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**When Fiscal Policy Undermines Resource Value:
The Role of Poorly Considered Instruments in Mining
Taxation**

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Introduction

- Governments often lack a comprehensive understanding of the economic decision-making processes underlying mining operations. Inadequately designed fiscal instruments can erode project value and diminish the potential revenue that the state may derive from mining activities.
- This presentation examines the impact of increased tax burdens on mining projects, particularly their influence on the cut-off grade.
- A higher tax load may elevate the cut-off grade, thereby reducing the economically minable reserve and ultimately decreasing both direct and indirect revenue streams available to the state.

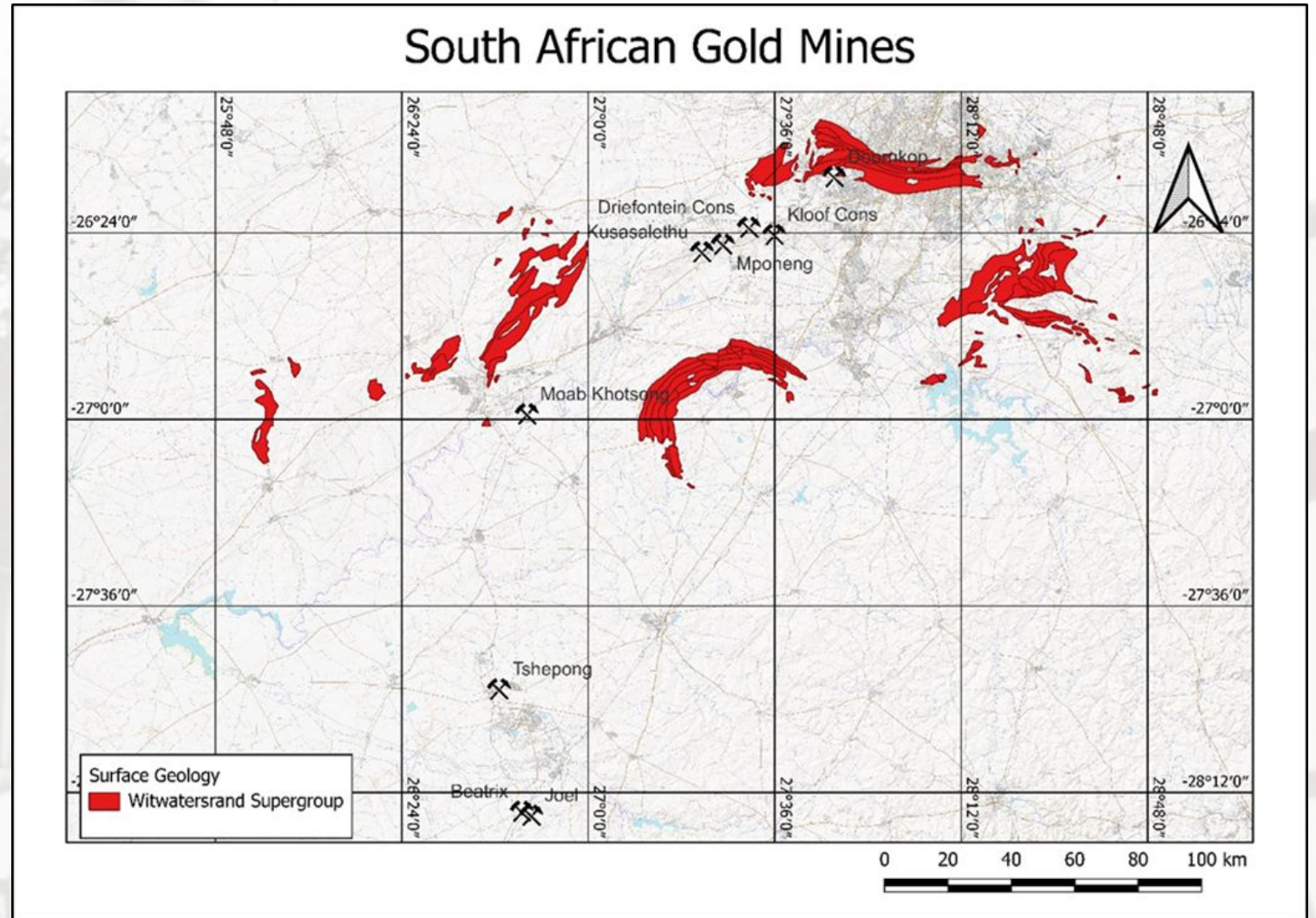
Introduction

- The concept of the Laffer Curve has been cited as a justification for refraining from further increases in personal and corporate income tax rates, particularly as South Africa seeks to address its widening budget deficit.
- This principle is equally applicable to the taxation of the mining sector.
- This analysis explores the implications of South Africa's mineral resource royalty regime, corporate tax structure, and gold taxation framework.
- It assesses how the interaction between tax formulae and economic cut-off grades may lead to outcomes that fall short of the government's revenue expectations from the mining industry.

