Qualification and Quantification of Environmental, Social and Governance (ESG) Risks and Uncertainties Across the Mining Lifecycle

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1. Introduction

The concerted push from all sectors to reduce or eliminate activities that have a negative impact on the planet and its environment continues unabated. Technological advancements have resulted in the development of sustainable clean energy solutions including solar and wind generated power, albeit that these power sources have notable limitations and typically require associated energy storage solutions to make them economically competitive with existing energy generating systems.

For clarity, energy generation is the single largest source of gaseous pollution, notably in the form of carbon emissions (IPCC, 2023), attributable mainly to the continued reliance on fossil fuels for our primary energy needs. Outside of energy generation, other industries and sectors produce more green house gases (GHGs) and other pollution than the mining sector. These higher polluters include the transport sector, the manufacturing and construction sectors, the fashion industry (up to 10% of global CO_2e (Bloomberg, 2022)) and the collective agriculture, forestry and land use sectors (Our World in Data, 2020). The comparative CO_2e releases over time are depicted in Figure 1 below.

The mining industry itself, which excludes refining and fabrication, and also excludes the actual combustion or burning of mined or extracted products and fuels, currently produces between 4 and 7% of global CO_2 emissions (McKinsey, 2020).

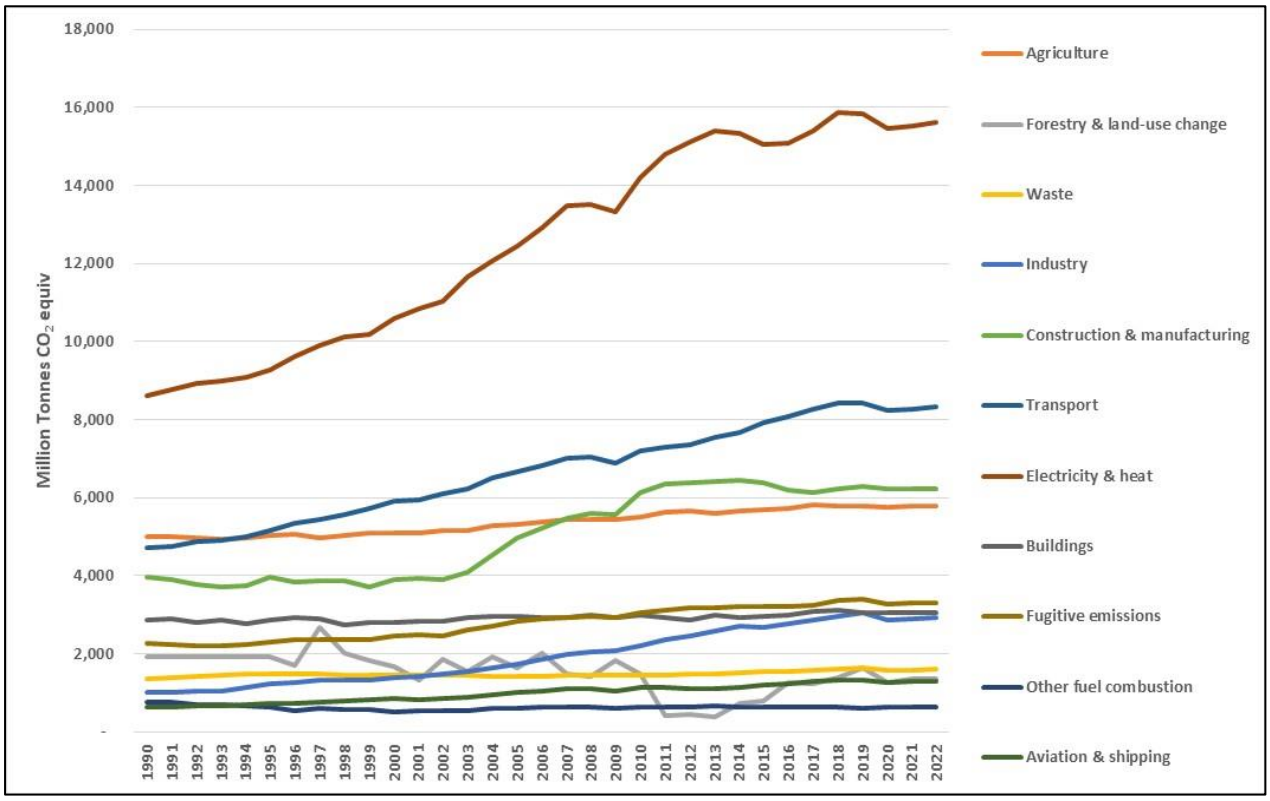

Figure 1: Greenhouse gas emissions by sector (MT CO_2e)
Modified after Our World in Data, 2020

