off-grid solar provider based in Nigeria and Kenya, implemented innovative local-currency and securitisation structures, including an NGN-denominated $80 million debt facility in 2025 and a KES-equivalent $156 million securitisation supported by a commercial bank consortium.
- MNT-Halan combined equity with repeated securitisations, raising over $400 million in 2023 and an additional $157.5 million in July 2024, alongside a cross-border acquisition to broaden credit products.
- Wave's $200 million, at a $1.7 billion valuation, Series A in 2021 signified a key scale milestone for francophone Africa fintech.

What DFIs are doing: anchor LPs, co-investment and technical assistance.

DFIs have continued to play a key role in market depth, utilising fund commitments, blended finance, and co-investment frameworks to mobilise private limited partners (LPs).

- Boost Africa (EIB and AfDB, with EU and OACPS support) provided capital and technical assistance to a group of early-stage VC funds, including TLcom Tide Africa, Partech Africa, AfricInvest VC Growth, Janngo, Atlantica, and Seedstars Africa Ventures, and reports mobilisation of over €380 million with strong follow-on results for portfolio founders.
- AfricaGrow (KfW and Allianz Global Investors) functions as a fund-of-funds supporting African PE and VC vehicles to address the SME and startup financing gap, often in collaboration with other European DFIs.
- FMO Ventures Program launched with €200 million and TA to invest directly and via funds in early-stage tech, later adding a second USD 200 million facility in 2024; it has backed managers such as TLcom and Breega Africa Seed, and participated in dedicated African seed funds.
- IFC Startup Catalyst makes $4–6 million anchor commitments into seed funds and accelerators to crowd-in institutional LPs, with recent Africa mandates including the Flat6Labs Africa Seed Fund and a female-led fintech seed vehicle.
- BII (UK) continues to anchor Africa VC and growth funds, including Partech Africa II, TLcom TIDE II, CRE Venture Capital Fund III and Ventures Platform Fund IV; BII has also signed an MoU with South Africa's PIC to expand joint pipelines and co-investments .
- EIB Global extended commitments to Africa-focused buyout and climate vehicles, for example $75 million to Helios Fund V and first-close support to the Helios CLEAR climate fund alongside BII and FMO.
- Afreximbank's FEDA scaled to roughly $770 million raised across strategies by early 2024, with over $450 million available for investment and a mandate spanning equity and private credit in trade-related sectors, including an $85 million ticket to ARISE IIP and strategic stakes in digital infrastructure.

These initiatives combine anchor LP capital with TA facilities, gender and climate lenses, and increasingly, structured co-investment rights that allow DFIs to invest directly alongside general partners (GPs) in larger tickets or strategic themes.

Box 4: The African Venture Capital Scene [continued]

Outlook.
First, Africa's early-stage funding pool is deeper and more diversified than in 2019, even after the 2023 correction. Second, venture debt, securitisations and local-currency facilities have become important complements to equity, particularly in energy access, fintech and asset-heavy platforms. Third, exits are demonstrably possible to regional strategics and financial sponsors, though secondary markets remain thin compared with other regions. Finally, DFIs have been effective in anchoring successive fund vintages, standing up fund-of-funds, and providing patient TA and ecosystem building that private LPs rarely fund.

As macroeconomic stability improves and domestic institutional investors participate more consistently, the combination of larger Africa-focused funds, growth equity vehicles, and flexible credit could support a new cycle led by climate, digital infrastructure, logistics, agri-food, and healthcare. Pipeline quality is not the binding constraint. Local-currency pools, prudently structured venture debt, and continued DFI co-investment will likely determine how quickly high-performing managers can scale their portfolios to exit at attractive multiples.

7.4.2 Attracting Venture Capital and Tech Investment

Innovation ecosystems need risk capital and patient partnerships. African venture markets have experienced a correction since 2022, yet fundraising continues to support technology companies with strong unit economics. Development finance institutions and regional development banks have responded with new vehicles and co-investment programmes. Policymakers can attract investment by ensuring exit pathways through domestic capital markets, clarifying tax treatment for venture funds, and using first-loss guarantees to attract private investors. Recent analyses show that Africa's tech sector has remained resilient by combining equity and debt, while specialised vehicles from regional banks are building pipelines in infrastructure, logistics, and digital services that complement mining-tech applications[134].

Technology and innovation will increasingly enable Africa to transform its mining resources into diverse industrial growth. Digital tools are already enhancing safety, productivity, and environmental outcomes, while biotechnology introduces new methods for low-impact extraction and tailings recovery. Indigenous startups, skilled technicians, and research partnerships will ensure solutions are designed for African operating contexts. Continental coordination can provide the scale and standards that individual countries cannot achieve alone.

The policy message is clear. Invest in the digital infrastructure of mines, develop open data systems, and align training with the equipment and analytics used on site. Combine research funding for problems that require scale, and establish partnerships that connect African institutions with global centres of excellence. Lastly, strengthen the capital markets and venture frameworks so that mining tech innovators can expand. If policymakers and industry leaders act on these priorities, mineral-driven industrialisation can shift from rhetoric to large-scale delivery.

08

SUSTAINABILITY

8. Sustainability

Decarbonisation is a hot topic not because of a lack of ambition, but because the switching costs are enormous, ranging from stranded fossil assets and long-lived capital stock to grid upgrades, factory retooling, new standards, and workforce retraining. Africa can turn those frictions into an advantage. The continent combines abundant solar, wind, geothermal, and hydro resources with many of the minerals essential to the transition, including platinum group metals, manganese, cobalt, graphite, and rare earth elements. With smart policy, Africa's industrialisation can be anchored in clean power, allowing direct reduced iron production with electric arc furnaces, low-carbon aluminium powered by hydro, and battery-materials refining to meet stringent environmental, social, and governance requirements.

Because Africa is starting from a low industrial base, the continent can leapfrog other regions of the world by prioritising plants designed for low emissions, high efficiency, and circularity from the outset rather than being retrofitted later at great expense. By linking resources, clean energy, and rigorous stewardship in one integrated plan, Africa can set the global benchmark for responsible beneficiation and assume genuine leadership in net-zero supply chains.

In this chapter, we focus on how Africa's industrialisation agenda can progress on this low-carbon path while strengthening competitiveness. Strong environmental, social, and governance (ESG) performance is no longer optional. It is now a requirement for finance to access demanding destination markets and achieve long-term resilience in a world that rewards traceable[140], low-carbon, and responsibly produced materials[141].

The analysis adopts a continental lens, anchoring recommendations in African Union strategies, including the Africa Mining Vision, the AU Climate Change and Resilient Development Strategy and Action Plan, the Green Recovery Action Plan, and the Continental Circular Economy Action Plan. Country cases appear only to illustrate wider policy choices. There should be no doubt that Africa can position itself as a supplier of choice for critical and base minerals by harmonising ESG requirements, decarbonising power for processing, adopting circular economy models, and building trusted transparency systems. Such a path can unlock green finance and enable producers to capture emerging green premia for low-carbon materials.

8.1 ESG as a market entry requirement

Global disclosure and product-standard regimes are raising the floor for acceptable performance. The ISSB climate and sustainability standards require listed firms to disclose material sustainability risks, strategy, and metrics . The EU's Carbon Border Adjustment Mechanism imposes a carbon price at the border for carbon-intensive imports, which will affect iron and steel, aluminium, fertilisers, hydrogen, and even cement as it phases in .

The EU Battery Regulation requires carbon footprint declarations, due diligence, recycled content targets, and digital passports for batteries . Buyers and lenders are aligning with these rules, which turns robust ESG into a practical licence to operate in export markets.

For mineral supply chains, due diligence has become an expectation. The OECD Due Diligence Guidance[145] serves as the benchmark for responsible sourcing in conflict-affected and high-risk areas.

Complementary assurance systems exist for smelters and refiners, such as the Responsible Minerals Initiative's Responsible Minerals Assurance Process (RMAP)[146], and country-level transparency is reinforced by the Extractive Industries Transparency Initiative (EITI) Standard[147], which was updated in 2023 with stronger anti-corruption and energy-transition provisions. At the site level, industry norms such as the International Council on Mining and Metals (ICMM)'s Mining Principles and Performance Expectations, the Global Industry Standard on Tailings Management, and the Initiative for Responsible Mining Assurance (IRMA) provide credible reference points for environmental and social performance. Investors, lenders, and insurers increasingly look for conformance with these frameworks when assessing project risk.

8.2 Green energy integration

Smelting, refining, calcining, and electro-winning depend on reliable and affordable electricity. As detailed in Chapter 3, Africa's power systems remain constrained[148], with low per-capita consumption and limited reserve margins; yet, the continent possesses exceptional renewable resources and is developing growing regional power trade platforms[149]. The policy task is to connect rich solar, biofuel, and hydro resources to processing nodes through industrial corridors and regional grids, thereby locking in competitive green power for investors[150].

To achieve this, we must first accelerate the deployment of renewables and firming capacity in and around mining provinces. Second, deepen regional interconnections through power pools to diversify supply and reduce costs. Third, green industrial parks and special economic zones that offer dedicated, contractible green power with bankable offtake. Initiatives such as the AfDB's Desert to Power and SAPP's transmission financing facility[151] illustrate how large-scale renewables and grid backbones can underpin industrial growth.

Hydrogen will be relevant for hard-to-abate processes such as direct reduced iron. Early offtake models in Europe, for example, H2 Green Steel[152], show how long-term contracts and public guarantees can unlock financing. African producers can pilot low-carbon iron and steel near renewable resource clusters, then export semi-finished products into markets that recognise low-carbon attributes , including future CBAM adjustments.

8.3 Circular economy pathways around critical minerals

Circularity reduces primary extraction needs, lowers energy use, and creates domestic value from waste streams. Urban mining of e-waste and end-of-life batteries can recover cobalt, lithium, nickel, manganese, and copper[154]. The Global E-waste Monitor shows rapid growth in discarded electronics, while the African Circular Economy Alliance and the AU's Continental Circular Economy Action Plan[155] provide a policy platform to scale recovery, repair, and remanufacturing. Battery-passport systems are evolving to track material content and ESG performance across lifecycles[156].

Practical steps include formalising e-waste collection, licensing refurbishers, establishing regional pre-processing hubs, and creating end-markets through producer responsibility and public procurement. Fiscal incentives can support battery recycling and black-mass processing. Standards for recycled content and product durability will facilitate the flow of materials through the system. The EU Battery Regulation's recycled-content targets establish an export-linked demand signal that African recyclers can access, provided traceability and environmental controls satisfy the law's requirements[157].

Table 12: Circular economy opportunities by value chain stage

Value chain stage	Circular interventions (3TG: tin, tungsten, tantalum, gold)	Circular interventions (Battery materials: cobalt, nickel, manganese, lithium, graphite)	Key metrics and targets	Policy and market enablers	Illustrative African examples
Collection	• Formalised buy-back points and cooperatives for ASM feedstock • Certified take-back for WEEE that contains 3TG • Deposit-return incentives for small electronics • Digital chain-of-custody at first aggregation	• End-of-life EV and stationary battery collection schemes • State-of-health diagnostics and safe storage before transport • Pack and module aggregation hubs near ports and industrial parks • Cross-border movement compliant with Basel rules	• Collection rate ≥ 65% of available waste streams • Tonnes collected per year and % with verified traceability • Safety incidents at zero harm	• Extended Producer Responsibility and WEEE regulations • Standard permits for handling used batteries and e-waste • Community contracts and fair-price schedules for ASM inputs	• Rwanda: national e-waste programme and Kigali plant • South Africa: producer responsibility organisations for electronics • Nigeria: NESREA WEEE guidelines and formal collection pilots
Pre-processing	• Safe manual dismantling and segregation of circuit boards and connectors • Mechanical separation: shredding, magnetic and gravity methods • Tailings re-treatment and re-concentration where viable	• Discharge, de-energise, and dismantle packs to modules/cells • Shredding and milling to black mass with electrolyte neutralisation • Thermal binder removal where needed with emissions control	• Yield from input to concentrate or black mass ≥ 90% • Specific energy consumption per tonne processed • Worker certification coverage and incident frequency	• Occupational health standards and accredited training • Environmental permits aligned with IFC and ISO 14001 • Access to finance for equipment and safety systems	• Egypt and South Africa: WEEE dismantling and sorting facilities • Morocco: black mass pilot lines in industrial zones
Refining	• Low-carbon tin smelting with oxygen-enriched burners and renewables PPAs • Hydrometallurgical circuits for tantalum and tungsten with closed-loop water • Chlorination and solvent extraction with reagent recovery	• Hydro processes to recover Co, Ni, Mn, Li salts from black mass • By-product valorisation of graphite, aluminium, and copper foils • Online purity monitoring to battery-grade specifications	• Recovery rates ≥ 95% for target metals • Product purity meeting battery grade or LME standards • Carbon intensity (kg CO_2e per kg metal) and water intensity (m^3/t)	• Renewable power supply agreements for refineries • Responsible sourcing standards and OECD due diligence • Digital MRV for traceability and sustainability claims	• South Africa: hydrometallurgy pilot plants linked to universities • Morocco: renewable-powered industrial parks pursuing battery materials
Product design	• Design for disassembly of electronics with standard fasteners • Eliminate permanent adhesives that block recovery • Component labelling and digital product passports	• Standardised module formats and clear cell labelling • Data access from BMS to support second-life applications • Targets for recycled content in cathodes and aluminium/copper parts	• Disassembly time per device and reparability score • Recycled content percentage by component • Passport coverage across product lines	• Eco-design regulations and right-to-repair rules • Public procurement that prefers recycled content and repairability • Industry standards aligned with the Global Battery Alliance	• Rwanda and Kenya: repair and refurbishment hubs for electronics • Regional pilots for digital product passports in supply clusters

8.4 Sustainable land and water management

Responsible environmental stewardship begins with land and water. The Global Industry Standard on Tailings Management[158] sets lifecycle requirements for governance, design, operation, closure, and post-closure of mining waste. For water, basin-level engagement is crucial to balance industrial use with the needs of communities and ecosystems. Integrated mine closure planning, including progressive rehabilitation, lowers liabilities and can unlock nature-based solutions finance where credible standards apply[159].