Background

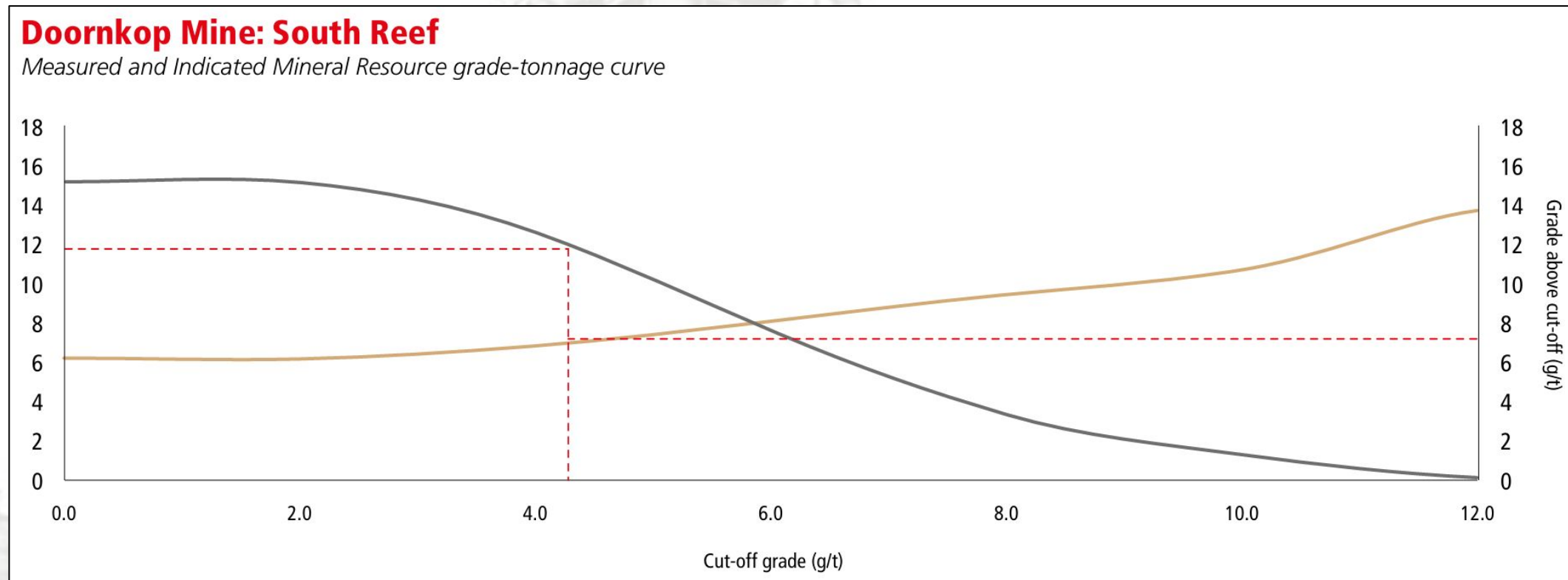
This study focuses on the South African deep-level narrow tabular gold mines

Ten mines have been Included in this study



Background

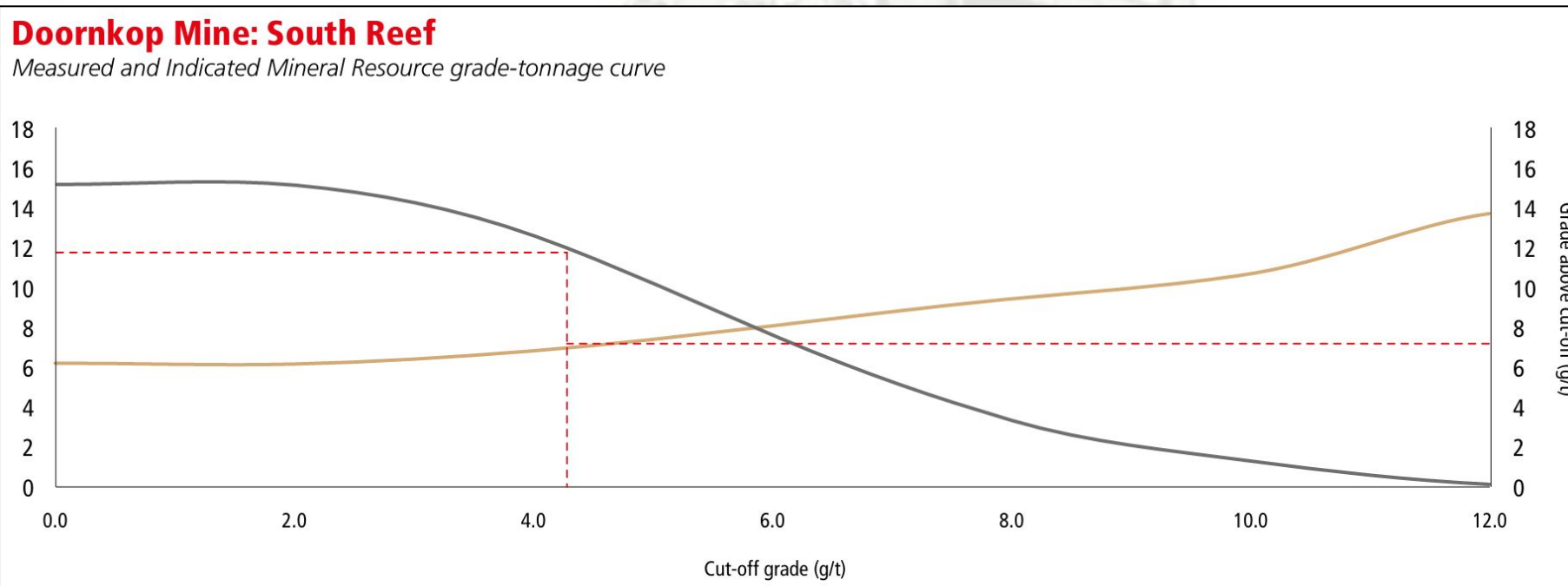
Each mine has a unique orebody, which can be represented by its grade-tonnage curve.