Many of the deleterious outputs or post-mining outcomes associated with mining activities are those that are not adequately covered under legal or regulatory requirements, and generally fall under the collective basket of ESG (Environmental, Social and Governance) risks and uncertainties. Regulations largely cover each of the individual components of ESG, but less so on the inextricably linked relationships amongst the ESG components.

2. The ESG Paradigm

The requirement to address and disclose, in a transparent manner, ESG metrics and actions to all stakeholders, including investors and banks as well as to government bodies and communities, is acknowledged.

Companies are facing increasing pressure from investors, customers, communities and regulators to monitor, manage and address ESG risk. Asset owners or company's partial exposures, including those of private equity firms, particularly in the minerals sector, are increasingly concerned with the way that asset managers manage ESG risk and uncertainty for corporate finance activities such as acquisitions, to protect value and even unlock or enhance additional value over the asset holding life.

There are a number of more common ESG aspects that the industry must embrace over the operating life of an asset. Common ESG risks include those related to social impacts and outcomes, climate change (impact mitigation), environmental practices and duty of care. From a social and governance risk perspective, elements may include respect for human rights, and also anti-bribery and corruption practices, as well as compliance to relevant laws and regulations.

Although some ESG risk elements remain constant over the asset holding period, potentially over the life of the operation, others may be more fluid, and in this regard, we need to embrace the notion of uncertainty and adopt a broader acceptance and comfort in the unknown.

As mentioned above, where ESG is broken down into the regulated components of Environmental, Social and Governance factors, companies typically comply with what is legally required or regulated. However, when we consider the non-regulated aspects of ESG, companies tend to reflect that they have achieved their legal requirements and the rest may be considered merely a nice-to-have. These unregulated aspects are best met through extensive dialogue and interaction with the stakeholders that are likely to be affected by the ESG outcomes over time. These stakeholders are predominantly made up of local communities, but they extend to other stakeholders too including employees, NGOs (non-governmental organisations), government bodies, activists, landowners, and others.

What also makes absolute compliance with ESG edicts somewhat challenging includes the following:

a) Many companies have multiple assets. Each asset impacts a different community and/or set of stakeholders, and hence each asset must tailor its ESG accommodations and pro-actions to adequately satisfy its own specific stakeholder group;
b) ESG compliance comes at a cost. It adds to operating expenses, and for small assets or companies with weak balance sheets, tendencies are to meet the legal minimum requirements associated with ESG or risk the threat of going under or becoming insolvent;
c) ESG specialists are few and far between, as this is an evolving requirement beyond the old social license to operate. ESG specific skills are in short supply.

3. ESG Risk and Uncertainty

In discussions with various stakeholders in the mining sector over the last few years, it has become apparent that a number of deficiencies exist around the way in which the minerals industry assesses and analyses ESG, most notably from a quantification (valuation) standpoint, but also, and to a lesser extent, from an identification or qualification standpoint. That is, while all of the regulated and governance-incorporated ESG requirements are typically addressed by mining companies, albeit not necessarily meaningfully or adequately, a complete ESG-compliance "award" or "compliance

certificate" remains elusive. This is largely because there is often still "some-ESG-things" that have not been addressed or may not yet be known that need to be addressed in the future. On top of this, and exacerbating the ESG value issue, an accurate quantification of that ESG aspect or potential outcome is difficult to achieve and often remains "just an estimate".

Emanating from those same industry discussions, the mining industry in general has, as relating to ESG:

- an appropriate grasp of the tangible risks (known knowns);
- a lesser grasp of the tangible uncertainties (known unknowns);
- a lesser grasp of the intangible risks (unknown knowns); and
- mostly incomplete knowledge and awareness of the intangible uncertainties (unknown unknowns).

For the above and as relating to mining-sector ESG, an explanation of these terms above, as well as their characterisations and implications, is warranted, starting with an explanation of risk and uncertainty.

