

# Capturing the Environmental Value and Critical Mineral Potential of Mining with Real Options Valuation

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## Project Highlights:

- Critically analyse economic analysis techniques for mining projects.
- Provide insights into tools that incorporate environmental & social principles into project management and investment in the resources sector.
- Explore the role of emerging critical minerals policies on exploration and mining.

## Overview:

Mineral exploration projects typically need to raise large amounts of capital from markets, investors and banks to advance to mining. The estimates of a project's potential against a capital investment are typically captured in a *discounted cashflow (DCF)*. Although widely used and understood by exploration companies and their investors, the DCF typically reduces some of the complexity and uncertainty that are inherent to exploration and mining, including currency exchange rates, price and cost volatility, disruptions to mining activity, and more.

The complexity of mining projects is increasing. Environmental, social and governance (ESG) performance are the most important risk factors in projects advancing, and exploration and mining companies are increasingly held accountable to a wide range of stakeholders to improve their ESG performance and impact. Increasing costs and liabilities from incorporating ESG standards need to be included in value estimations; as do the consequences of poor performance, and the "lost" values of impacted natural capital and ecosystem services. Mining is also becoming increasingly geopolitical, with greater involvement of state agencies in funding projects, or expansions to projects. This includes direct investment in infrastructure associated with mining, and investment, tax relief and offtake agreements for critical minerals – those vital for energy technologies, yet at risk of supply bottlenecks – produced by some mines.

Thus, there is a growing need to better account for cost of capital of mining projects and activities. The approach should take into account the time-varying nature of processes and factors. While DCF calculations provide a quick and simple valuation of projects' values, the fundamental assumption of the DCF methodology that the project is held passively can produce vastly inaccurate valuations. Changing demand for minerals (e.g., resulting from technological innovation), changes in geopolitical political stability of regions supplying minerals and the biggest consumers, or even regulatory changes (e.g., currently adopted EU's Corporate Sustainability Reporting Directive that requires EU firm to report on their environmental and social impact along the whole supply chain) can have a fundamental impact on the developmental and operational prospects of individual projects. Thus,

when evaluating projects, it is important to account for their opportunities or options to expand, shrink, abandon, modify or postpone. In other words, when valuing projects, it is important to identify and evaluate the “real” options that are attached to projects to develop sound risk management tools and practices.

*Real options valuation (ROV)* is a methodology which may provide exploration companies with a better estimation of a project’s worth, by accounting for different variables (including ESG factors), changing market conditions, and potential state investment at different stages of a project’s life—rather than homogenising and simplifying all of them into a single discount rate in the conventional DCF calculations. This project will compile econometric data from a number of projects that have advanced from exploration to mining, critiquing DCF predictions versus the projects’ actual financial performance. Using historical data, it will develop valuation methodologies utilising the real options valuations, and assess their performance against DCF. It will aim to identify universal and project-specific factors that provide better valuation than the traditional DCF methodology. Particular attention will be paid to the impact the rise of ESG standards and of state investment in projects have, and how their inclusion impacts on “new” options for mining projects, and support the investigation as to whether ROV is an appropriate tool for 21<sup>st</sup> century exploration and mining.

### **Methodology:**

This project combines three methods: *discounted cashflow analysis* (DCF) is the most common method of estimating the value of a mining project at the exploration or feasibility stage; *econometric analysis* will be used on suitable case studies to compare project performance against original discounted cashflow metrics, and in particular the highly uncertain components of the DCF; *real options valuation* will take advantage of the econometric outputs to re-evaluate projects with a more flexible and dynamic approach to the uncertain and volatile components. These uncertain components include the environmental and social impacts of projects (ESG), and project responses to environmental change, both as negative impacts and positive opportunities (e.g. growing markets for critical metal by-products).

### **Possible Timeline**

Year 1: Compilation of selected project data; published feasibility studies and annual reporting. Selection of case studies for further econometric analysis. Critical analysis of DCF method.

Year 2: Econometric analysis and quantification of ESG impacts on project performance. Initial re-evaluation of projects using ROV. Assessment of ESG and critical mineral real options.

Year 3: Refinement of ROV approach and econometric analysis. Critical review of ROV method and suitability for exploration / mine feasibility studies.

### **Training and skills:**

TARGET researchers will participate in a minimum of 40 days training over the 3.5 years of study composed of:

- an annual one-week workshop dedicated to their year group, and tailored to that cohort’s needs in terms of skills development – *for the first three years of their study*;
- an annual all-TARGET workshop with cross-year interactions, advanced training and opportunities to specialise in particular areas – *all years of study*;
- a number of one-day workshops;
- additional online events and in-person workshops attached to relevant conferences.

Lead supervisor *Prof. Ania Zalewska* is Professor of Finance in the UoL School of Business, and will provide enhance training and direction on ESG and investing, market development, and ROV. *Prof. Stephen Neethling* is a chemical engineer and Professor of Minerals Processing at Imperial College; he is the Director of the Metals and Energy Finance programme, and brings expertise in DCF, and modelling uncertainties in cash flows. *Prof. Dan Smith* is an economic geologist and will provide support on ESG and critical mineral policy and regulation, mining and DCF.

**Partners and collaboration:**

Dr Rose Clarke (Satarla) will provide additional training and supervision, and brings expertise in mining industry ESG performance certification and its growing links to finance in the mining and critical minerals space.

**Further details:**

Please visit <https://target.le.ac.uk/> for additional details on how to apply. For further details on project specifics, please contact Prof. Ania Zalewska [a.zalewska@leicester.ac.uk](mailto:a.zalewska@leicester.ac.uk).