FUTURE MINERALS FORUM

RICE UNIVERSITY'S Baker Institute for Public Policy

Building Shared Value Propositions in the Minerals Industries – Getting to How

Mark Cutifani and Dr. Michelle Michot Foss, with Foreword by Dr. Jim Krane

How A Leading Energy Supplier is Redefining Critical Minerals

Foreword

In this commentary, Mark Cutifani and Dr Michelle Michot Foss close a two-part exercise in thinking about the future of mining, minerals, and materials. The commentary was developed through a knowledge partnership between the Future Minerals Forum (FMF) and Rice University's Baker Institute, Center for Energy Studies, formed in 2023.

It would not be surprising for readers to encounter this commentary through one of the major global mining conferences in, say, Australia, Canada, or South Africa. FMF, however, is based in and led by Saudi Arabia, a country that is not typically associated with mining industry expositions. Moreover, FMF, from inception, is intended to be more than simply an annual gathering. The premise is to bind resource owning governments into a "super region" that, as of the FMF26 event, largely encompasses the greater Global South along with key outbound investing nations. The desire is to engage businesses, governments, and other stakeholders into action-oriented, problem-solving dialogue on the complex challenges that impede investment and development of mining and minerals supply and value chains. Underlying FMF is a belief in the benefits that can accrue from the mining industries, and especially if mining and minerals are viewed as integral to economic diversification for the cluster of Middle East hydrocarbon producers that have joined the club of top tier sovereign wealth funds worldwide.

For Saudi Arabia, the largest producer in the Gulf, developing a mining sector was once more of an afterthought than a central plank in its economic plans. That has changed. In convening the FMF since 2022 the Kingdom has demonstrated an enormous interest, ambition and commitment to shaping and improving the global mining sector, while seeking a profitable and strategic role for itself within the mining ecosystem's trade flows and supply chains.

Saudi Arabia of course, is already the world's most important steward of the oil market, as the number two producer, number one exporter, and number one holder of spare oil production capacity. Maintenance of spare oil production capacity in global markets, and the use of this capacity when market conditions dictate, provides global consumers with a valuable de-risking service that dampens price volatility. Over time, oil producers have earned a level of trust from importing countries concerned about security of supply. The Kingdom plays a prominent role within OPEC and the broader global energy landscape, maintaining strong relationships with producing nations in ways that support market stability. Saudi Arabia has also cultivated a reputation as a reliable supplier among importing countries, enjoying close and trusted relations with China, Japan, South Korea and India, among others. And finally, Riyadh's closest ties are with the largest oil consumer of them all, the United States. The Saudi-US partnership dates back 80 years and constitutes the backbone of the global oil market and a strategic framework for high-level collaboration across many frontiers.

Saudi Arabia's level of centrality, reliability, and trust in oil markets would translate well in the even more complex and opaque world of mining and the trade in minerals. At the moment, strategic competition among blocs of states has bled unhelpfully into mining supply chains, creating incentive for governments to leverage mineral production and processing for geopolitical advantage. Saudi Arabia's willingness and ability to convene mining interests from across the trade spectrum reveals a useful neutrality that could become a competitive advantage as a trusted intermediary among rival blocs. Could the Kingdom parlay its proven "market maker" role in oil into something similar in mining? The possibility is worth exploring.

While the Kingdom's efforts in mining its home geology have brought some success, the Saudi landmass may prove more suited to a midstream or even downstream role in mining supply chains. Saudi Arabia could be part of this, through its efforts to become a hub by hosting parts of the minerals value chain, such as processing and refining. In so doing, the Kingdom could assume a similar de-risking role to that provided in oil markets. Saudi Arabia's ability to engage constructively with stakeholders across global markets could further enhance its attractiveness as a destination for investment and collaboration in critical minerals and materials value chains. Would the world's minerals trade be better off with separate, duplicate supply chains for strategic critical minerals? Or with neutral hubs where supply chains intersect and are de-risked? The enthusiasm with which the global mining community is already embracing the Saudi role in convening the FMF suggests the Kingdom may gain a larger and more central future position in this crucial trade. We certainly hope Riyadh continues to embrace this role. The opportunities facing Saudi Arabia within mining value chains are subjects we intend to investigate in more depth. In the meantime, please enjoy this paper on practical strategies for aligning interests of the industry with the governments that oversee mining operations and the local communities that host them.

Jim Krane,

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Overview

In a previous commentary[1], we laid out a case for building shared value propositions between resource owning host governments and the mining industries. We also defined and laid out the premise for the notion of commercial frameworks, which blend policy and regulatory approaches that recognize and are compatible with the vital, linked functions in mining ecosystems (see Figure 1).
We emphasized that "if any one of these cannot or does not perform and deliver, the entire ecosystem becomes fragile and value realization suboptimal." Executing on the linked functions requires the building blocks of commercial frameworks, the combination of sound commercial fundamentals and workable policy and regulatory frameworks subject to dynamic business, government, and societal interactions. In light of the enormous economic benefits associated with minerals development and mining, we noted that it is well worth the effort to bridge business-government-social dimensions (BGS) in order to leverage mining investment capital for economic development and growth.