- ***Risks:*** the likelihood that the final outcome as evidenced differs to a small or large extent when compared against the final outcome that was forecast, predicted or expected.
- ***Uncertainty:*** a notable doubt or lack of sureness that the likely realised outcome has been estimated or even identified.

In addition to the above explanations of risk and uncertainty, the associated notions of tangible and intangible are explained below:

- ***Tangible:*** something that is real, not imaginary, and that can be seen, shown, felt or experienced.
- ***Intangible:*** something that is not real, may be imaginary, and typically cannot be seen, shown, felt, touched or otherwise experienced.

Combining the terms listed above then gives rise to the following derivations and their associated meanings (Maybee *et al* (2022); Rumsfeld (2002))

- **Tangible Risk (being a Known Known):** Real risks that exist that typically can be mitigated but if they eventuate, the potential outcome or impact can be confidently predicted. Examples may include cost and capital overruns, variations in grade, recovery and production rates, local commodity price (income) fluctuations, and other events that may impact costs and capital such as industrial action.
- **Intangible Risk (being an Unknown Known):** Risks that are not known at present and therefore are difficult or impossible to mitigate, but if they eventuate, the potential outcome or impact can still be predicted with confidence and appropriately mitigated. Examples include any level of floods or drought, above and below-ground conditions and instability, commodity supply and demand positions, product substitution and land-use after mine closure.
- **Tangible Uncertainty (being a Known Unknown):** Uncertainties that are known to exist but the potential outcome or impact eventuating cannot be predicted with any degree of confidence and hence cannot be adequately mitigated. Examples include carbon-generation directives and associated carbon trading and cost impacts, industrial action and strikes, some sovereign risk and climate change impacts.
- **Intangible Uncertainty (being an Unknown Unknown):** Uncertainties that do not currently exist (unsighted or unknown), but may arise and be identified at a future point. Since they are unknown, their occurrence and their potential outcome and impact cannot be predicted with any confidence. Examples may include local, regional or global instability (such as uprisings, embargos, sanctions, war) or unforeseen policy changes directly impacting mining operations.

To capture the previous definitions and terms, Figure 2 below provides a schematic of the relationships amongst the terms. The figure also attempts to identify some of the more readily recognised methodologies that are used to quantify the depicted categories of risk (tangible and intangible) and uncertainty (tangible and intangible).