Carbon crediting for mine-site restoration is feasible, provided that projects follow rigorous methodologies and demonstrate additionality, permanence, and community benefits.

In practice, this means utilising standards such as the Verified Carbon Standard for reforesting decommissioned pits and tailings footprints, securing long-term protection, and sharing revenue with local communities; the Kasigau Corridor Reducing Deforestation and Forest Degradation (REDD+) project in Kenya provides a useful template for how community agreements and monitoring can underpin credible credits[160].

Crucially, developers should treat credits as a complement to, not a substitute for, direct decarbonisation. For example, the Kibali gold mine in the DRC prioritised on-site abatement by building run-of-river hydropower and recirculating process water before considering any offsets[161]. Biodiversity offsets must also sit strictly within the mitigation hierarchy and only address residual impacts; Ambatovy in Madagascar has paired protected-area management with restoration after redesigning access roads and shrinking operational footprints[162], while Newmont's Akyem mine in Ghana established an offset programme with the Forestry Commission and local communities to achieve no-net-loss of forest habitat once avoidance and minimisation were exhausted[163].

Above all, early design should reduce disturbance and water demand at source, as shown by progressive dune-forest rehabilitation that tracks the mine face at Richards Bay Minerals in South Africa[164], and the shift to non-potable supply through the Erongo desalination plant[165] for Namibia's uranium operations.

8.5 Mine-site standards and community benefit sharing

Strong community relations reduce social risk and downtime, but they do so only when participation and benefits are tangible. Effective models range from social and labour plans to community development agreements and minerals development funds that earmark a share of revenues for local projects.

In Ghana, the Minerals Development Fund channels royalties into district-level projects, such as water systems, classroom blocks, and feeder roads, which are agreed upon with local assemblies[166]. Newmont's Ahafo Social Responsibility Agreement goes further by endowing the Ahafo Development Foundation, which finances scholarships and livelihood schemes chosen through community committees[167].

In Nigeria, the Segilola gold project[168] negotiated a community development agreement that funded boreholes, access roads, and vocational training, which helped maintain social licence during ramp-up. South Africa's social and labour plans illustrate the same principle when co-designed and transparently delivered, with companies that meet skills, housing, and local enterprise commitments experiencing fewer work stoppages[169]. The common thread is alignment with national law, transparent implementation, and genuine community voice in selecting projects tied to measurable outcomes.

African policymakers should adopt best practices in the IFC Performance Standards, ICMM's Mining Principles, IRMA's site-level audit framework, and the updated EITI Standard. This will signal to lenders and customers that commitments will be measured and disclosed. Newmont's Akyem and Ahafo operations in Ghana, for instance, publish site-level sustainability reports, operate accessible grievance channels with clear response timelines, and subject selected indicators to third-party assurance. Anglo American Platinum has engaged independent assessors against the Initiative for Responsible Mining Assurance (IRMA) Standard at major South African operations, and it discloses social investment outcomes alongside grievance statistics in sustainability reporting[170]. In EITI-implementing countries such as Ghana and Zambia, company-government reporting now includes subnational transfers, which communities can track against promised projects, improving accountability and reducing the risk of disputes over benefit sharing[171]. Independent assurance at the asset level, coupled with public grievance dashboards and regular disclosure of social investment results, provides the evidence base financiers need and the transparency communities expect.

8.6 Transparency and traceability

Digital traceability systems can cut compliance costs and support market access.

The Global Battery Alliance's work on digital product passports for batteries demonstrates how ESG indicators and provenance data can flow across the chain. In tin, tantalum, tungsten, and gold (3TG) supply chains, tools such as the International Conference of the Greater Lakes' (ICGLR) Regional Certification Mechanism, government chain of custody, and private schemes enable due diligence, although independent evaluations and civil society monitoring remain essential. Rwanda's experience with tantalum traceability shows both the promise of digital solutions and the need for robust public oversight.

Box 5: Renewable-powered mining and tantalum traceability

Rwanda has established a strong governance framework for 3T traceability, combining government oversight with recognised regional and international standards. The Rwanda Mines, Petroleum and Gas Board (RMB) operates an official chain-of-custody system for tin, tantalum, and tungsten that complies with the OECD Due Diligence Guidance and the International Conference of the Great Lakes Region's Regional Certification Mechanism. Typically, this involves validated mine sites, tagging and sealing consignments, monitored transport, controls at the exporter level, and certificate issuance at the point of export. Recent updates to ICGLR guidance and programme statements from International Tin Supply Chain Initiative (iTSCi) highlight rigorous tag management and fraud prevention by government officials in Rwanda, which is vital to market acceptance of Rwandan 3T exports.

Digital pilots have introduced another layer of assurance. In late 2018, Circulor implemented a permissioned blockchain system with Rwanda-based Power Resources Group that recorded weights, movements, and custody changes for tantalum across three mines and an ore-sorting facility.

The system reduced paperwork, generated tamper-resistant records, and provided real-time views to downstream buyers, enhancing the reliability of due diligence data with minimal extra effort for operators. Subsequent reports describe how scanners and QR codes linked to Hyperledger Fabric were used to associate each sealed bag with a unique digital identity from mine to processor.

Energy policy complements traceability by enabling cleaner, more efficient processing near mine sites. Hydropower remains Rwanda's dominant generation source, while grid-connected solar capacity and access continue to expand. Public reports show 408 MW of on-grid capacity in 2022, with renewables providing roughly half of generation, ongoing utility-scale projects such as the regional Rusumo Falls scheme, and a growing yet still modest on-grid solar base. Investment-promotion materials explicitly encourage mineral processing within the country, linking energy upgrades to value-addition ambitions. Independent scrutiny remains essential, however, given ongoing regional conflict risks and credible allegations of cross-border smuggling into Rwanda that could contaminate supply chains if controls lapse.

8.7 Pan-African policy cohesion and harmonisation

Pan-African policy cohesion begins with a clear architecture. The Africa Mining Vision outlines how mining can catalyse local linkages, from supplier development to skills and infrastructure[172]. The Climate Strategy and Green Recovery Action Plan add a long-term lens by prioritising climate resilience and green investment across energy, transport, water and land use[173]. The new Continental Circular Economy Action Plan then translates these ambitions into a ten-year programme for resource efficiency between 2024 and 2034, emphasising materials stewardship and secondary value chains[174]. Finally, the AfCFTA Protocol on Investment embeds sustainable development obligations and offers a continental

Pan-African policy cohesion begins with a clear architecture. The Africa Mining Vision outlines how mining can catalyse local linkages, from supplier development to skills and infrastructure[172]. The Climate Strategy and Green Recovery Action Plan add a long-term lens by prioritising climate resilience and green investment across energy, transport, water and vehicle to align environmental, labour, and consumer protections that underpin responsible investment and cross-border projects[175]. Taken together, these instruments provide a coherent framework for harmonising rules from mine site to market, while offering regional economic communities and national governments a shared playbook for implementation and peer learning.

A practical harmonisation agenda would turn that framework into working tools. First, adopt a continental ESG baseline that maps directly to the OECD Due Diligence Guidance and EITI disclosure so that company reports, inspectorate checks and public dashboards speak the same language. Second, agree mutual recognition of credible site and smelter standards to reduce duplicative audits and speed market access, supported by an African Minerals Sustainability Registry that issues machine-readable profiles interoperable with the Global Battery Alliance passport. Third, publish model contract clauses for green power supply, water stewardship and mine closure, including guidance on targets, monitoring and financial assurance.

Finally, embed these elements in Country Mining Visions and the AfCFTA investment facilitation toolkit, coupled with peer review cycles, digital reporting templates and capacity support for regulators, so convergence happens in practice rather than on paper.

8.8 Capturing green premia and mobilising green finance

Early signs of green premiums are appearing in metals markets, but mostly where big buyers have underwritten demand. In steel, automakers have signed binding offtakes that explicitly link volumes to low embodied-carbon production. Mercedes-Benz, for instance, has agreed to purchase approximately 50,000 tonnes per year from H2 Green Steel for its European plants, following an equity stake in the company.

Meanwhile, BMW has also contracted for CO_2-reduced steel deliveries starting from 2025[176]. Grid-equipment makers are also moving forward: Hitachi Energy has an agreement with H2 Green Steel that includes future green-steel offtake for transformers once production commences[177]. In aluminium, Apple purchased the first commercial batches from ELYSIS's inert-anode process for iPhone and MacBook enclosures[178], and Hydro reports fast-rising demand and premiums that scale with lower CO_2 footprints[179]. Independent tracking adds context: the World Economic Forum's Net-Zero Industry Tracker estimates typical business-to-business green premia of roughly 40 to 70 percent per tonne for near-zero steel and around 40 percent for low-carbon aluminium[180], with only marginal impacts at the finished-product level. Financing for the first wave of projects has hinged on those forward offtakes, complemented by public guarantees and concessional capital that close viability gaps. H2 Green Steel, for example, presold more than 1.5 million tonnes per year through multi-year contracts[181], then secured a €6.5 billion package that combined €4.2 billion in debt, approximately €300 million in new equity, and a €250 million EU Innovation Fund grant, alongside a Swedish National Debt Office green credit guarantee of up to €1.2 billion and additional InvestEU-backed lending from the European Investment Bank (EIB) and Nordic Investment Bank (NIB)[182]. As the EU's Carbon Border Adjustment Mechanism transitions from its 2023–2025 reporting phase to the chargeable regime from 2026, buyers' published Scope 3 trajectories will sharpen procurement filters, favouring producers who can verify low embodied carbon and responsible sourcing through recognised schemes. Where demand is still thin, these policy signals and de-risking tools are proving decisive in turning signed offtakes into bankable steel and aluminium capacity.

8.9 Competitiveness through harmonisation

Africa's competitiveness in mineral supply chains will depend on credible ESG at scale. Continental harmonisation can turn compliance into a strategic advantage. By coupling green power, circular economy capabilities, world-class site standards, and transparent traceability, African producers can reduce risk, access lower-cost capital, and meet the requirements of demanding buyers. The Africa Mining Vision, the AU climate strategy, the Green Recovery Action Plan, and the Continental Circular Economy Action Plan provide the anchor frameworks. The AfCFTA Protocol on Investment offers the legal vehicle. The moment is ripe to move from pilots to platforms, from voluntary to verifiable, and from fragmented projects to corridors that deliver green and competitive industrialisation.

Implementation roadmap: Ten immediate actions

1. Adopt an AU-level ESG baseline for minerals aligned to OECD, EITI, ICMM, IRMA, and GISTM, with a mutual-recognition mechanism for site assurance.
2. Mandate climate and sustainability disclosures consistent with IFRS S1 and S2 for state-owned mining companies and for listings on African exchanges.
3. Designate two to three green industrial corridors that connect renewable resources to processing nodes, with anchor tenants and bankable power offtake.
4. Launch an African Minerals Sustainability Registry interoperable with the Global Battery Alliance Battery Passport, beginning with cobalt, manganese, and graphite.
5. Create a continental toolkit for community development agreements and revenue-sharing, aligned with IFC Performance Standards and the EITI Civil Society Protocols.
6. Publish a model green-power clause for mining and processing concessions that prioritises grid-supporting renewables and storage, and sets water-stewardship commitments.
7. Operationalise extended producer responsibility for e-waste and batteries in at least five regional hubs, with fiscal incentives for black-mass recovery and refining.
8. Establish an AfCFTA-wide fast-track for sustainable investment that offers incentives for verified low-carbon processing and traceability, under the Protocol on Investment.
9. Issue sovereign or sub-sovereign green bonds to finance grid upgrades and water infrastructure in mining regions, backed by transparent impact reporting.
10. Publish annual progress dashboards against the Africa Mining Vision and AU climate goals, with disaggregated indicators for land, water, emissions, and community outcomes.