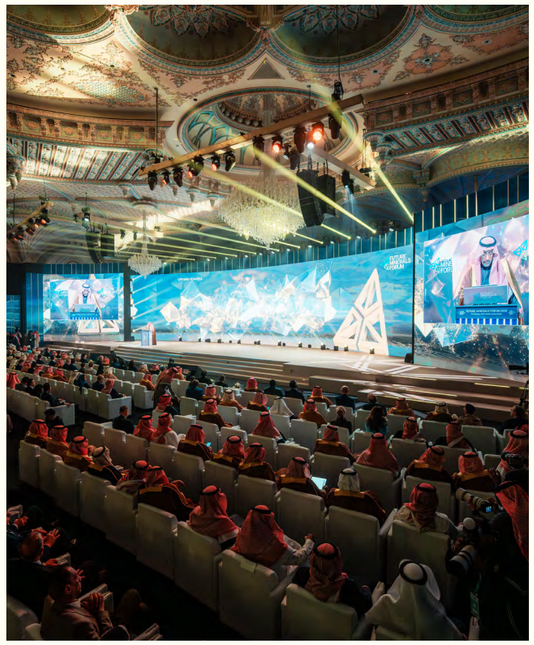

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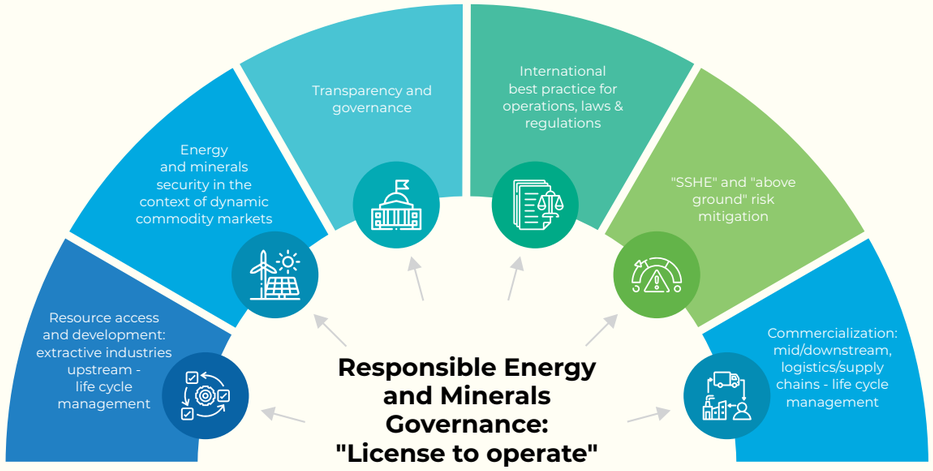
Figure 1. Linked Functions in the Mining Ecosystem



Developed by author, used with permission. 'SSHE' is safety, security, health, environment.

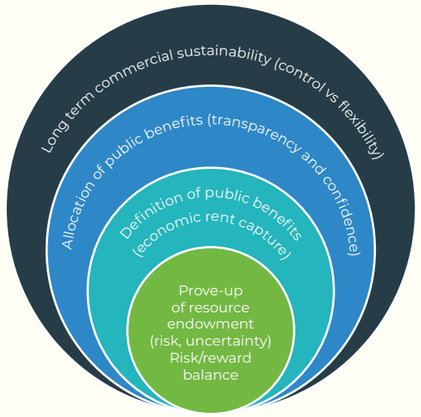
Source: Cutifani and Michot Foss, 2024.[2]

We argued that "ability and flexibility to deepen the mining value proposition hinges on establishing sustainability as an economic concept" and emphasized that long term, economic sustainability hinged on seven pillars (safety and health, environment, social performance, talent pools, replenishment of the resource and production base to ensure ongoing operations, unit operating costs in the lower half of global cost curves, and balance sheet strength). Our bottom line was that, **"Overall, with mining viewed as a partner this means alignment of interests between industry, resource owners and other stakeholders to achieve durable success."**

BGS interests must first align around upstream, where initial value creation happens and is most robust. Governments must be mindful of the entire mining project development life cycle and how their fiscal levers interact with different stages. And we closed with a message that industry cannot do it alone – conquering the "hill of value" takes a village. Governments are key to building, sustaining, and reaping benefits from their mining sectors. Their responsibilities are considerable, including allocation of economic benefits and ensuring transparency in ways that bolster trust and confidence.

Figure 2. “Hill of Value”: Achieving Durable Commercial Sustainability

In this commentary, we turn to the practicalities. We start with the usual premise that mining matters. First, the products of the earth provide materials that give us water, food, energy fuels for transport and electric power, shelter and everything else we use in our daily lives. Without mining in one form or another, humans cannot exist. That said, the task of building shared value propositions requires definition of – and embracing – the needs and wants of the respective interests.



Source: Cutifani and Michot Foss, 2024.[3]

Setting the Stage

In setting context for a discussion on mining, it is always worthwhile reminding ourselves why mining matters.

First,

the products of the earth provide materials that give us access to water, food; the fuels to generate energy; and materials to construct shelter and almost everything else we use in our daily lives.

Second,

the development of mining in the form of large-scale enterprises has become a global necessity to ensure the critical products of mining can be made available to all citizens of the world – as and when required and at a reasonable price.

Third,

the concentration of extraction to areas of higher-grade natural occurrences ensures minimization of our mining footprint – both in terms of physical footprints and associated impact on biodiversity.

For some, these numbers are self-evident and for others, they are likely a surprise.