The grade-tonnage curve for Doornkop Mine.

Background

A cut-off grade can be determined – and that will give an indication of the Mineral Resource tonnes above this grade (ore), and the average mining grade of the ore.



The grade-tonnage curve for Doornkop Mine. The resource cut-off grade of approximately 4.2 g/t results in ~12 million tonnes above this grade, at an average in-situ Measured and Indicated Resource grade of ~7.5 g/t.

Background

The (break-even) cut-off grade calculation is very simple

$$g/t = \frac{\left(\frac{AISC}{p}\right)}{(r \times SM)}$$

Where:

- g/t is the break-even grade in grams per tonne;
- $AISC$ is the all-in sustaining costs in US\$/tonne;
- r is the mine recovery factor in %;
- p is the metal price in US\$ per gram; and
- SM is the ratio of stope to milled tonnes (in %).



Cut-off Grade Optimisation Considering Taxation

The traditional linear approach to calculating the operational cut-off grade is to include the mineral resource royalty as a cost, and exclude the income tax.

	Planning	Operational	Marginal
Direct unit cost	X	X	X
Fixed cost	X	X	
Initial capital	X		
Ongoing capital	X	X	
Development	X	X	
Royalty	X	X	
Taxation	X		
Hurdle rate	X		

However, South Africa has a unique hybrid approach to mineral royalties, and a variable gold income tax rate, which alters the approach for considering the costs compared to other mining regions.

South African and Royalty and Gold Tax Costs

- Mineral resource royalties can be determined on volume or revenue (*ad valorem*).
- South Africa has a unique hybrid *ad valorem* formula, flexible depending on profitability.



South African and Royalty and Gold Tax Costs

- A 'good tax' should not disturb economic behaviour and thus should be neutral.
- Income tax is calculated on profits and therefore should not alter economic behaviour, because making a profit is considered a primary objective of any mining business.



The Impact Of Proposed Changes To The South African Gold Tax Formula

- On August 13, 2015, the Davis Tax Committee's first interim report on mining was posted for public comment, proposing no changes to the gold tax formula currently used for gold mines.
- This was to protect jobs and keep the gold mines operating, considering the marginal nature of many of the mines.

The Impact Of Proposed Changes To The South African Gold Tax Formula

- The final reports were published in November 2017.
- Although the committee has recommended retaining the gold mining formula for existing gold mines, it has proposed that new gold mines be subject to the same tax rates as other mining projects to ensure neutrality in the mining sector.

The Impact Of Proposed Changes To The South African Gold Tax Formula

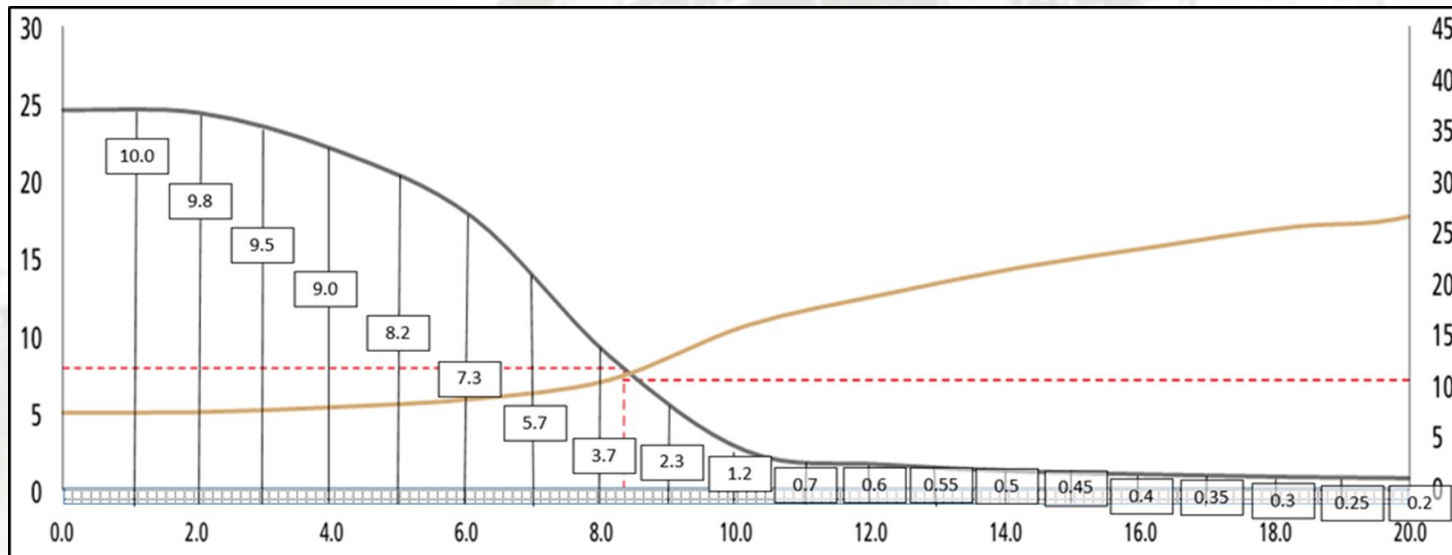
- The study by Lilford (2017), considering the proposed introduction of mining royalties in Australia, emphasised the importance of understanding how these changes affect cut-off grades.
- He stated, *“Policy-makers and legislators, typically representing a government body, are quick to impose royalties and other measures to secure income from natural resources operations”*.