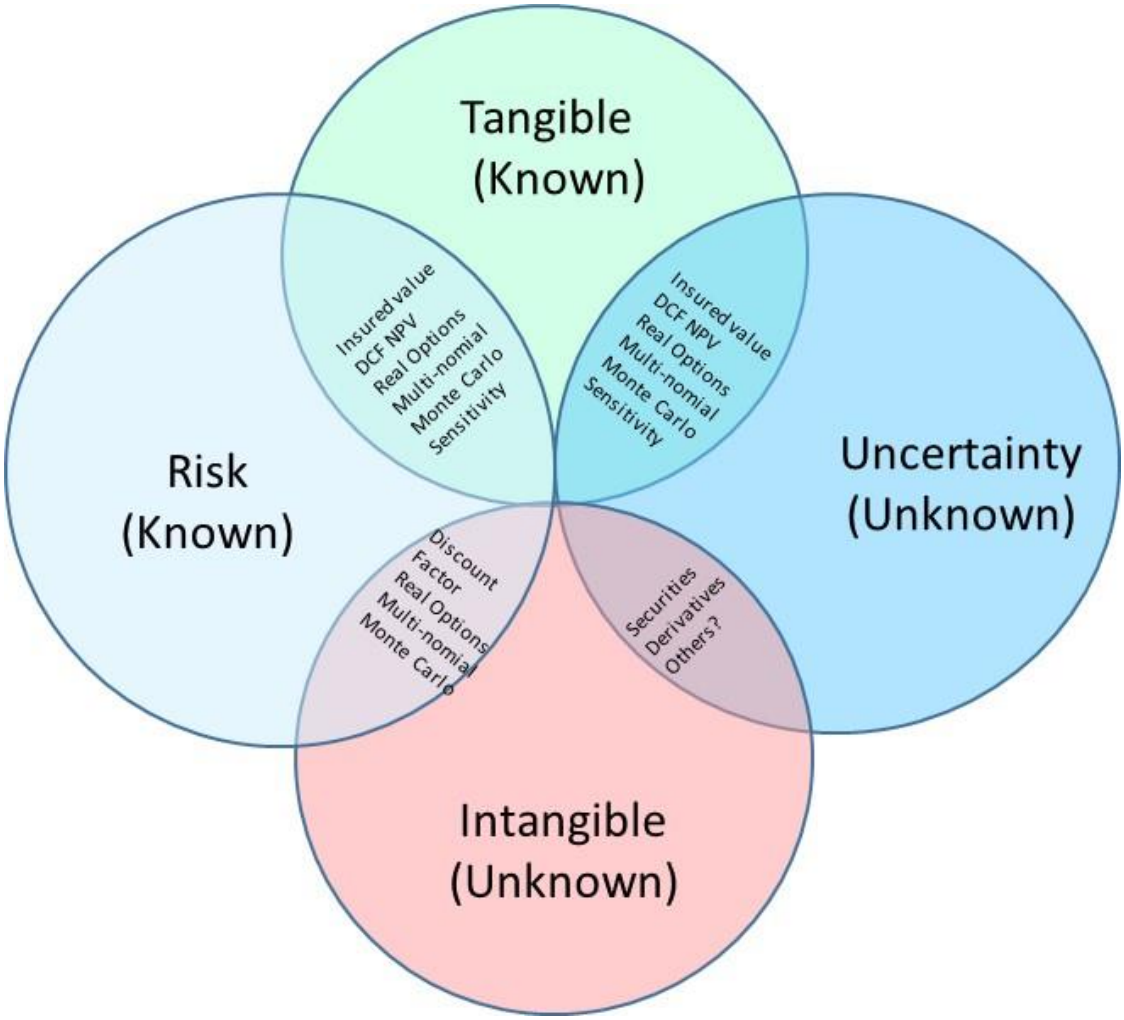

Figure 2: Depicting ESG Risk and Uncertainty Categories and Valuation Methods (modified after Maybee *et al* (2022))

Figure 2 above does not provide either an exclusive or comprehensive list of the valuation methodologies typically employed to quantify ESG risk and uncertainty. It merely provides the more frequently used methodologies dependent on the valuator's knowledge of the ESG risk or uncertainty, and whether those risks and/or uncertainties are tangible or intangible. Intuitively, some of the ESG risks and their associated outcomes can be insured against, and therefore replacement or loss-of-value/income insurance products can be used to approximate untoward outcomes, which may also present a means of estimating or quantifying the value associated with that risk. That is, risks are generally insurable, and tangible outcomes also tend to be insurable.

However, when we consider unknown unknowns, the fundamental problem with these intangible uncertainties is that we do not know what ESG issues or outcomes may arise in the future and we have no idea of how to best accommodate or mitigate what we do not know if and when they do arise. This unknown unknown paradigm remains somewhat elusive at this stage in terms of both qualification and quantification.

This gap introduces an opportunity to determine, or at least progress our collective thinking, and then put forward potential solutions that can accommodate the quantification of intangible uncertainties. In achieving this, it is probable that we can address the key aspects associated with tangible uncertainties and intangible risks too, even if this remains at a probabilistic outcomes level.

The propensity for achieving an optimal quantifying solution will require some lateral thinking and probably a fair level of underlying complexity. However, it is appreciated that anything too complex may also be too confusing and may not find a use in industry, and hence simplification remains a preferred direction. Either way, any complex or simple solution is likely to be worth the effort.

4. Addressing Intangible Uncertainties (Unknown Unknowns)

As this is only a position paper, it is necessary to provide further preliminary thinking and to give more light on how to potentially quantify intangible uncertainties. In a perfect world, the market is allowed or given the task of quantifying intangible uncertainties. The instrument that mirrors the ESG unknown unknown's value may be embedded in a somewhat complex solution, being a financial derivative hosting (potentially) embedded warrants. The derivative instrument(s) and underlying or associated warrants would present a tradeable mechanism to allow for volatility corrections as well as the continual re-pricing of the underlying exposure itself. That is, the tradeable instrument would proxy as an insurance product reflecting the underlying value, whether an asset or a liability, of the likely outcome of the ESG risk or uncertainty over time.