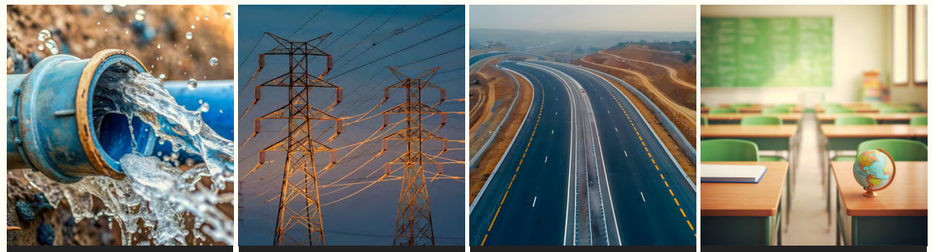
To summarise the impact points, the mining industry drives more than 45% of global economic activity, while being the key to reducing our net human footprint on nature by more than 30% at the same time. Mining defines sustainability in terms of both economic and environmental performance.

For all of these reasons, “materials solutions industry” is a more appropriate descriptor of the mining businesses.

Needs and Wants – Achieving Alignment

Mining brings discernible benefits to local communities as well as national economies.

In local communities mining operators can facilitate the provision of facilities and infrastructure including:



Water

Energy

Roads and transportation infrastructure

Social infrastructure including health and education facilities

Mining can lift local communities as well as national economies, if the investments and cash dividends are discernibly managed and applied. The mining industry supports extensive supplier ecosystems. Procurement and employment generate extensive multipliers. We know this from experience.

Also known is that mining can be a foothold to industrialization and economic development, if countries can get certain things right.

1 Resource owning governments must put their initial focus on comparative advantages. Value added investment will flow as mining sectors are established and results discerned.

2 Enabling frameworks that ensure durability and sustainability of mining investments and operations are essential for value added to accrue. These frameworks must incorporate distribution of benefits, or they will not ensure stability. It is vital that investors and customers have confidence in industry performance and resilience.

3 Again – the industry cannot perform without effective supply chain logistics and linkages. Vital infrastructure can, and should, be the backbone of local, regional, and national economic development. Enabling frameworks must first accommodate the buildout of basic infrastructure required, with thoughtful planning for how that infrastructure can support economic activity beyond mining along with quality of life.[4]

With these basic ingredients, communities and nations can inherit benefits from mining well beyond the retirement and decommissioning of operations and facilities.

All of that said, in reality value propositions associated with mining projects can be quite diverse. Achieving alignment of interests, reaching agreement on shared propositions requires first recognizing differences and then exploring how respective perceptions of value overlap and leverage for long term, durable, economically sustainable projects. Non-exclusive examples for the main groups that typically would be engaged are the following.

Shareholders

maintain and rely on targets for return on investment, ROI, in order to engage and invest.

Mining Industry

makes investment in infrastructure (and builds lasting economic development).

Employees

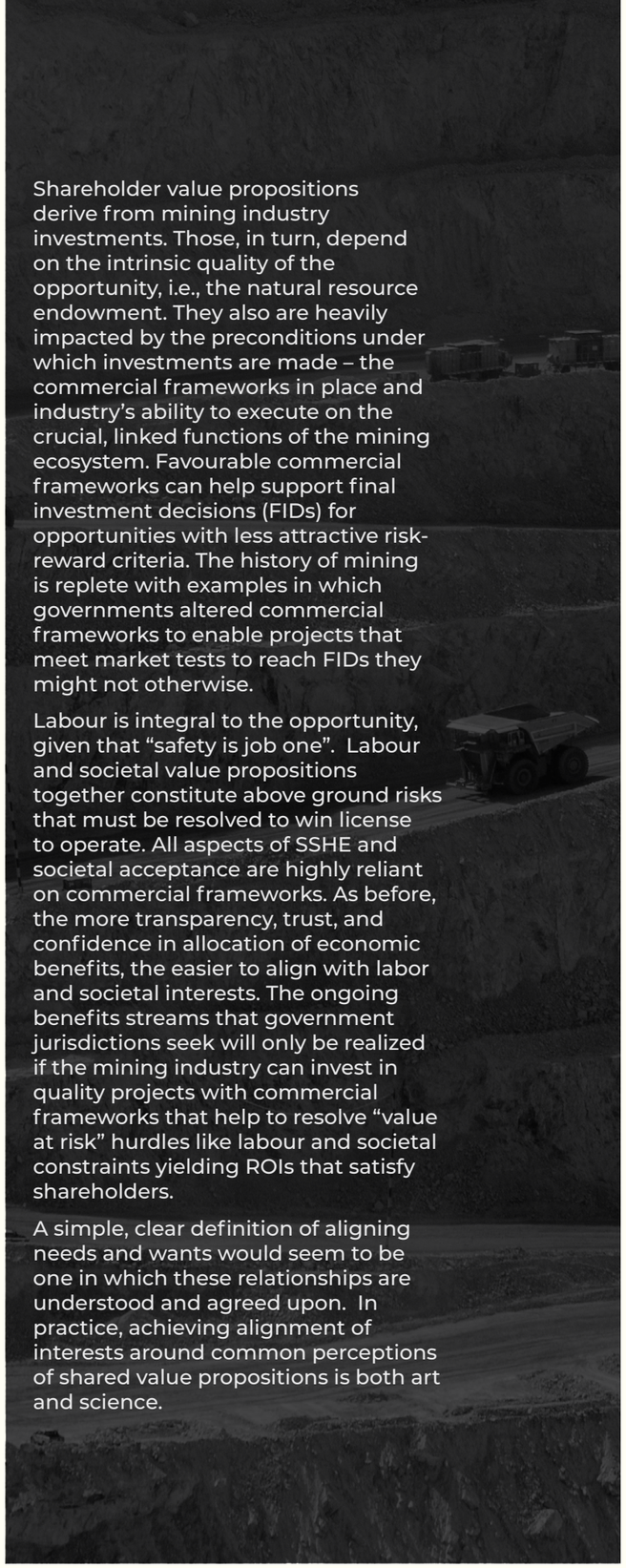
receive compensation for providing labour.