The Impact Of Proposed Changes To The South African Gold Tax Formula

- Lilford identified that these same regulators seldom question the impact that such additional costs beyond profit-based taxes have on the actual operations regarding economic life.
- Considering the criticisms raised by Lilford, the impact of changing the current gold tax levied on South African gold mines to the 27% income tax rate levied on all other mining operations is considered.

Methodology

- Block listings are needed – not available in the public domain.
- These were simulated from the published grade-tonnage curves.
- Measurements are taken at regular grade intervals.



Grades (g/t)	Measure (cm)	Proportion	Tonnage
0.5	10	0	0.00
1.5	9.8	0.2	0.50
2.5	9.5	0.3	0.75
3.5	9	0.5	1.25
4.5	8.2	0.8	2.00
5.5	7.3	0.9	2.25
6.5	5.7	1.6	4.00
7.5	3.7	2	5.00
8.5	2.3	1.4	3.50
9.5	1.2	1.1	2.75
10.5	0.7	0.5	1.25
11.5	0.6	0.1	0.25
12.5	0.55	0.05	0.13
13.5	0.5	0.05	0.13
14.5	0.45	0.05	0.13
15.5	0.4	0.05	0.13
16.5	0.35	0.05	0.13
17.5	0.3	0.05	0.13
18.5	0.25	0.05	0.13
19.5	0.2	0.05	0.13
20.5	0.15	0.05	0.13
21.5	0.1	0.05	0.13
22.5	0.05	0.05	0.13
23.5	0.05	0.05	0.13
Total		10.0	25.00

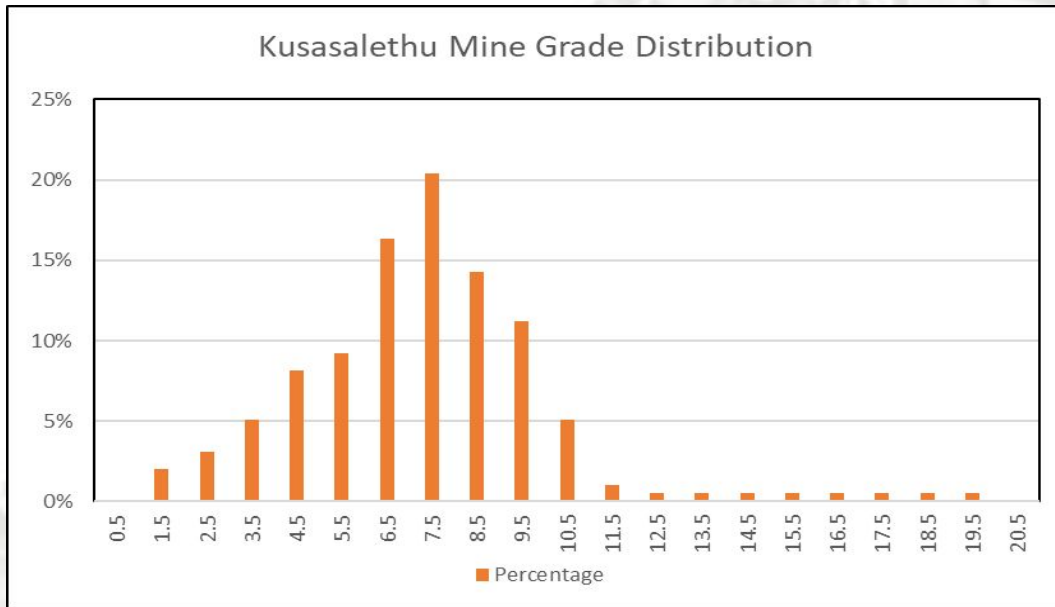
Methodology

- The next step involves using distribution fitting software (Palisade @Risk or Risk Simulator 2023).
- Gold grades are typically lognormal, but may be two- or three-parameter lognormal in the Witwatersrand reefs.
- The tonnage for the blocks to be populated (split into Measured and Inferred) is determined by the block sizes indicated in the annual Mineral Resource and Reserve reports, stoping width, and the density.