09

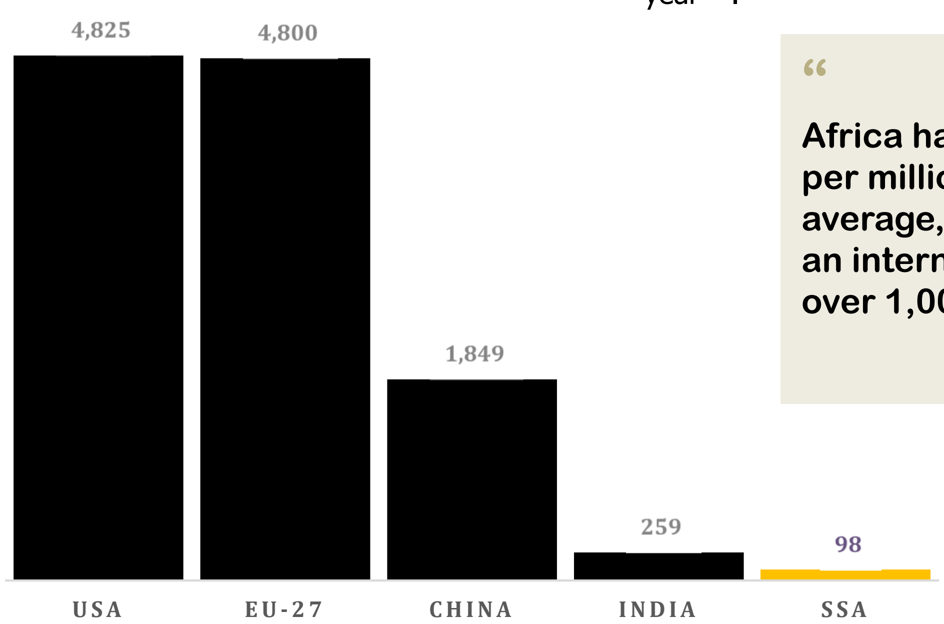
HUMAN CAPITAL AND SOCIAL INCLUSION

9. Human Capital and Social Inclusion

Africa's shift from raw mineral exports to competitive industrialisation and onward sustainable development depends on skilled professionals who can operate, maintain, and improve complex systems. Where these capabilities are lacking, plants underperform, costs increase, accidents rise, and investment declines. Strong, inclusive skills drive productivity, innovation, and shared community benefits. This chapter contends that human capital and social inclusion are essential for successful industrialisation. Without a coordinated and sustained strategy for skills and inclusion, the continent's potential will not be realised.

The analysis proceeds in six steps. It first quantifies the foundational skills gap in Africa relative to peer regions. It then sets out practical mechanisms to mobilise expertise from the African diaspora.

Figure 4: Number of R&D researchers per million people



Sources: OGTT Research based on compiled data from Eurostat, UNESCO Institute of Statistics and the World Bank

The chapter examines gender inclusion as an economic imperative, not only a matter of equity. It links human capital strategy to intergenerational justice and youth empowerment. It explains how young entrepreneurs and small firms can be integrated into value chains that benefit from beneficiation. Finally, it proposes an actionable framework that governments, firms, and communities can adopt over the next decade.

9.1 The Foundational Skills Gap

9.1.1 The numbers that matter

Across the world, the countries that dominate mineral processing and advanced manufacturing graduate large cohorts of engineers and technicians each year. In the United States, higher education institutions conferred approximately 123,000 bachelor's degrees in engineering during the 2021–22 academic year[183].

> **"Africa has 79 engineers per million people on average, compared with an international norm of over 1,000."**

China awarded around two million first university degrees in science and engineering in 2020. Engineering constituted about one-third of those awards[184]. India awarded about 2.5 million first university degrees in science and engineering in 2020, also with a high share in engineering fields[185]. Labour classifications, such as the International Standard Classification of Occupations (ISCO) 08, categorise engineering professionals, including civil, mechanical, electrical, chemical, mining, and industrial engineers; however, they exclude most software developers, who are considered Information and Communication Technology (ICT) professionals. By contrast, Sub-Saharan Africa's engineering capacity remains limited. A landmark assessment by the African Capacity Building Foundation estimated that there were only 79 engineers per million people on average across the continent, compared with an international norm of over 1,000 per million, implying a shortfall of several million engineers to meet Africa's development needs[186].

The tertiary education base is expanding, yet it remains relatively small in comparison to the population. Sub-Saharan Africa's gross tertiary enrolment ratio remains in single digits or low teens in many countries. Total tertiary enrolment was about nine million students in the late 2010s according to UIS based World Bank analysis, which equates to about four percent of global tertiary students despite Africa's much larger population share[187]. The bottleneck is not only quantity. Employers across African manufacturing report skills mismatches, limited practical exposure, and weak foundational competencies among graduates, which collectively reduce plant productivity and increase supervision costs[188].

The implications of this lack of capacity are straightforward. Concentrators, smelters, and refineries need a steady stream of engineers and mid-level technicians who understand process control, pyrometallurgy, hydrometallurgy, as well as Programmable Logic Controllers, sensors, maintenance planning, and safety systems. Developing this pipeline requires action well before university, since deficits in basic literacy, numeracy, and science at primary and lower secondary levels influence low pass rates in mathematics and physics, which limit the number of students eligible for engineering and Technical and Vocational Education and Training (TVET) programmes at the post-secondary level[189].

9.1.2 Quality of preparation and relevance

Firms often cite the quality of practical training as a bigger constraint than formal credentials. Supervisors spend time teaching basic shop-floor protocols, safety routines and the use of instruments that should be mastered during training. World Bank research has long emphasised the importance of work-integrated learning and competency-based curricula linked to occupational standards in enhancing job readiness[190]. African Development Bank programming points in the same direction. The Bank's Skills for Employability and Productivity plan prioritises modernised TVET laboratories, instructor upgrading, and dual training arrangements that embed apprentices in firms while they complete modular coursework[191].

9.1.3 Digital and green skills

New processing plants integrate digital control systems that depend on data literacy, basic coding logic and the ability to work with sensor data. The greening of metallurgical processes introduces additional demands in energy management, electrification, and environmental monitoring.

These skills can be taught, but only if curricula are refreshed regularly, instructors receive continuous professional development, and partnerships with equipment suppliers create pathways for technology transfer. Africa's Development Dynamics 2024 reveals that returns to education are high in Africa, with an additional year of schooling increasing earnings by more than 11 percent on average, which strengthens the economic case for investing in quality and relevance[192].

Africa should launch a bold, continent-wide partnership between governments, universities, and industry to build an African institute or university that can rival the likes of MIT, China's Tsinghua University, or India's Institutes of Technology (IIT) system.

This institution would be mission-driven to close Africa's engineering talent gap by offering rigorous, industry-embedded programmes, grand-challenge research, and world-class labs tied to strategic sectors such as energy, digital infrastructure, advanced manufacturing, and critical minerals. It should be jointly funded and governed by a consortium of African states, anchored in deep collaboration with leading local universities, and co-designed with employers to ensure graduates are work-ready from day one. To widen access and reflect regional strengths, the institution can open campuses across the continent, for example in West, East, North, Southern, and Central Africa, linked by shared curricula, research platforms, faculty exchanges, and co-op placements with African and global firms.

Table 13: Engineering graduates as a share of S&E first degrees, selected countries, 2020

Country/Region	Engineering share of S&E (%)	Engineering (% of all degrees)	S&E/STEM basket (% of all degrees)
China	69.9	32.8	46.9
United States	17.9	7.9	44.1
India	33.6	12.0	35.7
Germany	57.4	23.3	40.6
United Kingdom	20.0	8.9	44.5
SSA	44.3	7.0	15.8

Sources: NSF Science and Engineering Indicators, NSB-2023-32.

Notes: China includes computer sciences within engineering per NSF. Values equal the engineering percent of all first degrees divided by the total S&E percent of all first degrees.

9.2 Engaging the African Diaspora

The African Union has designated the diaspora as Africa's Sixth Region. This political framing is useful, but sustainable industrialisation demands instruments that translate aspiration into capability on the plant floor and in classrooms. Many African countries have diaspora engagement units. The continental framework has been strengthened through AU decisions and ECOSOCC modalities for diaspora participation[193]. The task now is to transition from general engagement to targeted mechanisms aligned with the continent's industrialisation goals.

9.2.1 Mechanisms that work in practice

Four mechanisms can be deployed at scale. First, structured mentorship platforms that pair diaspora engineers and managers with African junior professionals for twelve to eighteen months, with clear competency milestones and verified hours. Second, short industry secondments in which diaspora professionals from operating smelters, refineries, or OEMs spend six to twelve weeks on-site in Africa to help commission equipment, train staff, and document standard operating procedures. Third, virtual knowledge transfer occurs through scheduled problem-solving clinics, where plant teams present live dashboards and bottlenecks in their processes for guided troubleshooting. Fourth, visiting professorships that place diaspora academics for one to two semesters in African engineering and geoscience faculties to co-teach courses, update laboratories, and co-supervise capstone projects.

PASET's Regional Scholarship and Innovation Fund offers a platform for these mechanisms. RSIF links African universities with international partners and firms, supports doctoral training in applied science and technology, and funds research and innovation grants. It can be used to broker diaspora secondments and co-supervision arrangements that are directly aligned to skills needs[194].

9.2.2 Financing and incentives

Cost and coordination are the main obstacles. Governments can create a small matching-fund window that covers airfare and modest honoraria for diaspora professionals, provided firms commit to defined training outcomes. Where diaspora bonds exist, a fraction of proceeds can be earmarked for skills transfer projects connected to beneficiation. Tax incentives can recognise in-kind contributions such as curriculum design, equipment donations, and remote teaching hours. The guiding principle is that diaspora engagement should be tightly coupled to measurable learning outcomes, not just inspirational events.

9.3 Gender Inclusion as an Economic Imperative

Women are highly active in artisanal and small-scale (ASM) mining across Africa. Several surveys indicate that women comprise between 40 percent and 50 percent of the ASM workforce in certain countries and regions[195]. Yet, women are starkly underrepresented in the formal, large-scale mining workforce. Global studies put women's share of employment in the formal mining industry at roughly 15 percent, with many countries below 20 percent[196]. This is a lost economic opportunity as well as an equity concern. Plants and supplier ecosystems that draw on the whole talent pool perform better. Closing the participation gap, therefore, supports productivity, safety, and community legitimacy.

> “
> **Women are starkly underrepresented in the formal, large-scale mining workforce.**
> ”

9.3.1 Removing practical barriers

Programmes that work tend to focus on addressing practical barriers. These include childcare, safe and hygienic facilities, fit-for-purpose personal protective equipment for women, and strict protocols on harassment with confidential reporting channels. Access to finance remains a persistent challenge for women-led supplier SMEs. Enterprise development funds attached to mining licences can set targets for women-owned firms, deliver supplier readiness training, and offer invoice discounting products to overcome working capital gaps. Land and licensing rules should remove restrictions that prevent women from holding mining titles and from participating in co-operatives.

9.3.2 Building pathways into skilled roles

At the plant level, firms can establish multi-year apprenticeship tracks for women in instrumentation, maintenance, metallurgy laboratories, and control rooms, supported by on-the-job coaching. Scholarship schemes should reserve seats for women in metallurgy, mining engineering, and chemical engineering departments. Partnerships with secondary schools can sponsor hands-on STEM clubs and competitions with guaranteed internship slots for top performers. Companies should publish gender-disaggregated data on pay, training hours, and promotion rates to maintain accountability.

9.4 Intergenerational Justice and Youth Empowerment

9.4.1 Demographics and rationale

Africa has the youngest population in the world. More than 60 percent of Africans are under the age of twenty-five, and the working-age population is expected to expand rapidly through the mid-twenty-first century[197]. If education and skills systems keep pace and if labour markets generate learning-rich jobs, this demographic profile can be a dividend. If not, the result will be higher unemployment and social strain. The industrialisation strategy must therefore be a youth strategy. It should create structured pathways from school to skilled work in mining, processing, and advanced manufacturing.

9.4.2 Curriculum reforms and vocational training programmes

Curriculum reform should prioritise five elements. First, mastery of foundational mathematics and science through focused instruction and regular diagnostic testing. Second, competency-based modules in mechatronics, welding, process control, industrial safety, electrical systems, and data literacy are aligned to occupational standards. Third, work-integrated learning through dual training and extended internships in operating plants. Fourth, instructor upgrading and certification with periodic industry residencies. Fifth, recognition of prior learning to help experienced artisanal miners and informal technicians transition into formal roles. AfDB[198] and World Bank[199] guidance emphasise these elements across successful skills programmes.