Society

seeks a right to participate although approach is not always clear.

National, regional, local governments

look for benefits streams to maintain infrastructure.



Shareholder value propositions derive from mining industry investments. Those, in turn, depend on the intrinsic quality of the opportunity, i.e., the natural resource endowment. They also are heavily impacted by the preconditions under which investments are made – the commercial frameworks in place and industry's ability to execute on the crucial, linked functions of the mining ecosystem. Favourable commercial frameworks can help support final investment decisions (FIDs) for opportunities with less attractive risk-reward criteria. The history of mining is replete with examples in which governments altered commercial frameworks to enable projects that meet market tests to reach FIDs they might not otherwise.

Labour is integral to the opportunity, given that "safety is job one". Labour and societal value propositions together constitute above ground risks that must be resolved to win license to operate. All aspects of SSHE and societal acceptance are highly reliant on commercial frameworks. As before, the more transparency, trust, and confidence in allocation of economic benefits, the easier to align with labor and societal interests. The ongoing benefits streams that government jurisdictions seek will only be realized if the mining industry can invest in quality projects with commercial frameworks that help to resolve "value at risk" hurdles like labour and societal constraints yielding ROIs that satisfy shareholders.

A simple, clear definition of aligning needs and wants would seem to be one in which these relationships are understood and agreed upon. In practice, achieving alignment of interests around common perceptions of shared value propositions is both art and science.

Complexity and Optionality

For sake of argument, let us propose that alignment of interests can happen, and the notion of shared value propositions can be achieved and adopted. A next reality is complexity of the mining industries and minerals and materials supply and value chains. Each of the linked functions entails an array of requirements. The mining ecosystem is only as robust as capacity to execute within and across the linked functions. A key concept in the hill of value (see Figure 2), is **flexibility. Optionality** entails the structural ability to choose among possibilities. Options are rights, not obligations, to execute. Optionality thus implies the flexibility to make decisions as the future unfolds. Commercial frameworks can be devised and implemented to support optionality.

The willingness to do so encourages industry participants to define and set strategies for ongoing value creation. That willingness, in turn, can alter the balance of needs and wants.

Complexity in a Materials Solutions Industry

The mining and minerals businesses operate within a milieu of extraordinary complexity.

- Natural resource endowments – the geology of minerals occurrences – are amazing in their variability and quality.
- The industry is characterized by large disparities in size and type of operators and capitalization.
- Operators produce a vast assortment of commodities every single day including minor, but crucial, elements essential to modern technologies.
- The industry cannot perform without effective supply chain logistics and linkages.
- Importantly, while mining is a capital-intensive industry, workforce integrity and safety are imperatives.

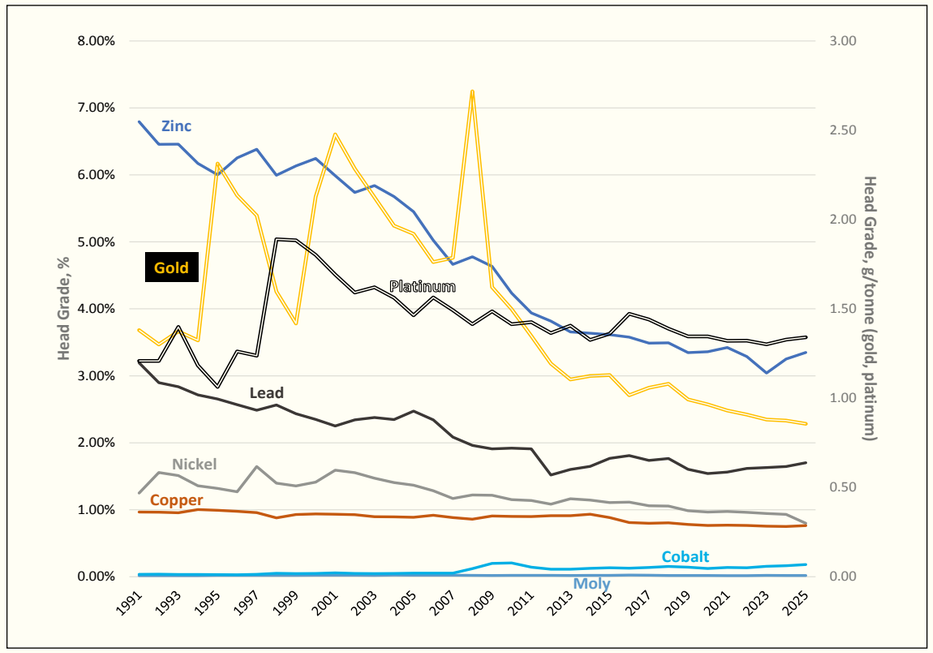
Complexity affects industry's ability to deliver materials at a cost that remains economic and socially affordable to society. This means resetting core business structures, corporate strategies and operating business models.