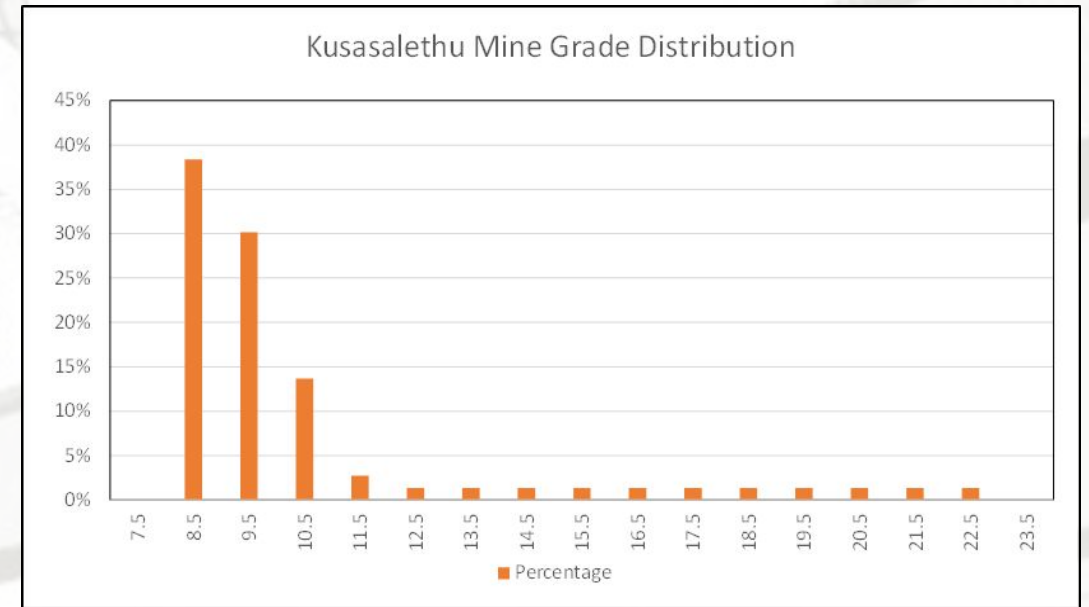


Methodology

The grade categories with the tonnage proportion (as a percentage) are allocated to each category of the mine. Various options were tested to obtain the best fit.



Lognormal distribution



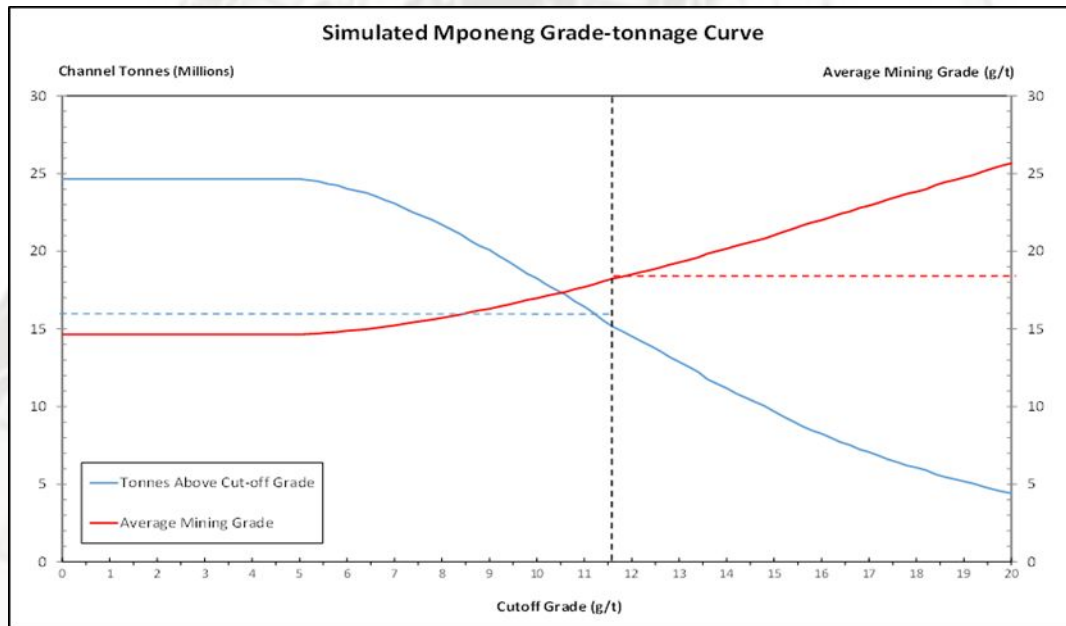
Exponential distribution

Methodology

- Production and financial information for the ten gold mines obtained from the annual reports.
- A simple cash flow model, including the mineral resource royalty and the gold tax formulae, was used to determine the profit, NPV_{12} , total revenue, and total revenue to the state.

Methodology

- The break-even cut-off grade was determined using the break-even formula for each mine.
- This was then used to determine the average mining grade and available tonnes above the cut-off grade.