9.4.3 Youth leadership pipelines in resource governance

Intergenerational justice requires giving younger professionals a voice in how mineral wealth is governed. Ministries and regulators can establish youth fellowships that rotate participants across geological surveys, environmental units and community development departments. Community development agreements should set quotas for youth representation and for youth-led projects in education, enterprise support and environmental rehabilitation. Regulatory internships can train young lawyers and economists to draft fair licence terms, monitor compliance and manage data on local content.

9.4.4 Embedding intergenerational equity in law and funds

Intergenerational equity can be hard-coded through fiscal rules and savings mechanisms. Resource funds that set aside a portion of receipts for future generations signal that today's projects must deliver long-term value. Transparent rules on transfers to education and skills programmes ensure that mineral rents buy human capital. Botswana's experience with sovereign savings from diamonds is often cited for its long horizon. The principle is not to copy any single model, but to legislate explicit rules that bind future governments to invest a share of resource revenues in young people.

9.5 Integrating SMEs and Young Entrepreneurs into Beneficiation

9.5.1 From the periphery to the core

Supplier ecosystems determine whether beneficiation creates broad-based opportunity. Many African SMEs operate at the periphery of mining value chains, providing low-margin services with little technology learning. Local content frameworks can change this pattern if they focus on capability. South Africa's mining policy architecture[200] and Nigeria's experience in oil and gas[201] demonstrate that procurement targets are most effective when combined with supplier development, standards compliance support, and access to finance.

9.5.2 Finance, standards and technology upgrading

SMEs that wish to move into higher value manufacturing for plants need credit for equipment, working capital to handle long payment cycles, and help to obtain certifications. Public-private supplier development programmes should offer audit-style diagnostics that identify gaps in quality management, maintenance routines, documentation, health and safety compliance, and digital record keeping. Grant-matched vouchers can fund upgrades. Procurement rules can break large contracts into lots suitable for smaller firms while still enforcing strict quality standards.

9.5.3 Cluster development around processing hubs

Where a smelter or refinery exists, an industrial cluster can be built around it. Shared facilities such as testing labs, tool rooms, and training centres can lower the cost for SMEs to participate. Universities and TVET colleges can co-locate satellite programmes that serve cluster firms. Anchor companies should publish medium-term procurement plans so that SMEs can plan investments and apply for targeted support.

9.6 Governance, Sequencing and Measurement

9.6.1 Skills compacts

Countries can negotiate skills compacts with major mining and processing firms. These are side agreements to licences that define annual intake targets for apprentices and interns, co-funded instructor residencies, and contributions to shared training infrastructure. A compact should specify occupational profiles, competency standards, certification pathways, and reporting templates. Tax allowances can recognise verified training hours delivered by firms.

9.6.2 Skills observatories and data systems

Skills observatories should be established or strengthened to publish annual dashboards on graduate output by field, TVET pass rates, apprenticeship placements, and employment outcomes. Data must be disaggregated by gender and age. Observatories can be situated within national statistical agencies or universities, but they require formal data-sharing agreements with education ministries, qualification authorities, and employers. The UNESCO Institute for Statistics provides open data tools that can be adapted for such national dashboards[202].

9.6.3 Measuring what matters

Beneficiation and industrialisation are systems challenges. Success depends on how quickly Africa can raise the stock of competent engineers and technicians, increase the participation of women and youth in skilled roles, and develop supplier ecosystems capable of meeting strict standards. A simple scorecard to track: the number of engineering and technician graduates placed in mining and processing roles each year, the percentage of women in plant and technical positions, the proportion of procurement spend placed with local SMEs that meet quality standards, and the number of diaspora secondment hours completed with verified competency gains. Publishing these metrics will enhance accountability and enable lenders and investors to more effectively assess risk.

Africa's mineral endowments are significant. Industrialisation strategy can convert endowments into learning, productivity, and better jobs, but only if countries treat human capital and social inclusion as primary investments, not afterthoughts. The skills gap remains the binding constraint. The diaspora is a strategic asset that can accelerate knowledge transfer. Gender inclusion is both fair and efficient. Youth deserve pathways that turn schooling into skilled work and civic leadership. SMEs must be brought from the periphery into the core of the value chain. With these priorities embedded in policy, licences, and firm practice, industrialisation shifts from aspiration to execution. Without them, it remains a mirage.negotiate skills compacts with major mining and processing firms. These are side agreements to licences that define annual intake targets for apprentices and interns, co-funded instructor residencies, and contributions to shared training infrastructure. A compact should specify occupational profiles, competency standards, certification pathways, and reporting templates. Tax allowances can recognise verified training hours delivered by firms.

10

THE LEADERSHIP IMPERATIVE

10. The Leadership Imperative

This report has been written particularly as a wake-up call to African leaders. No one should take pride in ruling over impoverished populations. No leader should find comfort in ribbon cuttings that barely change the lives of citizens. No external actor is coming to build Africa's industrial future. Africans must help themselves, and the responsibility to organise this effort rests squarely with those who hold public office, starting from the very top. This has been said ad nauseam, but is still worth repeating: Africa can no longer wait for handouts while its resources are extracted with little to show at home. The best blueprint will remain words on paper without political will. Policy, capital, and technology all bend to leadership. Without it, Africa's industrialisation will remain only a slogan. With bold leadership, industrialisation becomes a collective continental purpose that survives election cycles and compounds gains over time.

Countries with similar geology travel very different paths because leaders make or avoid choices. Leadership is a choice about horizon, honesty, and courage. It is the discipline to face vested interests, to align laws with enforcement, and to invest in people before patronage. It is the refusal to outsource responsibility to donors or consultants. It is the clarity to say that structural change is the work of decades and to build the institutions that will carry that work forward. Great leaders build a credible public administration, invest in people, and enforce rules without favour.

10.1 The Primacy of Development-Oriented Planning

A development-oriented state treats mining as one instrument within a wider industrial strategy. The primary aim is not to immediately maximise fiscal receipts but to durably raise domestic value addition, deepen skills, grow supplier ecosystems, and build institutions that sustain learning. Countries that have done this well make mining the anchor for adjacent capabilities. The Africa Mining Vision articulates this approach. It urges countries to use mineral wealth to catalyse broad-based development through linkages, human capital, and sound governance[203].

10.1.1 What a development-oriented state looks like in mining

Such a state starts with clarity of purpose. Cabinet sets a limited number of measurable objectives, for example, the share of refined exports, the number of technician apprentices placed in operating plants, or the proportion of procurement spend placed with certified local firms. Each objective has a lead ministry and a joint delivery plan. Budget allocations follow that plan.

10.1.2 From rent to investment

The centre of government tracks performance using robust data. Parliament receives regular reports and holds oversight hearings where ministers explain deviations. Audit institutions test the integrity of revenue collection and transfers to education and infrastructure funds[204]. Civil society has access to information and participates in multi-stakeholder bodies that oversee publication and problem-solving[205]. Leadership also shows in fiscal choices. When prices spike, pressure mounts to raise spending quickly. Development-oriented leaders:

- Use rules and institutions to balance stabilisation with investment.
- Allocate a portion of windfall receipts to sovereign savings and a portion to a skills and infrastructure window that targets binding constraints for beneficiation.
- Publish how funds are used and measure results.
- Avoid off-budget vehicles that escape scrutiny.
- Align tax incentives with performance, for example allowing accelerated depreciation on pollution control retrofits or credits for verified training hours.
- Maintain competitive royalty and corporate tax rates while expanding the base through better administration and transparency. In this way, fiscal policy expands the productive base rather than fueling consumption booms[206].

10.1.3 Tests for credible industrial strategy

A credible industrial strategy meets three tests. First, it identifies specific products and process routes where the country has or can build a competitive edge, such as copper rod, manganese alloys, or battery-grade precursors. Second, it sets measurable milestones and assigns clear responsibility for delivery, including reforms in power, trade facilitation, and skills. Third, it defines the instruments that will be used and outlines their sequencing. Policy banks and development finance institutions can support viable projects, but the strategy cannot hinge on subsidising uneconomic plants indefinitely[207]. The aim is disciplined experimentation with transparent review and the courage to stop what does not work[208].

10.2 Forging Unbreakable Policy Coherence

Industrialisation strategies fail not because the ideas are wrong but because the system pulls in different directions. The mining ministry issues a processing policy that collides with a tariff schedule set by the trade ministry. The energy ministry cannot guarantee a tariff path that allows plants to plan. The transport agency prioritises passengers over high-capacity freight. The finance ministry tightens procurement rules in ways that disable timely maintenance. Policy coherence is the leadership task of aligning incentives, budgets, and operating routines so that every component supports the shared objective.

10.2.1 Horizontal coherence across ministries

Leaders should build horizontal coherence through formal and informal mechanisms. For example, a presidential or prime ministerial delivery unit can convene weekly meetings where ministries resolve cross-cutting issues with data in hand. Performance contracts for ministers can include indicators owned by other ministries, which creates incentives to collaborate. Joint budget submissions for cross-cutting programmes such as industrial power, corridor logistics, and skills replication can be required. Legal instruments can embed consultation and concurrence rules so that critical policies cannot change without collective review. These approaches shift the culture from siloed compliance to joint problem-solving, which is essential when bottlenecks emerge as projects advance.

10.2.2 Vertical coherence across tiers of government

Vertical misalignment undermines credibility. Sub-national authorities control permits for land use, water, and environmental authorisations. If national ministries do not coordinate with provinces, states, and municipalities, projects face delays, inconsistent requirements, and community conflict. Leaders should establish intergovernmental compacts that set time limits for approvals, define one-stop processes, and share revenues transparently so that local governments have resources to provide services. Regional bodies add another layer. Harmonised licensing norms and environmental standards within regional economic communities reduce arbitrage and administrative cost for firms operating across borders.

10.2.3 Instruments for coherence and credible commitment

A small set of instruments can lock in coherence. Publicly available policy roadmaps give investors a basis for planning and allow citizens to track progress. Regulatory impact assessments require agencies to quantify effects and consult peers before changing rules[209]. Stability clauses in mining agreements can be matched by sunset reviews to prevent rigidities from freezing harmful policies. Data platforms that publish licence, production, payment, and procurement information reduce uncertainty and signal commitment to fair play. Independent regulators for power, environment, and competition can apply rules evenly. Together, these instruments create a web of credible commitment that survives personnel changes.

10.3 The Courage to Confront Vested Interests

Reform often collides with interests that profit from the status quo. Some political actors benefit from opaque licensing and procurement. Some firms prefer exporting concentrates because it allows arbitrage on quality and pricing and shifts environmental obligations elsewhere. Some intermediaries thrive on volatility and weak enforcement. Leadership must recognise these incentives and build a strategy to change them. Courage requires setting strategic capabilities that make reform stick.

The first capability is transparency backed by enforcement. Leaders should institutionalise beneficial ownership disclosure and open contracting so that conflicts of interest and collusive patterns become visible. The second is competition policy that opens space for new entrants in logistics, services, and processing while sanctioning abuse of dominance. The third is a coherent communications strategy that explains reforms in plain language and builds a coalition for change among workers, communities, and emerging entrepreneurs. The fourth is contract management that confronts persistent non-compliance. Where investors fail to meet minimum work programmes or refuse to publish required information, regulators must escalate sanctions predictably and, if necessary, take them to court. These actions increase the cost of predation and reward productive investment[210].

10.3.1 Internal interests and political finance

Political finance can create obligations to donors who seek rents in licensing or procurement. To address this, countries may consider strengthening party finance rules, capping contributions, and enforcing disclosure. Public funding tied to compliance can reduce dependence on private money. Appointment and rotation rules for key regulators reduce exposure to capture. Merit-based recruitment and pay scales that reflect responsibility improve integrity and performance. Ethics frameworks should include cooling-off periods before former regulators can join firms they once oversaw. These measures reduce conflicts at their source and protect reformers.

10.3.2 External interests and bargaining power

External players include trading houses, multinational processors, and financial actors who benefit from raw exports. Negotiating with them requires technical skill and political backing. Leaders should invest in commercial analysis capacity within ministries and in independent advisory panels. They should align fiscal and non-fiscal incentives so that processing investments face clear, stable rules. They should invite competition through open auctions and standardised contracts. They should use regional platforms to pool demand for inputs such as power and logistics and to market opportunities jointly. By widening the field and reducing discretion, leaders improve terms while keeping the door open to responsible partners.

10.4 Driving continental integration from within

The world lacks a global cooperative body for mineral-rich developing regions that can set norms or defend collective interests. Africa can fill that gap for itself by building institutions that negotiate as a bloc where interests converge. This can move integration from a slogan to a daily practice of harmonising standards, opening

The world lacks a global cooperative body for mineral-rich developing regions that can set norms or defend collective interests. Africa can fill that gap for itself by building institutions that negotiate as a bloc where interests converge. This can move integration from a slogan to a daily practice of harmonising standards, opening borders for goods and skills, and sharing infrastructure. Leaders must drive this practice from within, since external actors will not do it for them.