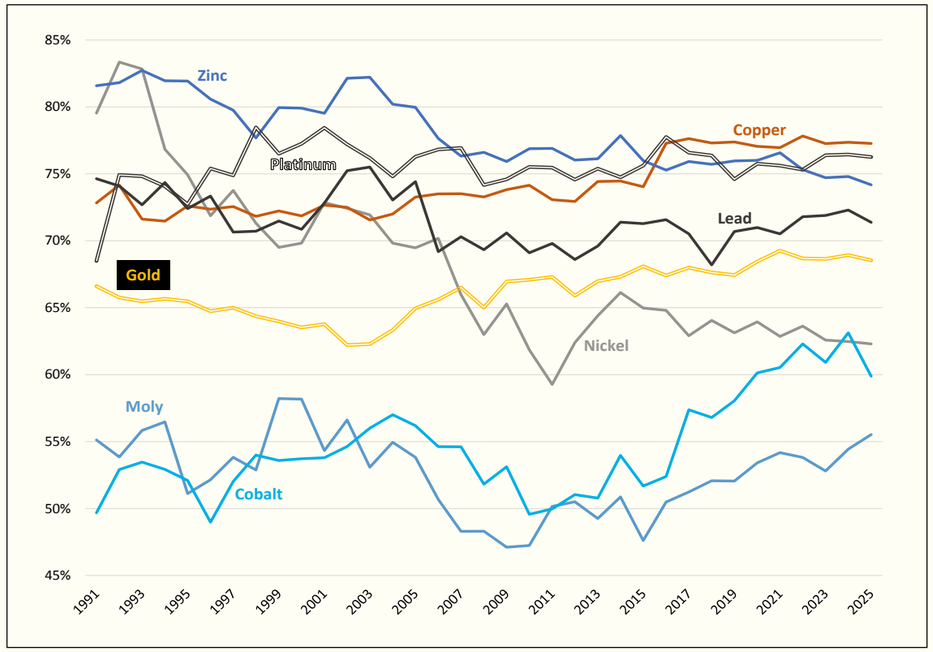
As mines develop, operating companies are generally captive to at least five primary structural cost drivers.

- Exploration costs per unit of payable product ("paid metal") – doubling in metals over 20 years.
- Increasing mine depths at a rate of around 40m per year.
- Lowering mined grades at 1.5% per year for the last 100 years.
- In mine development, costs per stope (cavern space) or bulk mined tonnes extracted.
- Input costs rising above average inflation rates reflecting energy and labor intensities in more remote regions, as compared to major population centers.

The implication of these five forces is that for most mining businesses, quality improvements of 7% to 15% must be attained each year, ***just to stand still.***

Figure 3. Head Grades (top) and Recovery Rates (bottom), Selected Metals



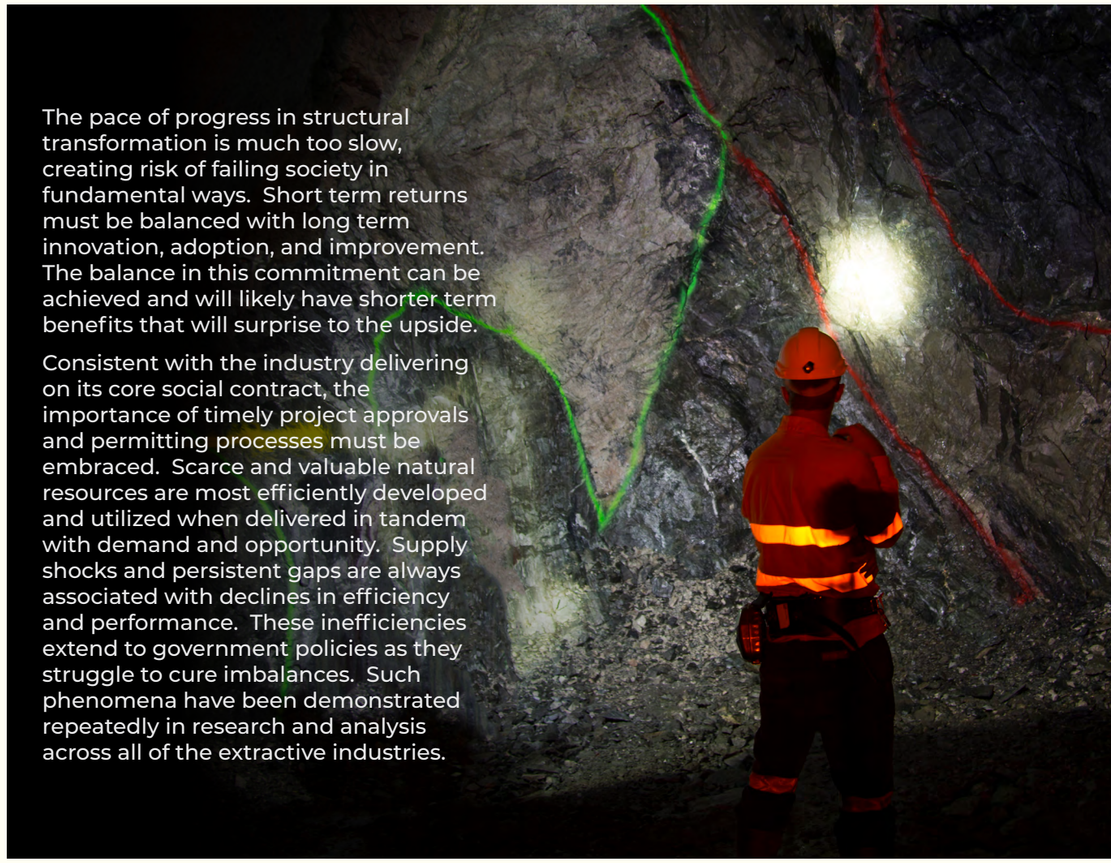


Source: M. Michot Foss based on data from SPG, accessed via license. Head grades are the grade of mined material going into the mill, usually lower with lower grade ore bodies. Recovery rates are rate of recovered metal, depending upon metal and processing choice.