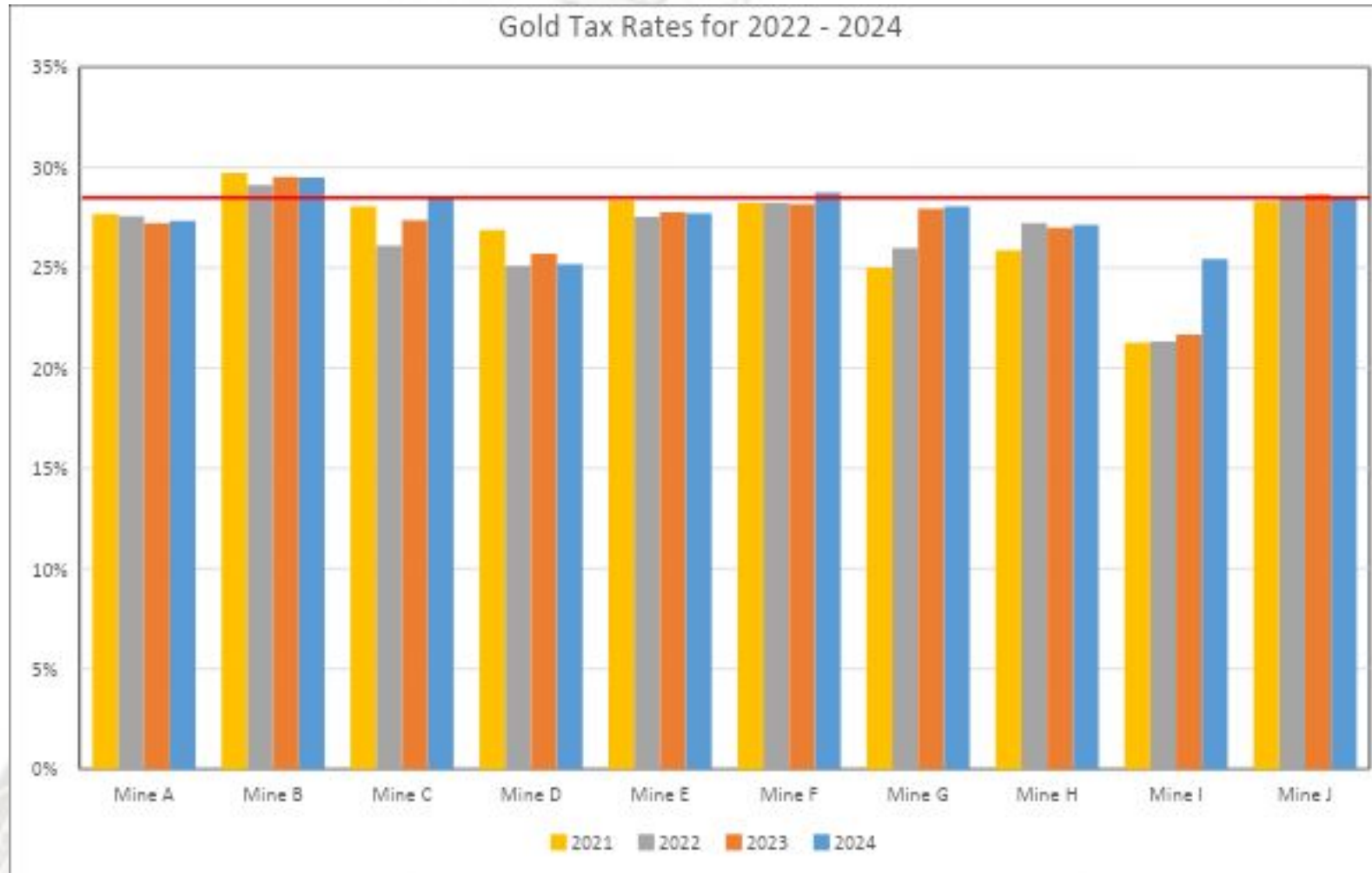


cut-off grade of 11.6g/t,
million tonnes at an
17.5g/t

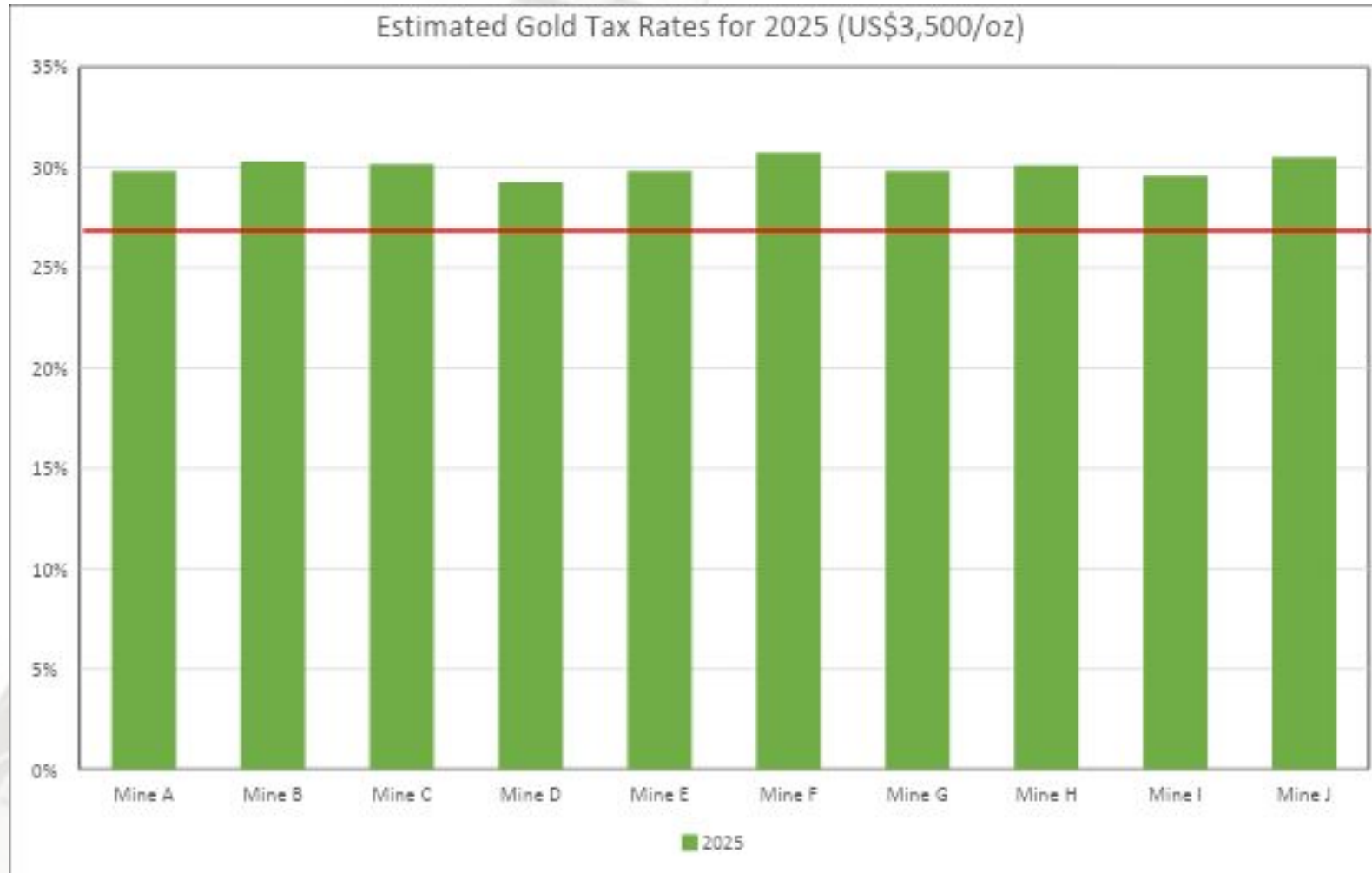
Methodology

- The gold tax formula was then replaced by the corporate tax rate of 27%.