Three integration fronts matter most for industrialisation. The first is trade policy under the AfCFTA. Rules of origin and tariff schedules can favour regional processing if they are designed and enforced with that goal in view. The second is infrastructure. Power pools and cross-border transmission make it possible to locate plants where renewable potential is strongest and to share capacity across borders. Rail and port corridors designed for bulk freight reduce costs for minerals and downstream products. The third is standards. Harmonised environmental, safety, and product standards reduce compliance costs and allow SMEs to sell components across the region. These changes require leadership that can negotiate compromises among states and keep the long horizon in view.

10.4.1 Regional value chains and specialisation

It is important to remember that no single country needs to perform every step. Regional value chains allow countries to specialise according to comparative capabilities while sharing gains. One country might focus on concentrate production and sulphuric acid supply, another on smelting and refining, and a third on fabrication or battery precursors. Cross-border industrial parks with shared services can

It is important to remember that no single country needs to perform every step. Regional value chains allow countries to specialise according to comparative capabilities while sharing gains. One country might focus on concentrate production and sulphuric acid supply, another on smelting and refining, and a third on fabrication or battery precursors. Cross-border industrial parks with shared services can serve as anchors for such chains. Leaders must agree on macro-level rules and on dispute resolution mechanisms that give firms confidence to invest across borders. Development finance institutions can co-finance anchor projects and risk mitigation facilities. Publication of cross-border procurement pipelines can help SMEs plan investments that support regional clusters.

10.4.2 Collective bargaining and knowledge clubs

Collective bargaining should extend beyond price coordination, which is often impractical. Africa can create knowledge clubs that share contract templates, environmental standards, and data on costs and technology performance. A continental centre for industry analytics could maintain cost curves for different process routes, track learning curves for equipment, and publish benchmark tariffs for industrial power. These tools level the informational playing field and increase the bargaining power of governments and local firms.

> “
> **Africa should build institutions that negotiate as a bloc.**
> ”

Case Study 12: Chile's Strategic Leap in Copper Value Addition

Chile shows how sustained political leadership can use coherent institutions to push value addition while maintaining competitiveness. Leaders across political cycles built a governance architecture that combined state capacity with private investment. They nationalised the major copper mines in 1971 and created the national Copper Corporation of Chile (CODELCO) as a state-owned producer, while allowing a strong role for private operators under a clear legal framework. They established Chilean Copper Commission (COCHILCO) to provide independent analysis and oversight of the copper sector and Production Development Corporation (CORFO) to support industrial development. They expanded smelting capacity at Chuquicamata, Caletones, Potrerillos, and Ventanas, and later invested in environmental retrofits to meet stricter standards. They also invested in supplier development programmes and skills in mining regions, which created local ecosystems of maintenance, engineering, and services. Although Chile's share of global smelting declined as China expanded capacity, the country retained a significant base of smelters and refineries and built deep capabilities in geology, operations, and project management. The benefits included stable fiscal revenues, a high-quality regulatory environment, and a dense network of universities and firms that support innovation. The record is not a linear success. Environmental concerns around older smelters and the need to diversify beyond copper remain. Yet the case illustrates how leadership, institutions, and disciplined policy can move a resource-rich country up the value chain while learning over time.

Lessons for Africa

The Chilean case underscores four leadership lessons. First, stable yet adaptable rules attract capital while allowing upgrades in environmental and safety performance. Second, strong public agencies that publish data and analysis reduce opacity and build credibility. Third, investment in skills and suppliers magnifies the local footprint of mining. Fourth, leaders must continually evaluate comparative advantage and be prepared to renovate aging assets or pivot to new products. These lessons are transferable to African contexts with the necessary adaptations to power costs, logistics, and market access.

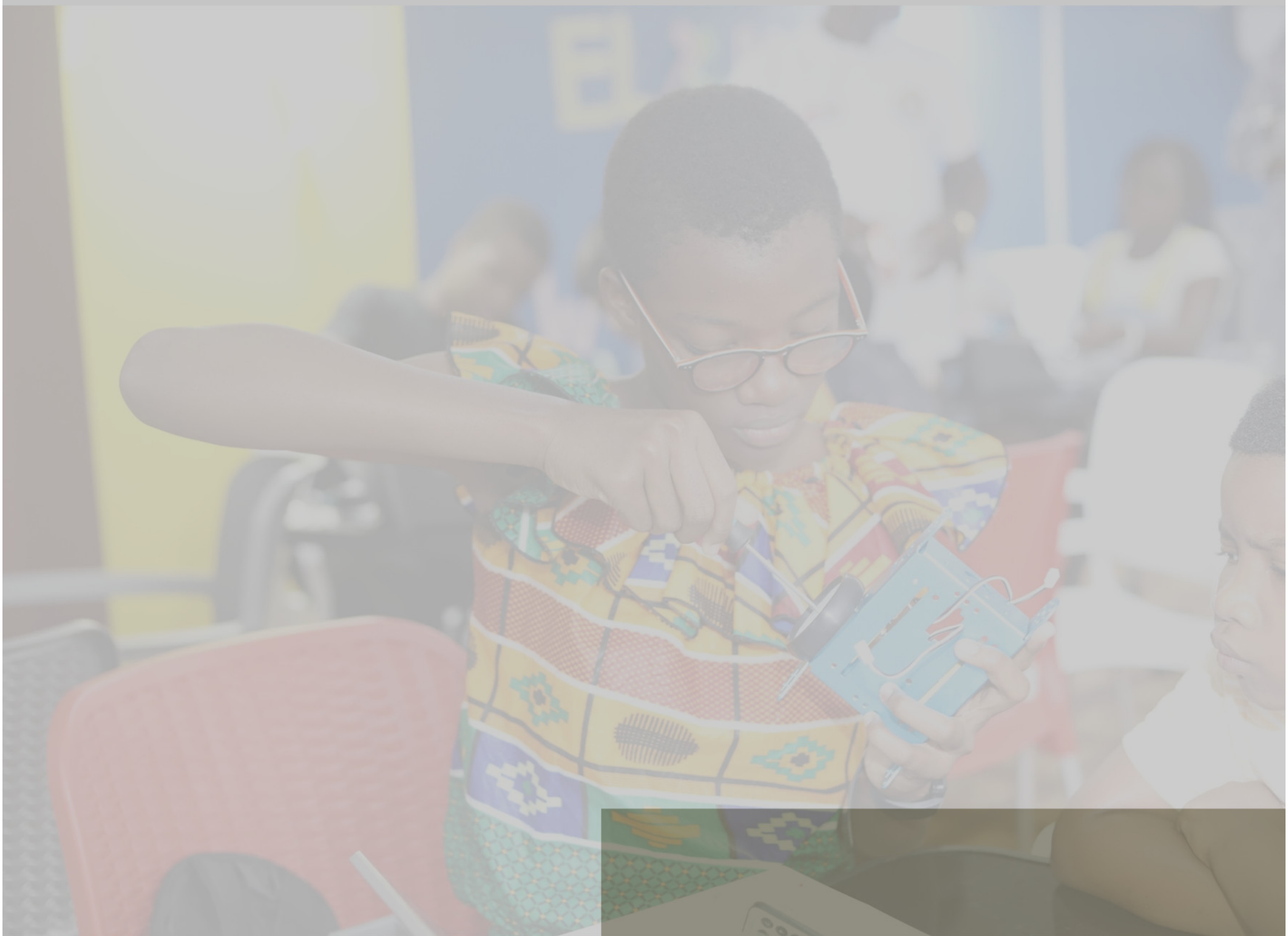
10.5 A Call to Action

The leadership agenda for Africa's industrialisation is demanding but achievable. It requires clarity of purpose, system-wide coherence, and courage to confront interests that prefer the status quo. It also requires a continental mindset that sees national reforms as building blocks of a larger project. The reward is structural transformation that raises productivity, resilience, and dignity. To move from diagnosis to action, leaders can commit to a practical programme for the next decade.

First, set national targets for value addition that are realistic and binding. Publish a policy roadmap with milestones for power, logistics, skills, and licensing, and report progress quarterly. Second, embed transparency into law and into digital systems that publish licence, production, payments, and procurement data. Join or deepen participation in EITI and adopt open contracting and beneficial ownership standards. Third, create delivery institutions that can coordinate across ministries and tiers of government with authority to resolve bottlenecks. Fourth, make skills the front line of policy by funding apprenticeships, instructor residencies, and diaspora secondments tied to plant needs. Fifth, negotiate regional compacts under AfCFTA that pool demand for power and logistics and harmonise standards for safer and more competitive production. Sixth, update environmental and safety regulations and sequence retrofits so that plants meet standards without sudden shocks. Seventh, deploy development finance to crowd in private capital for viable projects and supplier upgrading, with strict transparency and performance covenants. Eighth, strengthen competition policy and courts so that entrants with new technology can challenge incumbents fairly. Ninth, professionalise state-owned enterprises and require them to publish audited financials and performance contracts. Tenth, invest in communications that explain the rationale and the path to citizens, workers, and firms. People will tolerate short-term sacrifices when leaders earn trust through truthful engagement and visible delivery.

Leadership at this scale asks for integrity and humility to learn. Policies will not work perfectly the first time. What matters is a disciplined cycle of testing, feedback, and correction, protected from the noise of daily politics. When leaders institutionalise that cycle and hold to the horizon of structural transformation, industrialisation ceases to be a slogan. It becomes the operating logic of the economy. Africa can choose that path. The decision is political. The time is now.

11



MONITORING, METRICS, AND EVALUATION

11. Monitoring, Metrics, and Evaluation

Mineral-driven industrialisation of Africa will be a test of institutions as much as it is a test of engineering. Countries can legislate local content, announce industrial parks, and court anchor investors, yet the effort will stall without robust systems that measure performance, expose problems early, and assign responsibility for correction. This chapter outlines the mechanisms for monitoring, metrics, and evaluation that bring policy to life. It outlines clear indicators, credible data systems, and independent oversight as the foundations of investor confidence, public trust, and operational discipline. In their absence, industrial strategies drift, rent-seeking flourishes, and citizens question whether promised gains will ever reach communities.

11.1 Establishing Key Performance Indicators

Effective monitoring starts with indicators that reflect the policy logic. Industrialisation aims to shift the composition of exports, increase domestic value added, create good jobs, stimulate supplier ecosystems, and collect revenues transparently for reinvestment in people and infrastructure. Indicators should therefore be grouped across economic, social, and governance dimensions. Each indicator needs a precise definition, a baseline, a realistic target, a clear data source, and an accountable institution that will publish results at a predictable frequency.

We propose a balanced scorecard that governments can adapt to their context. The minimum set should be stable over time to allow trend analysis. Countries may add sector-specific indicators for subsectors such as gold refining, battery minerals processing, or steel rolling.

Indicators should cover both outcomes and leading process metrics. For example, the value added per tonne of concentrate refined domestically is an outcome, while the percentage of plants publishing monthly mass-balance reports is a process metric that signals whether the control cycle is functioning effectively.

11.1.1 Economic indicators

The economic strand should track movement from raw material exports to processed goods. The share of refined exports in total mineral exports is a simple ratio that signals structural change. Value added per tonne at different stages of processing, calculated as net sales minus input costs divided by throughput, gives an efficiency view. Domestic procurement is another critical lever. Governments should require companies to disclose the number and value of contracts awarded to local SMEs by category of goods or services, with verification that suppliers meet quality and safety standards. Plant-level utilisation rates, energy intensity per tonne, and recovery rates in concentrators and refineries signal operational performance directly relevant to competitiveness.

Public agencies can also track catalytic investment. The number of new firms established in processing clusters, the volume of private capital deployed into supplier upgrading, and the uptake of shared testing or tool-room facilities all indicate whether clusters are taking hold. These indicators should sit alongside trade metrics that capture the diversification of export baskets. Together, they create a picture of whether industrialisation is improving resilience to commodity price swings and raising the complexity of the economy.

11.1.2 Social indicators

Industrialisation must create good jobs and expand opportunities. Governments should measure the number of direct jobs in plants and the number of indirect jobs in the supplier ecosystem. The numbers should be disaggregated by gender, age, and location. Training investment is a leading indicator of sustained productivity. Companies should report their annual spending on apprenticeships, technician training, and instructor residencies, along with the number of trainees who complete competency-based assessments. Community development agreements can be effectively monitored through transparent scorecards that track the delivery of agreed-upon projects, satisfaction surveys, and grievance resolution times. Where social housing or resettlement is required, indicators must follow international standards for livelihood restoration.

Social indicators are not add-ons. They support plant productivity and reduce conflict risk. A workforce that sees prospects for advancement and communities that see visible benefits are more likely to collaborate with firms on problem-solving. Data on safety matters as well. Lost-time injury frequency rates and near-miss reporting are core operational metrics that should be disclosed, as they reflect management quality and culture. International frameworks such as ICMM performance expectations[211] and Global Reporting Initiative (GRI) standards[212] provide reference points for definitions and disclosure formats.

11.1.3 Governance indicators

Governance indicators must anchor trust. A public mining cadastre that shows who holds which licence, where the licence is located, its status, and its history is the baseline.