Complexity and Time Horizons

Constraints on mine development and approvals can hasten descent into unaffordable social development models. Structural cost offsets become more compelling by the day, creating new risks and uncertainties.

- Materials sciences identifying opportunities for thrifting and commodity substitution. The latter is an especially dynamic arena, ranging from shifting chemistries for batteries (for instance, from nickel rich formulas to the growing popularity of iron phosphate designs) and magnets (iron nitrides displacing neodymium) to new inventions like advanced carbon materials – graphene and carbon nanotube fibers that can displace materials for buildings and semiconductors and conductive metal wire and cable.
- Circular economy developments where the cost of recycling becomes increasingly more attractive compared to primary mining. "Urban mining" has become an imperative when it comes to policy choices favoring materials intense "green" energy technologies.
- Structural mining innovation facilitated by new approaches, using artificial intelligence (AI) and any other tools to help modernize and legitimize mining as a "Materials Solutions Industry" that serves the greater needs of society.



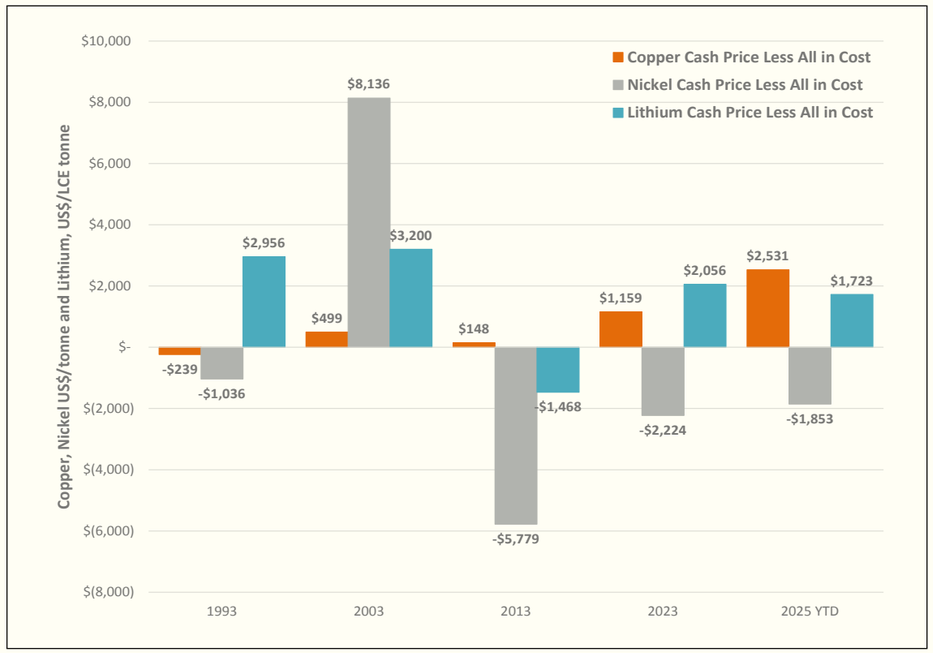
The pace of progress in structural transformation is much too slow, creating risk of failing society in fundamental ways. Short term returns must be balanced with long term innovation, adoption, and improvement. The balance in this commitment can be achieved and will likely have shorter term benefits that will surprise to the upside.

Consistent with the industry delivering on its core social contract, the importance of timely project approvals and permitting processes must be embraced. Scarce and valuable natural resources are most efficiently developed and utilized when delivered in tandem with demand and opportunity. Supply shocks and persistent gaps are always associated with declines in efficiency and performance. These inefficiencies extend to government policies as they struggle to cure imbalances. Such phenomena have been demonstrated repeatedly in research and analysis across all of the extractive industries.

Complexity and Profitability

An illustration of the impacts of complexity on margins is provided in Figure 4 for the same metals we focused on previously (Cutifani and Michot Foss, 2024[5]). Our analysis captures gains and losses when "all in" cost, a crucial metric, is taken against cash price. "All in" costs include sustaining costs – capital expenditures that must be made for ongoing operations – as well as additional production costs. For the extractive industries overall – oil and gas, mining and metals including fuels like coal and uranium – long run returns on investment tend to be on the low side. Gains and losses accrue over time, resulting in a distinct challenge for global capital markets and investor appetites. Much of the problem derives from the volatility inherent in large, lumpy, capital intense businesses with long planning and development time horizons. Commodity price variability also plays a role. If costs appreciate faster than price, miners are squeezed. Unmitigated, price volatility can dampen planning and delay FIDs. Copper production growth has not kept up with demand, actual or expected, showing up in the persistent rise in cash price. Current prices for copper also highlight the ongoing technical and engineering risks inherent in more complex mining engineering, as recent outages affect supply-demand balances. Ructions in nickel markets as enormous volumes of nickel from laterites entered the market have kept nickel output flat. Lithium has been in almost pure speculation mode.

Figure 4. Average Gains and Losses:
Margins After All In Costs for Copper, Nickel, Lithium Global Operations



Source: M. Michot Foss based on data from SPG, accessed via license.