Simplistically, the idea of a tradeable derivative instrument appropriately reflecting the positive or negative ESG value over time follows:

- Mining companies are legally bound to cover the costs and actions necessary to accommodate ESG risks and uncertainties. These obligations typically cover all of the tangible risks, many of the intangible risks and a few of the tangible uncertainties associated with ESG for that asset or company. However, the remaining (residual?) ESG intangible uncertainties are generally ignored and, consequently, are proposed to be accommodated by this tradeable, multi-faceted, financial derivative instrument;
- A mining company can hold or trade (acquire and/or sell) any amount of the financial instruments it deems adequate to either cover its perceived ESG requirements and obligations or to realise an ESG investment return. Inadequate cover will result in the usual Director risks relating to solvency, liability, etc, which are typically associated with tangible risks;
- The derivative instrument itself will house obligations and/or commitments from various third parties (contractors, service providers, financiers/insurers, etc) that will result in that contracting party being required to deliver an action or outcome necessary to fulfil the requirements of the instrument, whether that exercised obligation manifests as a service, an effort, advice, pecuniary response, or other adequate solution embodied in the instrument;
- The financial derivative may also house a subset of additional performance or delivery warrants that, when exercised, convert into an ancillary or complimentary product or action by that third party to remedy the ESG outcome;
- The underlying instruments and warrants will be exercised, if necessary, to enact a performance, which may be required for any asset, anywhere in the world. This aspect raises thoughts around sovereign risk variances, technical variations, accessibility, etc, which differ from one project to another and hence may affect the value of the instrument itself;
- The rights to the financial instrument will be freely tradeable (as listed shares or other securities) on an appropriate exchange. The listed, tradeable instrument then places the responsibility on the project owner or operator to ensure it has adequate cover to accommodate intangible uncertainties (unknown unknowns) around ESG that may eventuate. Since ESG outcomes may actually enhance value rather than detract from value, the potential upside reward for excess holdings in the instrument can provide an investment return to the holder, without inadvertently affecting the

volatility of the instrument itself. Other stakeholders (government, funds, individuals or investment organisations, etc) can also hold and trade these market securities;

- The tradeable financial instrument will be market priced and will be subject to the vagaries of supply and demand (volatility) of that investment product. The instrument's liquidity will depend on how tightly the securities are held, but if sufficient securities are offered or issued, liquidity should not be an issue.

5. Conclusion and Recommendations

As this is only a position paper, no attempt has been made to formally develop an appropriate financial derivative instrument that will address the issue of quantifying ESG outcomes. Rather, a conceptual framework has been put forward to guide the development of such an instrument. For the instrument to be tradeable on an exchange, once the instrument has been more formally conceptualised, necessary approaches to stock exchanges (trading platforms) and securities regulators will be made.

References

Azadi, M., Northey, S., Ali, S., and Edraki, M. (2020). Transparency on greenhouse gas emissions from mining to enable climate change mitigation. Nature Geoscience 13 (2) 100-104.

Bloomberg. (2022). https://www.bloomberg.com/graphics/2022-fashion-industry-environmental-impact/?leadSource=uverify%20wall

IPCC. (2023). Intergovernmental Panel on Climate Change. https://www.ipcc.ch/reports/

Maybee, B., Lilford, E., and Hitch, M. (2022). ESG Risk, Uncertainty and the Mining Life Cycle. Available at SSRN: https://ssrn.com/abstract=4143277 or http://dx.doi.org/10.2139/ssrn.4143277

McKinsey. (2020). https://www.mckinsey.com/capabilities/sustainability/our-insights/climate-risk-and-decarbonization-what-every-mining-ceo-needs-to-know

Our World in Data. (2020). https://ourworldindata.org/emissions-by-sector

Rumsfeld, D. (2002). "Defense.gov News Transcript: DoD News Briefing – Secretary Rumsfeld and Gen. Myers, United States Department of Defense (defense.gov)". February 12.

Bio

Dr Eric Lilford is an engineer and a minerals and energy economist, being a Professor and the Head of Minerals & Energy Economics at Curtin University. He is also an executive within a clean energy storage solutions business (salt cavern energy storage solutions). He has extensive international experience in senior management roles in the mining industry, including MD and CEO positions. His +30 year background includes investment banking, marketing & business development as well as academia across the resources, energy and advanced technology sectors. Eric is on the panel of experts for the IMF and provides training programmes to governments and industry practitioners alike in the minerals and energy economics sectors.