Revenue collection should be monitored through reconciled disclosures that link production volumes, royalty and tax payments, and government receipts. Beneficial ownership disclosure identifies the natural persons who ultimately control licence holding companies. Public procurement figures for plant construction and maintenance should be published in open data format, with contract documents and implementation updates. Parliament should receive regular compliance reports. These elements reflect established good practice and are embedded in global standards such as EITI[213] and the IMF Fiscal Transparency Code[214].

11.2 Developing Real-Time Information Systems

Timely information reduces risk. Operators need live data to optimise plants. Policy makers need timely updates to adjust policy and oversight. Citizens and investors need predictable publication to build confidence that numbers will not be withheld. Digital governance tools allow these needs to align. A national beneficiation dashboard can track a standard set of indicators across licences and plants. It should draw data directly from source systems where possible, not from spreadsheets that are compiled by hand. The approach is to integrate existing systems rather than to build a monolith that replaces them.

A practical architecture has four layers. The first is data generation at source, including plant control systems, company financial systems, environmental monitors, and the mining cadastre. The second is data exchange through secure APIs and standardised templates. The third is a data warehouse that stores curated datasets with audit trails and version control.

The fourth is the public interface, a dashboard that presents high-value indicators, time series charts, geospatial views, and downloadable datasets. Access controls should protect commercially sensitive elements while defaulting to openness for core governance metrics. Data documentation must be published to allow independent users to interpret the numbers correctly.

The EITI Standard encourages systematic disclosure and integration of extractives data into government systems. The Open Contracting Data Standard outlines the structure for procurement data, from planning to contract implementation. The Open Ownership Principles set out the elements of effective beneficial ownership regimes. Using these reference points reduces design risk and makes domestic data interoperable[215] with global tools that analysts and investors already use.

11.2.1 Production, revenue, and ESG streams

Production data should be captured at the point of measurement and reconciled against shipment records. Dashboards can present daily or weekly throughput, recovery rates, and stock levels for plants that are publicly accountable. For revenue, the key is to track declared royalties and taxes from companies and receipts recorded by the revenue authority, with automated checks for variance beyond a defined threshold. Environmental and social reporting should include emissions, effluents, water abstraction, waste disposal, rehabilitation funds, and community investment executed against agreed plans. Operators can publish summary ESG reports quarterly, along with links to detailed, underlying data in machine-readable format. Where verification is required, the dashboard can flag items for scheduled audits.

11.2.2 Public cadastre and licence analytics

A cadastre is the authoritative registry of mineral rights. A modern cadastre records the coordinates of each licence, the holder and beneficial owner, the status, the grant and expiry dates, the work programme obligations, and the area. A public portal allows citizens and investors to see who holds ground and whether obligations are being met. Licence analytics can track processing times for applications, frequency of licence transfers, compliance with minimum work programmes, and the share of ground held inactive for extended periods. Publishing these metrics discourages hoarding, improves allocation, and reduces the space for rent extraction. Ghana's online cadastre illustrates how a transparent repository improves certainty for all parties[216].

11.2.3 Data quality and safeguards

Real-time systems require strong controls. Data owners should assign stewards who validate submissions against defined rules. System logs must record changes, with user attribution and timestamps. Periodic data quality reviews should test completeness, consistency, and accuracy, and publish findings. Where high-stakes figures such as royalty payments are involved, independent auditors should examine data flows from source to publication. Cybersecurity standards must be defined with reference to national frameworks. Open data can coexist with strong privacy and security if governance rules are clear and enforced.

11.3 Ensuring Independent Oversight

Data supports accountability only when independent actors can scrutinise it and respond. Three institutional pillars matter. First, multi-stakeholder bodies that include government, companies, and civil society can oversee publication and address systemic issues. Second, supreme audit institutions should audit revenue collection and the management of resource funds. Third, parliaments must use the data in budget hearings and licence reviews, and they must publish their findings. Each pillar needs access to information, legal standing, and predictable resourcing.

The EITI multi-stakeholder group model offers a starting point. The model brings stakeholders together to agree what will be published, to review reconciliations of payments and receipts, and to identify corrective actions. The Natural Resource Governance Institute's Resource Governance Index provides a benchmark for the quality of laws and practices across licensing, taxation, state-owned enterprises, and local impacts, which can help actors set targets and track improvement over time. IMF fiscal transparency standards and Public Expenditure and Financial Accountability (PEFA) assessments provide additional tools for evaluating the credibility of budgets and reporting.

11.3.1 Role of civil society

Civil society organisations play distinct roles. Watchdog groups scrutinise procurement and revenue numbers, check contract compliance, and investigate licence histories. Community-based organisations monitor the delivery of community development agreement commitments, conduct perception surveys, and document grievances. Think tanks provide independent policy analysis and help design indicators that can be measured with available data. The most effective coalitions combine these capabilities. Authorities should facilitate access to data, protect legitimate civic space, and respond formally to evidence-based findings.

11.3.2 Parliamentary oversight

Parliamentary committees can institutionalise hearings on the performance of the minerals sector. A standing schedule can cover revenue collection, licence allocation, environmental compliance, and local content each year. Committees should call ministers, regulators, and company representatives to explain variances and present remediation plans. Public transcripts and follow-up timetables signal seriousness. Professional staff can use dashboards to prepare briefing notes that summarise trends, highlight outliers, and propose questions. Collaboration with the supreme audit institution increases the impact of findings.

11.3.3 Independent evaluation and learning

Independent evaluation complements routine monitoring. Evaluations should be commissioned at defined intervals to test whether beneficiation programmes are achieving stated outcomes and to identify course corrections. Methodologies should include contribution analysis and process tracing where attribution to a single policy is difficult. Evaluators should have access to datasets and to implementation files. Findings should be published with management responses that state which recommendations will be adopted, by whom, and by when. Lessons should feed back into programme design and into updates of the KPI framework.

Case Study 11.1: Ghana's Online Mining Cadastre as a Transparency Tool

Ghana's Minerals Commission operates a publicly accessible online repository of mineral licences that improves certainty for investors and citizens. The portal displays the location and boundaries of licences on an interactive map, together with the licence holder, the type of right, the status, the area, and key dates. Users can filter by region, licence type, or company name, and can download selected datasets. Officials update the register as applications move through review and as rights are granted, transferred, suspended, or expire. The repository links to relevant legal instruments and procedural guides, which helps applicants understand requirements and timelines. By publishing authoritative information in one place, the system reduces discretion in the allocation process, curbs the scope for speculative hoarding of ground, and assists due diligence by lenders and partners. Communities can see who holds rights over land in their area and can raise questions with evidence in hand. The platform complements Ghana's EITI disclosures on production, payments, and receipts, which together form a coherent transparency architecture.

11.4 Implementing a Results-Focused MME System

Ministries and regulators can build a monitoring, metrics, and evaluation system in phases. The first phase sets the legal and institutional foundations. Legislation should establish duties to disclose, define the scope of indicators, and grant the regulator the power to collect data and impose sanctions for non-compliance. A ministerial directive can approve the KPI suite and designate data owners across agencies. The regulator should publish a data dictionary that defines each indicator and lists accepted sources. A public calendar should set publication dates for each dataset.

The second phase focuses on systems. Agencies should map existing data flows, identify gaps, and agree on standard exchange formats. Where old systems cannot export data, interim templates can be used while upgrades are planned. A central data warehouse should be established with role-based access. Procurement for the public dashboard should prioritise usability, accessibility, and open licensing of code to avoid lock-in. Help desks and training sessions should support company staff who must submit data. Pilots with a small group of plants can test the end-to-end process before full rollout.

The third phase embeds routines for use. Officials should integrate dashboards into weekly management meetings. Regulators should issue quarterly compliance bulletins that list entities with overdue reports and the actions taken. Parliament should schedule hearings that align with publication dates. Civil society should plan independent analyses that are released in the same window, so that public debate is timely. Continuous improvement should be expected. Indicators can be refined as data quality and policy priorities evolve, provided that changes are documented and historic series are preserved.

11.4.1 Defining responsibilities and incentives

Responsibility must be unambiguous. Each indicator should have a designated data owner and a senior official who is accountable for publication. For companies, licence conditions should require timely submissions and public disclosure of defined items. For agencies, performance contracts can include targets for on-time publication. Where incentives are aligned, compliance tends to improve. Where they are not, sanctions may be necessary. Regulators can suspend licence transfers or approvals until overdue data are submitted. Public recognition for high performers can complement sanctions by rewarding consistent transparency.

11.4.2 Budgeting for sustainability

Monitoring systems require steady funding. Budgets should cover hosting, cybersecurity, software maintenance, data stewards, and independent audits. Donor support can fund initial capital costs, but core operations should be allocated to the recurrent budget to ensure continuity. Pooled financing across agencies reduces duplication. Cost recovery can be considered for premium services that do not undermine the public interest in open data, such as specialised analytics for firms that request them.

11.4.3 Data protection and commercial sensitivity

Publication should be the default for governance-critical data; yet, legitimate confidentiality must be respected. Laws on access to information should define limited exemptions for commercially sensitive items and personal data. Exemptions should be narrow and subject to public interest tests. Aggregation and anonymisation can protect privacy while preserving the value of statistics. Decisions to withhold data should be logged and subject to appeal. The aim is to uphold the principle that transparency serves both accountability and markets.

11.5 Linking Monitoring to Investor Confidence and Public Trust

Investors discount political and operational risk when they can see rules applied predictably and when they can interrogate data. Reliable dashboards that present production, payment, and licensing data reduce uncertainty about the behaviour of counterparts and regulators. They lower the cost of due diligence and shorten approval timelines. They also create discipline within firms. Knowing that performance will be visible, managers tend to improve record-keeping, internal controls, and maintenance planning. These improvements are reflected in fewer disputes, improved safety, and stronger relationships with communities.

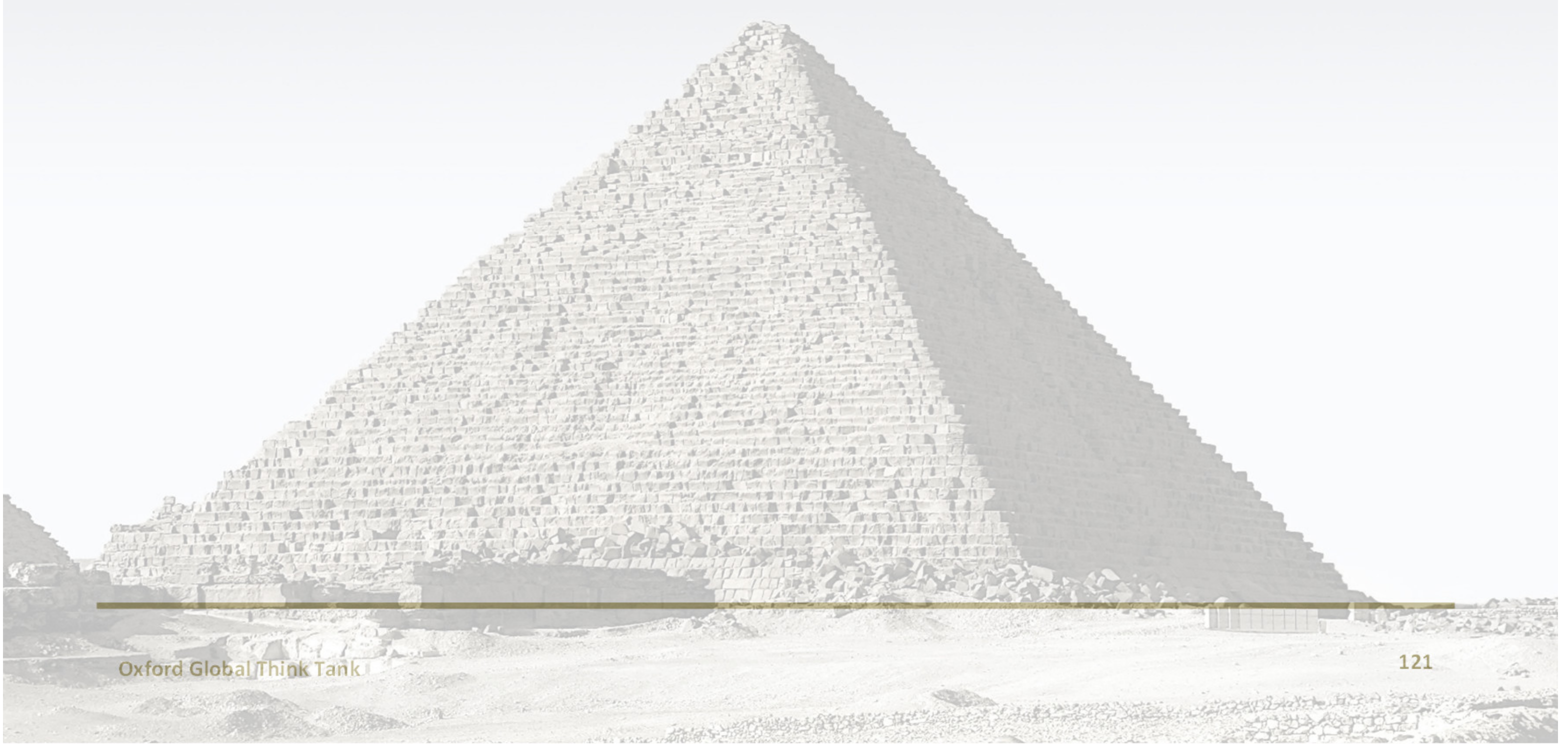
Public trust grows when citizens can check claims against published numbers. Trust also depends on participation. Multi-stakeholder processes enable civil society to contribute to setting indicators and propose corrections when data reveal issues. Parliamentary use of information demonstrates that elected representatives are exercising oversight. Where evidence reveals gaps, a credible response is critical. Publishing remediation plans, tracking progress, and explaining delays keep constituencies engaged. The feedback loop between data, dialogue, and decision-making is the essence of democratic accountability.