The Merits of Optionality

In the Overview above we emphasized the importance of governments adjusting commercial frameworks in order to help market tested opportunities to launch. Likewise, risks and uncertainties inherent in industry complexity can be mitigated through optionality. Optionality can range from early negotiation of minerals rights for future development, based on drilling and assays; to decisions on sizing facilities (capacities); to use of financial markets for mitigating price risk (hedging). The mining and minerals industries have many practices that can be leaned upon for this purpose. However, as before, the industry cannot do it alone. Commercial frameworks – policy and regulatory frameworks that recognize the linked functions of the mining ecosystem – should support optionality. They must enable enough flexibility to encourage companies to exercise options when they make sense. A golden rule of thumb is that "optionality is great, if you can pay for it".[6]

Thus, part of the equation entails considerations such as treatments for cost recovery so that companies can evaluate investment strategies.

Too often, companies do not look at optionality as a systemic opportunity set that could help improve and reduce costs and/or increase revenues. Or, they will progress through cycles in which management attention to optionality and strategic and tactical intents will wax and wane. Both can lead to inconsistent results, undermining value propositions across the board.

Given complexities of mining life cycle and supply chains, both industry managements and governments should discern the importance of achieving better understanding about:

- Assets and the embedded optionality; and
- Competitive dynamics and the likely behaviour of other market participants in that same context.

Where and how do some obvious optionality opportunities reside? We can offer some suggestions.

Geology

Size and scope of the resource enable a range of different options. These include size, scale, grade and recovery curves, mining strategies, and stockpile strategies which also are time related.

Processing

Optionality can be found at the mill in crushing and grinding and flotation for concentration. Blending can help to improve recovery rates and optimize mill capacity. Options for leaching range from in situ, to heap and higher capital intensity options allowing pursuit of product forms.

Mining Strategies

Open pit versus underground, bulk versus selective, and using orebody characteristics to mine and sort – bulk ore sorting approaches – are all representative of optionality in mine planning. Solvent extraction-electrowinning, SX-EW, is a widely known example of optionality, now contributing more than 20% of global copper supply, and enhancing output at many established projects.

Marketing

Marketing offers a rich assortment of optionality strategies and tactics. These include product forms, co- and byproduct credit value, end product forms (income option strategies). Price volatility, a bane of extractives and commodities industries, is sought after in financial markets. Both producers and customers of commodities – agricultural products, oil, natural gas, coal, non-fuel minerals and metals, and more – make use of hedging and price risk management to stabilize and protect sacrosanct cash flows. The mining industry can operate comfortably in open markets that are financially deep (liquid), a condition that governments should encourage and foster. Price and price variability send signals that influence decisions about forms and product applications as well as timing for production.

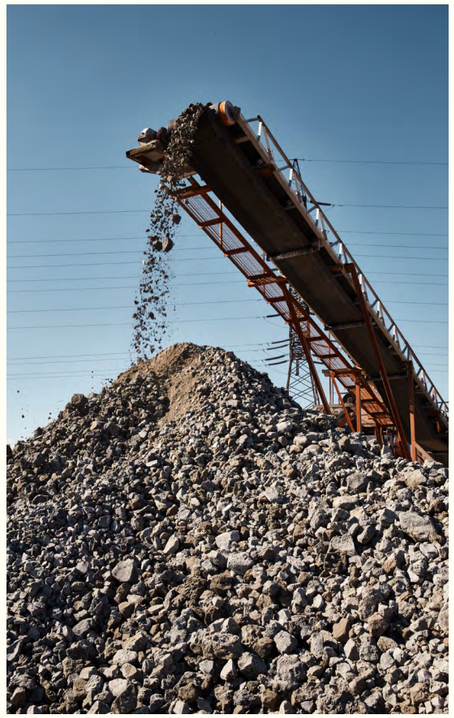
Optionality in Practice

An exercise in value optimization entails thinking about each orebody and operation and asking "odd" questions about what the assets can be. This means constantly evolving thoughts as knowledge of orebodies evolves, as understanding of natural variations accrues. At the same time managements must watch markets and price volatility. Dynamics for orebodies will change based on a range of both internal and external moving parts.

Figure 5. Historical Perspective: "Hands On" 3D of A Learned Orebody

Source: Author photo of ca. 1918 model of West End Mine, Tonopah Mining District, Nevada, W.M. Keck Museum, Mackay School of Miners, University of Nevada-Reno.

When optionality becomes engrained within organizations, the key in mining then becomes implementation. Investment targets become about the ability to stand up mining businesses that can deliver in the most likely market scenarios while also providing multiple options that reflect alternative, possible, plausible market scenarios. Optionality is not always about investment to "create". It is just as likely to be about how to preserve "natural" optionality embedded in the project, once understood and mapped. The earlier possibilities are recognized, the better the chance of converting a possibility into value.



As noted, **these are mindsets governments should want in their mining sectors.** Indeed, they are mindsets that all BGS parties involved in the shared value proposition should want to encourage, not least because of the challenge of ensuring long term commercial sustainability. This means that flexibility in commercial frameworks provided by governments is essential, a vital part of the shared value proposition.

Carpe Diem – Observations and Recommendations

To sum up, in an industry of great complexity, companies can do better to more systematically map optionality embedded in their supply and value chains. To realize those options, of course, requires an enabling environment. Moreover, we argue that governments should want to provide constructive environments for maximizing value potential and commerciality through optionality. This includes freedom for operators to make commercial judgements.

It all hinges, in turn, on alignment of interests. Thus, given an opportunity, achieving alignment of interests with an enabling environment is most likely to yield outcomes that optimize social benefits and welfare. We make the case that an enabling environment includes flexibility to make commercial decisions to execute options that can maximize value of the asset and enterprise and ensure commercial sustainability and durability over the long haul.