- This was done for 2021, 2022, 2023 and 2024.
- The average difference for the four years is presented.

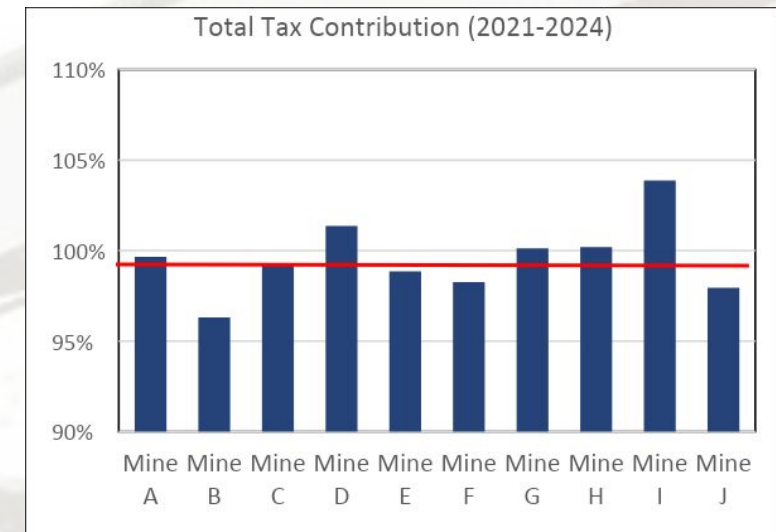
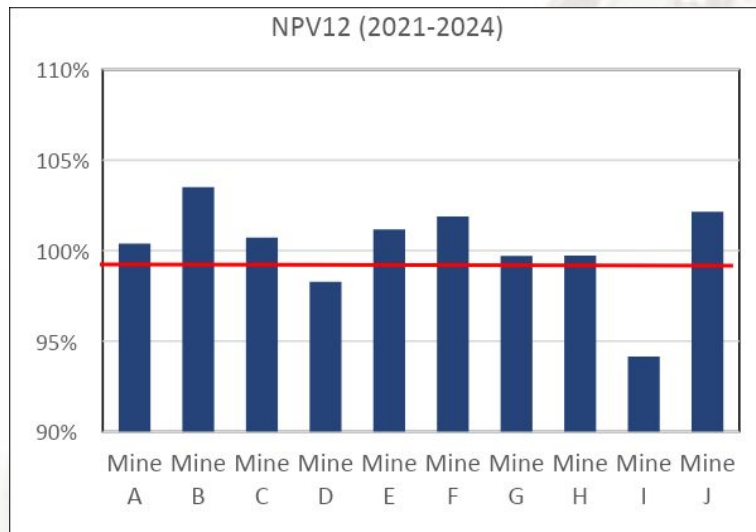
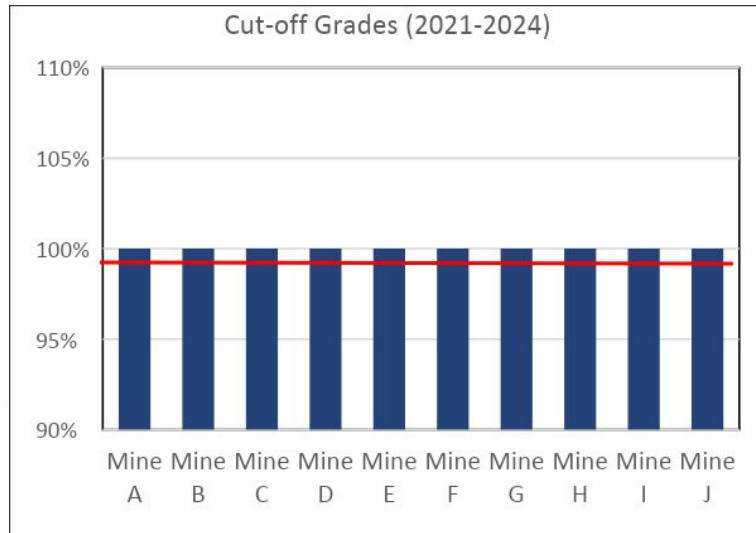
Gold Tax Rates (2021-2024)