11.6 Risks and Mitigation Strategies

Several risks can undermine the effectiveness of monitoring and evaluation. Data may be poor in quality or incomplete. Systems may be fragmented, with agencies guarding information silos. Political resistance may grow when indicators expose underperformance or malpractice. Skills shortages can slow implementation. Cybersecurity incidents may disrupt publication or erode confidence. Each risk can be mitigated through design choices and institutional commitments.

To address quality, adopt clear data standards, assign stewards, and publish quality assessments with corrective actions. To break silos, legislate data sharing, and build joint platforms with governance boards that include all contributing agencies. To manage political resistance, anchor publication duties in law, define sanctions for non-compliance, and cultivate coalitions that prioritise transparency for market efficiency, not just for ethical reasons. To bridge skills gaps, invest in training and contract experienced implementers while developing internal capacity. To reduce cyber risk, adopt recognised standards, conduct penetration testing, and maintain offline backups of critical datasets.

Industrialisation succeeds when institutions match the complexity of multiple systems. Indicators that measure what matters, digital platforms that publish reliable data, and independent bodies that use this information to drive policy correction together form the operating system for policy. With these elements in place, investors will see predictable governance, communities will see delivery against promises, and governments will steer strategies with evidence rather than impulse. The result is not simply better reporting. It delivers better performance and, over time, fosters a deeper base of trust, allowing long-term industrial investment to grow.



12

LOW-HANGING FRUIT

12. Low-Hanging Fruit

Africa can build momentum for mineral-driven industrialisation by delivering quick wins that change incentives on the ground within the short to medium term. The goal is not to replace long-horizon reforms but to complement them with practical steps that reduce risk for investors, raise standards, improve transparency, and create early jobs. This chapter sets out a shortlist of priority actions that are feasible and tailored to African realities. The proposals draw on established evidence and on lessons from successful pilots in adjacent sectors such as mobile money, digital identification, and open contracting.

12.1 A New Deal for Artisanal and Small-Scale Mining (ASM)

Artisanal and small-scale mining employs millions, supplies critical minerals, and often operates outside formal systems. Rapid formalisation is a low-cost way to raise incomes, improve safety, and increase fiscal receipts while creating a pipeline of feedstock for domestic processors[217],[218], [219]. The new deal is to make formality cheaper than informality through simple rules, mobile-first tools, and predictable benefits.

12.1.1 Opportunity

Governments can convert informality into immediate asset. By registering miners and traders digitally, publishing standard prices, and facilitating responsible buyers, authorities can reduce the discount that ASM producers face. Linking cooperatives to geological extension services and safe processing sites can lift productivity and reduce harm.

12.1.2 Specific actions for the next 12 months

First, deploy a mobile-first ASM registration platform that works on basic phones via Unstructured Supplementary Service Data (USSD) and on smartphones through an app. Registration should capture the person's details, the cooperative's information, the site coordinates, the mineral, and the next of kin for safety purposes. The system should issue a digital card or QR code that allows access to services and verifies compliance[220].

Second, partner with fintech firms to create low fee digital wallets for miners and cooperatives[221]. Royalties and fees can be paid through mobile money with automated receipts to the revenue authority. This reduces leakage and enables the offering of small working capital loans and micro insurance based on transaction histories. Governments can negotiate fee caps with providers to protect users[222].

Third, launch geological extension services for ASM through a blended model. Public geologists can publish open pegmatite and alluvial maps and hold field clinics.

Universities can run weekend workshops in mining towns. Private labs can offer discounted assays through voucher schemes for registered cooperatives. A help desk on WhatsApp can answer questions about ore quality, processing options, and safety. Materials should be in local languages and include sketches of basic ore sorting and gravity separation techniques[223].

Fourth, designate safe processing parks for ASM in proximity to deposits. Provide water, power, tailings ponds, and basic security. Publish environmental house rules and offer pooled procurement of mercury-free equipment, retorts, and personal protective equipment. Assign a private operator through an open concession to maintain the site and collect cost recovery fees under a transparent schedule[224].

Fifth, create a responsible buyer offtake facility. A state-backed window or development bank line can pre-finance certified buyers who commit to transparent pricing and traceability and who supply feedstock to domestic processors, where available. The facility should publish daily reference prices and contract awards to avoid elite capture[225].

12.1.3 Expected impact and actors

Within a year, it is feasible to register tens of thousands of miners, raise royalty collection, and reduce accidents in designated parks. Processors can receive a more consistent supply with basic quality assurance. Revenue authorities will have access to transaction data to enhance compliance. The actors include mining ministries, geological surveys, local governments, fintech firms, universities, development banks, and civil society.

12.2 Launch Pilot Special Beneficiation Zones (SBZs)

Investors need some degree of certainty on land, energy, water, permits, and logistics. Governments can deliver on this within defined zones that offer plug-and-play infrastructure and streamlined procedures. Four pilot SBZs can be announced immediately, one in each sub-region, anchored in existing corridors and matched to regional minerals. The objective is to prove bankability quickly and to create templates that can be replicated.

12.2.1 Opportunity

Zones allow governments to concentrate scarce administrative capacity. By preparing the land, connecting clean power, and obtaining pre-clearance permits, authorities can compress project timelines by months. Zones can also host shared services such as testing labs, tool rooms, and training centres that help SMEs meet standards. Successful economic zones across Africa have shown that clarity and speed attract investment when fundamentals are in place[226].

12.2.2 Specific medium term actions

Identify four pilot sites: lithium or bauxite in West Africa near a port and hydropower; cobalt or copper in Central Africa close to an existing smelter and rail; battery minerals or rare earth pre-concentrates in East Africa near geothermal or hydro; and ferroalloys or PGM recyclers in Southern Africa where wind and solar can be firmed by gas or hydro. Utilise existing industrial parks or port zones whenever possible to expedite the process.

Designate pre-permitted land parcels within each SBZ. Publish cadastral overlays, environmental baselines, and resettlement status. Establish a one-stop service that can issue building, environmental, and operating permits within thirty days for projects that meet published checklists. Adopt model lease agreements and model connection agreements for power and water. Put all templates online.

Guarantee clean energy access. Sign bankable power connection agreements with utilities and power pools. Where necessary, procure dedicated renewable plants with storage through competitive tenders, backed by partial risk guarantees. Publish levelised tariffs and connection fees. Allow behind-the-meter generation where grid reliability is a risk[227].

Offer predictable, time-bound incentives tied to performance. Options include accelerated depreciation for pollution control and energy efficiency upgrades, reduced import duties on plant equipment that meets best available techniques, and tax credits for verified training hours for apprentices and instructors. All incentives should be rule-based and published.

Build shared facilities. Equip an ISO compliant testing lab, a metrology centre, a tool room, and a training centre that mirrors plant environments. Contract private operators for each shared service through open tenders and performance-based contracts. Allow SMEs to book time online and pay transparent fees.

Publish a procurement pipeline for the SBZ. Break large contracts into lots where possible to enable qualified SMEs to compete. Adopt the Open Contracting Data Standard for all procurement activities in the zone and publish contract documents, implementation updates, and payment details [228].

12.2.3 Expected impact and actors

A well-thought-out SBZ can mobilise investment within twelve to eighteen months. Shared services lower entry costs for SMEs and improve quality. Firm timelines encourage anchor investors. Transparent procurement reduces risk and stimulates local supplier development. Actors include trade and industry ministries, energy and environment regulators, utilities, port and rail authorities, development finance institutions, and private operators.

12.3 Fast-Track the AfCFTA Protocol on Mining

It is no mystery that regional value chains require harmonised rules. The AfCFTA mining protocol can provide a legal basis for common standards, rules of origin for processed products, and cooperation on trade remedies and competition. Fast-tracking ratification is a high-impact action because it unlocks market access and reduces compliance costs. A coalition of willing states can move first, with others joining later.

12.3.1 Opportunity

The protocol can facilitate the mutual recognition of product standards, coordinate tariff schedules for inputs and outputs, and establish frameworks for transit, data sharing, and dispute resolution. It can also mandate publication of licence and contract data and commit parties to beneficial ownership transparency for licence holders, which increases trust in cross-border ventures[229].

12.3.2 Specific actions for the short to medium term

Heads of state from multiple African countries can sign a presidential compact that commits to ratification within twelve months. The compact should include a model bill for national parliaments, a timetable for regulatory alignment, and a commitment to publish progress on a monthly basis. Regional economic communities can provide technical support and convene peer review sessions to resolve sticking points.

Negotiate a fast-track annex on rules of origin for priority products such as copper rod, aluminium sheet, manganese ferroalloys, and battery precursors. Agree mutual recognition of testing and certification for these products. Publish a public help desk and guidance notes for firms.

Create an AfCFTA Beneficiation Taskforce with representatives from trade, mining, standards bodies, and revenue authorities. Mandate the taskforce to draft harmonised tariff lines for inputs such as refractory bricks, graphite electrodes, and process chemicals, and to remove redundant non-tariff barriers. Publish a dashboard that tracks ratification and implementation steps by country.

12.3.3 Expected impact and actors

A credible timetable for ratification signals to investors that regional rules will stabilise. Mutual recognition reduces costs for firms and speeds market entry. Actors include the AfCFTA Secretariat, regional economic communities, trade and mining ministries, standards bodies, parliaments, and private sector associations.

12.4 Empower a New Generation of Mining Entrepreneurs

SMEs and young founders can provide services and manufacture components if they receive tailored support. A continental accelerator for mining value chains can unlock this potential quickly. The design should combine finance, procurement access, and mentorship with strict standards.

12.4.1 Opportunity

Young engineers, technicians, and data scientists already build solutions for maintenance, instrumentation, and safety. With structured procurement access and patient capital, these teams can scale. Experience from supplier development programmes shows that targeted capability upgrades can improve on-time delivery and quality compliance within months[230].

12.4.2 Specific actions for the medium term

Establish a Mining SME and Youth Accelerator with three pillars. The finance pillar will create a dedicated venture capital and revenue-based financing fund with first-loss capital from development banks. The market access pillar will secure procurement set-asides of at least 10 percent in public mining projects and in SBZs for qualified SMEs, with open frameworks to avoid cartelisation. The capability pillar will offer mentorship networks that match founders with plant managers, engineers, and quality specialists for six to twelve months.

Create a supplier readiness certification with three levels. Level 1 covers basic compliance on safety and record keeping. Level 2 covers documented processes and quality control. Level 3 covers ISO aligned systems. SMEs can bid for larger contracts as they move up levels. Publish a directory of certified suppliers across the continent.

Adopt prompt payment rules for SME contracts, with automatic interest on late payments by public entities. Offer invoice discounting facilities backed by development banks to solve working capital gaps. Integrate open contracting so that award data is public and collusion can be detected.

Create university to cluster pipelines. Fund capstone projects tied to SBZ needs and guarantee internship slots. Sponsor annual problem-solving hackathons with awards for implementable solutions. Recognise and scale the best pilots through procurement commitments rather than prizes alone.

12.4.3 Expected impact and actors

Within a year, dozens of SMEs can achieve Level 2 certification and win contracts for maintenance, fabrication, instrumentation, and digital services. Youth-led teams can move from prototypes to paid deployments. Public entities will benefit from improved delivery and lower costs through increased competition. Actors include industry and trade ministries, development banks, anchor firms, universities, chambers of mines, and SME associations.

12.5 Activate Dormant Laws with Immediate Effect

Many countries already have laws on local content, environmental compliance, beneficial ownership disclosure, and open procurement. The gap is in enforcement. A continent-wide one-hundred-day enforcement sprint can deliver visible results and reset expectations. The sprint should focus on a narrow set of high-value obligations with clear penalties for non-compliance.

12.5.1 Opportunity

Publication duties and licensing obligations can be enforced quickly. Many countries have adopted the EITI Standard and passed access to information laws. Environmental regulations often require emission monitoring and tailings management plans. Local content rules often exist but are not measured. Enforcing a few obligations well can shift behaviour across the system[231].