What can be done to create enabling environments?

We described the process of aligning interests and achieving shared value propositions as art and science. In practice, pragmatic approaches and solutions can be sought and put into place. Partnerships, collaborations, and joint ventures all can be used with success, given motivations and drivers. The “art” comes in understanding, building, and sustaining the key relationships. Both industry and host governments can do better on this front.

In every country’s quest to build economic independence, there is an inherent contract with external parties, be they other countries, global enterprises or other key actors. Cooperation is essential, even in the most competitive conditions. Each participant must take full stock of where things stand in that economic development journey to appreciate what accommodations and partnerships can help most effectively towards the next economic milestone.

When it comes to the mining industry’s most direct audiences, local host communities constitute the most important voices. Those that purport to speak for local communities tend to be as illiterate to their needs and wants as industry proponents tend to be when promoting projects. Industry participants can benefit discernibly if time and attention are paid to local partners’ voices. Without their support the industry does not have a sustainable future.

Approaches and mechanisms are evolving as efforts gain traction to engage stakeholders and improve alignment of interests around needs and wants while recognizing industry complexity and risk.

It is clear that national (governments) and international (multilateral) funders/donors will play an increasing role to help “de-risk” mining and minerals development, especially in more challenging locations.

National and international donors and lenders are developing special focus vehicles around identified regional gaps. Compacts already have been in use and are emerging as preferred mechanisms.[7] The mining industry has not typically been party to the compact process and a recommendation is that mining businesses be engaged. Only with full engagement can requirements for efficient and optimized mining operations and local, regional, and national development gaps and needs best be resolved.

For these partnerships and public-private arrangements to succeed, governance and institutional capacity building within countries hosting investment and mining activity will be essential. This is particularly acute when it comes to resolving the many gaps, both real and perceived, surrounding social value and distribution of benefits from mining supply chain investment and operations.

In our previous commentary (Cutifani and Michot Foss, 2024), we emphasized

the importance of professional and institutional capacity for commercial frameworks. We noted, “Institutional and professional ‘infrastructure’ dictate what can get done and how quickly. A commercial framework, no matter how ideal in the eyes of beholders, will only be implemented to the extent that institutional and professional capacity allows.”

This places onus on institution capacity building – **governance fundamentals.** Professional and institutional capacity, including competence in project management, are at a premium, no matter the locale. This is true whether the imperative is designing and implementing effective commercial frameworks that can attract and host mining investment, or carrying through on the many ideas related to transparency and traceability.

Capacity building offers yet another BGS connection. Mining businesses can, and already do, host secondments and work with universities and training centers in places where they do business. Beyond such initiatives, more concerted governance capacity building is needed to address particular challenges such as elements of responsible sourcing like traceability.

Crucially, governments must be amenable to these efforts, given abundant evidence that without their willingness to support enabling environments, they will not win investment flows. As important is managing expectations about what donors, investors, and the mining industry can accomplish in desired time frames. Without reasonable views, successful outcomes simply may not be assured.

Our commentary was prepared under the auspices of the Future Minerals Forum, and FMF can serve as a platform for fostering and enabling action-oriented responses. For instance, FMF can provide a formal space through its advisory networks for discussion and convergence on these myriad issues. It can provide room for discussion and new developments surrounding donor and investor engagements. It can, through its Future Minerals Framework, create a living document that provides an outlet for vetting competing ideas on sustainability and commercial frameworks to ensure they are pragmatic, workable, and executable. Through its Center of Excellence network, FMF can engage with funders and donors, industry, and independent groups for design and execution of targeted capacity building.

There is no “one-size fits all” model that will deliver miracles. Mining businesses and host governments each must understand where things stand and what practical options can best serve future development pathways. In that same context, the mining industry, government, and other stakeholders all have roles to play as economic prosperity for one provides a catalyst for others to grow as they support success.

Acknowledgements

The authors are grateful for support from the Future Minerals Forum and Rice University’s Baker Institute for Public Policy, Center for Energy Studies, for this endeavor. We also deeply appreciate the engagement with our colleagues at the respective organizations.

1) Mark Cutifani and Michelle Michot Foss, 2024, Building Shared Value Propositions in the Mining Industries, Center for Energy Studies | Energy, Minerals, and Materials | Research Paper with Future Minerals Forum, November, https://www.futuremineralsforum.com/media/vt1mrneu/fmf25-content-report-16122024.pdf and February 14, 2025, https://www.bakerinstitute.org/research/building-shared-value-propositions-mining-industries.
2) Cutifani and Michot Foss, 2024, endnote 1, page 11.
3) Cutifani and Michot Foss, 2024, endnote 1, page 19.
4) We made these key points previously. Cutifani and Michot Foss, 2024, endnote 1.
5) See Cutifani and Michot Foss, 2024, endnote 1, page 17.
6) Comment made to one of the authors in 2010 by Darcel Hulse, then president and CEO of Sempra LNG.
7) For background, see the World Bank Group, 2025, Repositioning Zambia to Leverage Energy Transition Minerals for Economic Transformation: A Roadmap, April 23, https://www.worldbank.org/en/topic/extractiveindustries/brief/repositioning-zambia-to-leverage-energy-transition-minerals-for-economic-transformation-a-roadmap. Also see background on the compact process and criteria as deployed since 2008 by the U.S. Millenium Challenge Corporation, https://www.mcc.gov/.
8. See Cutifani and Michot Foss, 2024, endnote 1, page 11.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