Case Study 14: Nasarawa State, Nigeria – Proactive Lithium Corridor

Nigeria's constitutional set-up places solid minerals on the Exclusive Legislative List. Mineral titles, royalties, environmental approvals and security operations sit with federal agencies such as the Mining Cadastre Office, the Ministry of Solid Minerals Development and the Federal Ministry of Environment, which leaves governors with little direct authority over licensing or enforcement. In practice, this centre-led architecture often creates gaps that deter responsible investors: overlapping levies and roadblocks along haulage routes, unclear land access around prospective deposits, weak coordination on security, and uncertainty about how community development agreements will be negotiated and honoured. Nasarawa's starting point was to accept these constraints as given and then design a collaboration model that uses the powers that states do control, notably land assembly and planning, last-mile infrastructure, investment facilitation, skills, and local security coordination.

The state mapped lithium-bearing pegmatites along the Keffi–Akwanga–Wamba axis and declared a serviced Nasarawa Lithium Hub where it could actually move the levers it owns. Through its investment agency, it created a single window that co-locates a Federal Mines Office desk one day each week, so investors can resolve state and federal steps in one sitting. Land use certificates and grid connections are processed to firm timelines; the state uses industrial-park rules to standardise utility tariffs and effluent requirements that mirror federal environmental regulations, avoiding duelling standards. A joint technical committee comprising the Mining Cadastre Office and the Nigeria Geological Survey Agency reviews exploration plans before submission, thereby reducing the need for back-and-forth communication after filing.

Security is handled through a standing state–federal task team that includes the Nigeria Police, NSCDC, and traditional councils to close illegal pits, protect legitimate operations, and de-escalate disputes early. Because the state cannot issue mineral titles, it focuses on the complements that make a federal licence bankable: access-controlled plots, an embedded substation and dedicated feeders, serviced water, a weighbridge, and a shared assay lab operated with a local university and accredited private partners.

On the commercial and social side, Nasarawa organised artisanal miners into cooperatives eligible for formal buying schemes, then helped them open verified accounts and register tax IDs. The state brokered model offtake clauses that require transparent pricing against published benchmarks, traceability tags from pit to hub, and compliance with federal due diligence rules. It paired this with voucher-based assays to reduce under-payment at the pit gate and with short, modular training that upgrades miners into plant-ready technicians. To tackle political-economy friction, the governor signed a memorandum with federal agencies and local governments that eliminates non-statutory fees, fixes a single list of lawful charges, and sets a publication schedule for production, payments, licences, and grievances on a public dashboard. Early results include fewer informal buyers around sensitive sites, faster cycle times from interest to site mobilisation, and clearer risk allocation for investors. The broader lesson is that, even within a centralised legal regime, a state can unlock strategic minerals by acting as a capable convenor: aligning its land, infrastructure, skills, and transparency tools with federal authority so that private decisions add up to formalisation, community stability, and investment at speed.

12.5.2 Specific short-term actions

Issue compliance notices to all licence holders requiring publication of beneficial ownership, licence coordinates, and contract summaries within sixty days, where the law already mandates it. Publish the list of entities that comply and those that do not.
Require operating plants to publish monthly mass balance reports that show input grades, throughput, recovery, and tailings volumes in aggregated form suitable for public disclosure. Require quarterly environmental monitoring reports and community development agreement scorecards to be posted to a central portal.

Enforce open contracting on new public procurement above a defined threshold. Publish tender notices, award decisions, contracts, and implementation updates in machine-readable format. Publish a late payment register for public entities, with interest automatically added to overdue invoices.

Empower regulators with temporary additional inspection capacity through secondments from other agencies and through contracted auditors. Set up a public hotline and case tracker for reporting breaches and tracking corrective actions.

12.5.3 Expected impact and actors

The sprint will raise the cost of non-compliance and create habits of disclosure. Investors gain confidence from predictable enforcement. Communities gain information for engagement. Regulators gain practical experience in coordinated action. Actors include mining and environment regulators, access to information commissions, audit institutions, prosecutors, civil society, and industry associations.

12.6 Sequencing, Risks, and Mitigation

Quick wins must be sequenced to reduce risk. Governments should start with actions that build credibility and generate data. Mobile registration and open contracting deliver early proof points. SBZs then concentrate capacity and lower transaction costs. Regional rules under AfCFTA lock in gains and expand markets. Enforcement sprints reset expectations while accelerators help SMEs respond to new demand.

Risks include weak data quality, political resistance from actors who benefit from opacity, capacity shortages in regulators, and infrastructure bottlenecks. Mitigation starts with narrow scope, public dashboards, and external verification. It continues with targeted resourcing for regulators, structured peer learning among agencies, and partnerships with development banks for power and water connections. Transparent communication with communities reduces conflict risks and builds support for change.

12.6.1 Monitoring and evaluation for quick wins

Each action should have a short results framework. For ASM, track registered miners, wallet transactions, accidents, and responsible offtake volumes. For SBZs, track time to permit, connection times, anchor investments committed, SMEs certified, and training hours delivered. For AfCFTA, track ratifications, mutual recognition agreements signed, and firms using new rules. For accelerators, track contracts won, on-time delivery, and compliance with prompt payment. For enforcement sprints, track obligations published, inspections completed, and sanctions applied. Publish results monthly and review quarterly, with corrective actions agreed publicly.

12.7 Build momentum now

Africa can move from analysis to execution by picking low-hanging fruit with discipline. Rapid ASM formalisation will improve incomes and transparency while feeding processors. Pilot SBZs will prove that bankability is possible when land, power, and permit systems are clearly defined. Fast-tracking AfCFTA mining rules will create the legal spine for regional value chains. A continental accelerator will empower SMEs and young founders to supply plants at quality. An enforcement sprint will show that rules matter. Together, these actions can shift expectations within twenty-four months. The long horizon remains essential, but progress today will unlock ambition tomorrow.

CONCLUSION

Conclusion

This report has pursued a single organising proposition: mineral-driven industrialisation is a strategic imperative for Africa's sovereignty, stability and prosperity in the twenty first century. It began with the diagnosis of a stubborn paradox. A continent with exceptional mineral geology remains a small player in midstream and downstream value creation. It traced the structural and political economy reasons why, showed how volatility and weak institutions translate geological wealth into fiscal fragility, and set out a coherent operating system that can reverse the pattern. It then advanced a comprehensive agenda across policy, finance, technology, human capital, and sustainability, complemented by concrete actions that governments and partners can implement immediately.

Leveraging Africa's natural wealth for industrialisation will be the cornerstone for a resilient African political economy in a world that is rewiring supply chains around low-carbon technologies, security of supply and product standards. It is the practical route to build fiscal buffers, thicken labour markets with skilled jobs, create supplier ecosystems, and establish bargaining power in markets where price discovery and specifications have long been set elsewhere.

Leadership is identified as the binding constraint. Heads of state and government must move beyond exhortation to a discipline of execution. Africa must confront vested interests that benefit from opacity and easy rents, enforce policy coherence across ministries, departments, and agencies, and empower technocratic teams that can negotiate, finance and deliver complex industrial systems. Leadership should be both continental and national. The AfCFTA provides the legal scaffolding for a single market. The report recommends constituting an AU Commissioner for Commodities and Industrialisation, which can provide the institutional centre of gravity to align mining, energy, transport, trade, and finance. Together, these create the conditions under which mineral corridors, industrial hubs and standards can be scaled to continental reach.

To African leaders, therefore, the call is direct. Choose a small number of corridor-anchored hubs where the fundamentals are strongest. Guarantee bankable power and water, open access rail and terminal capacity, and streamlined permits inside well-governed Special Beneficiation Zones. Publish contracts, tariffs and performance dashboards. Sequence export measures to real capacity, and use time-bound incentives tied to quality and training outcomes rather than discretionary exemptions. Negotiate anchor offtake with credible partners and bind deals to clear milestones. Protect the reforms through transparent boards, independent audits and steady reporting.

To the African Union, coalition of willing states, and regional economic communities, the agenda is to provide the operating system. Fast-track an AfCFTA protocol on mining, including annexes on standards, conformity assessment, and responsible sourcing. Update REC mining protocols to cover tailings safety, carbon disclosure and cross-border permitting. Maintain a price, royalty and corridor performance dashboard so that parliaments, markets and citizens can see what is working. Fully operationalise PAPSS and the Africa Currency Marketplace for routine trade settlement and project finance needs in local currencies where viable.

To the African Development Bank, Afreximbank and peer development finance institutions, the agenda is to build up their balance sheets to be suitable for indispensable development that catalyse other sources of private capital. One idea is to pursue SDR-backed hybrid capital windows that expand long-term lending for midstream plants.

Conclusion

Offer partial risk and partial credit guarantees that are triggered by specific corridor failures in power or rail to de risk bankability. Back the listing of African champions with cornerstone equity and credit enhancement. Utilise the Africa Investment Forum and its associated platforms to expedite the transition of plants and shared utilities to financial close on a pipeline basis, rather than through one-off deals.

To private investors and financiers, the invitation is to build long-term businesses rather than transient extraction plays. Deploy capital into smelters, refineries, precursors and recycling assets that sit close to ore and energy, and pair those assets with training obligations and technology partnerships that create resilient operating teams. Use transparent, exchange-referenced pricing and share a portion of learning curve gains with host communities through supplier development and apprenticeships. List vehicles in African markets to broaden ownership and accountability, and structure allocations that include retail and diaspora investors where rules permit.

To civil society, academia, and the diaspora, the role is to hold all actors accountable and contribute expertise that accelerates learning. Structured mentorship platforms, problem-solving clinics, visiting professorships and open teaching materials can compress the time it takes to build the skills that complex plants require. Independent monitoring of contracts, payments and environmental performance will reinforce trust and correct course early when indicators flag problems.

The vision that closes this report is specific. Within the immediate to medium term, a first wave of ASM formalisation should be visible in registration data, safe parks and responsible offtake.

Pilot SBZs should show bankable power contracts, shared laboratories and a pipeline of anchor investments under construction. An AfCFTA mining protocol should be tabled with model clauses for cross-border processing, and the AU Commissioner's office should publish dashboards on prices, royalties, and corridors. Within five to seven years, a set of corridor-anchored hubs should be producing battery precursors, refined metals, and alloys at a competitive cost with credible ESG certification, selling into a continental market and to global buyers. Within a decade, African champions in energy, strategic minerals, and logistics should be listed across multiple African exchanges with broad ownership and steady dividends. A share of green iron, aluminium, and battery materials should carry a recognised low-carbon premium in destination markets.

The choice is therefore stark but hopeful. Continue exporting primary ores and intermediates while importing jobs, technology, and resilience, or build the institutions, corridors, and companies that allow Africa to design, process, and manufacture for itself and the world. The second path demands courage, patience and discipline, but it is entirely within reach. If African leaders choose it, and if partners align behind it with capital, standards and skills, then the continent will not only narrow its prosperity gap. It will become an indispensable pillar of clean industrialisation worldwide, with a future defined by broad-based opportunity, fiscal strength and technological capability for generations to come.

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List of Acronyms

Acronyms	Full term
AfCFTA	African Continental Free Trade Area
AfDB	African Development Bank
AELP	African Exchanges Linkage Project
ASM	Artisanal and Small-Scale Mining
AU	African Union
AUM	Assets Under Management
BRVM	Bourse Régionale des Valeurs Mobilières
CBAM (EU)	Carbon Border Adjustment Mechanism
COP	Conference of the Parties (climate)
CRMA (EU)	Critical Raw Materials Act
DRC	Democratic Republic of the Congo
EIB	European Investment Bank
EITI	Extractive Industries Transparency Initiative
ESG	Environmental, Social and Governance
EU	European Union
FX	Foreign Exchange
GBA	Global Battery Alliance
GISTM	Global Industry Standard on Tailings Management
ICGLR	International Conference of the Great Lakes Region
ICMM	International Council on Mining and Metals
IFC	International Finance Corporation
IFRS	International Financial Reporting Standards
IMF	International Monetary Fund
InvestEU	InvestEU Programme
IPO	Initial Public Offering
IRMA	Initiative for Responsible Mining Assurance
ISSB	International Sustainability Standards Board
JSE	Johannesburg Stock Exchange
KPI	Key Performance Indicator
NIB	Nordic Investment Bank
OECD	Organisation for Economic Co-operation and Development
OSBP	One-Stop Border Post
PAPSS	Pan-African Payment and Settlement System
PGMs	Platinum-Group Metals
PPP	Public-Private Partnership
REDD+	Reducing Emissions from Deforestation and Forest Degradation
RMB (Rwanda)	Rwanda Mines, Petroleum and Gas Board
SADC	Southern African Development Community
SBZ(s)	Special Beneficiation Zone(s)
SDR(s)	Special Drawing Rights
SME(s)	Small and Medium-sized Enterprise(s)
SWF	Sovereign Wealth Fund
WEF	World Economic Forum

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