Estimated Gold Tax Rates (2025)



Impact of Changing to 27% Income Tax

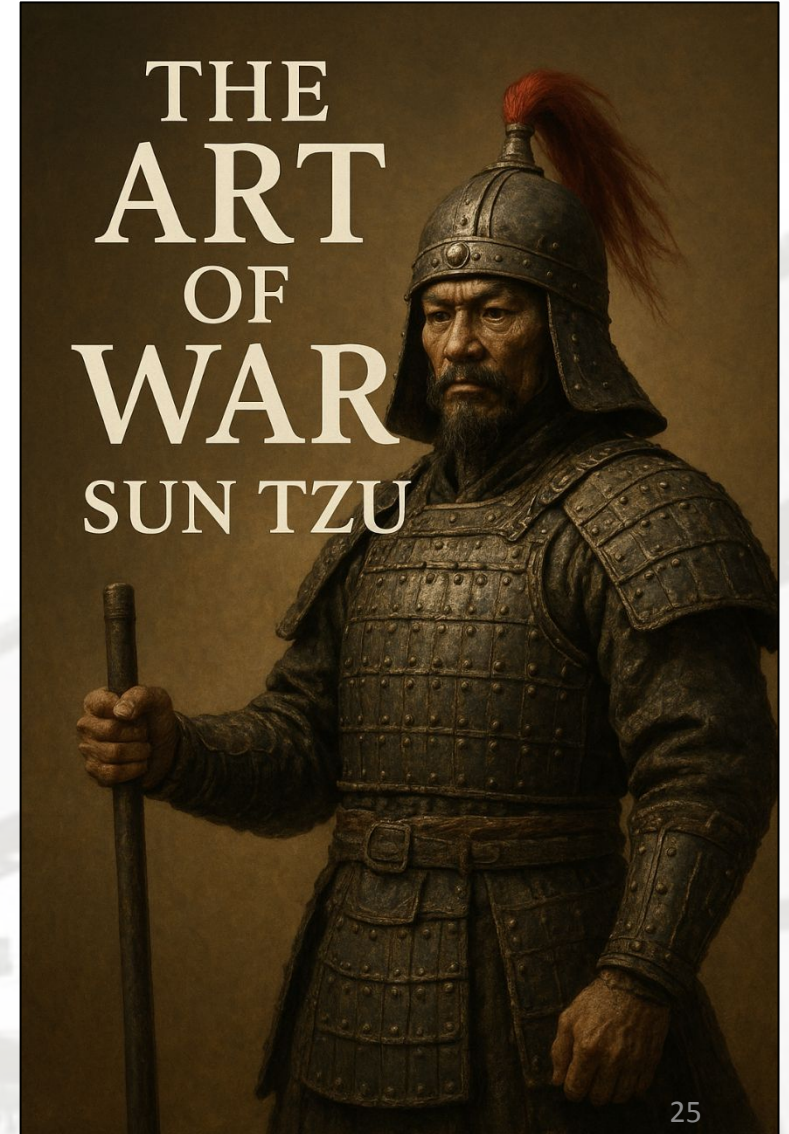


Observations

- There are no changes to the cut-off grade, total tonnage mined, or revenue.
- There is a slight increase (0.2%) in the average profit generated by the 10 mines.
- There is a slight increase (0,2%) in the average NPV_{12} for the 10 mines.
- There is a 0.4% decrease in the total tax contribution from the 10 mines.

Systems thinking in Mineral Resource Management

- Treating your mineral resources like the battlefield – the Art of War....
- The Art of War, attributed to Sun Tzu, is an ancient Chinese military treatise written around 2,400 years ago.
- It is one of the oldest and most influential works on strategy, tactics, and leadership, and it has been widely studied not only in military contexts but also in business, politics, and sports.

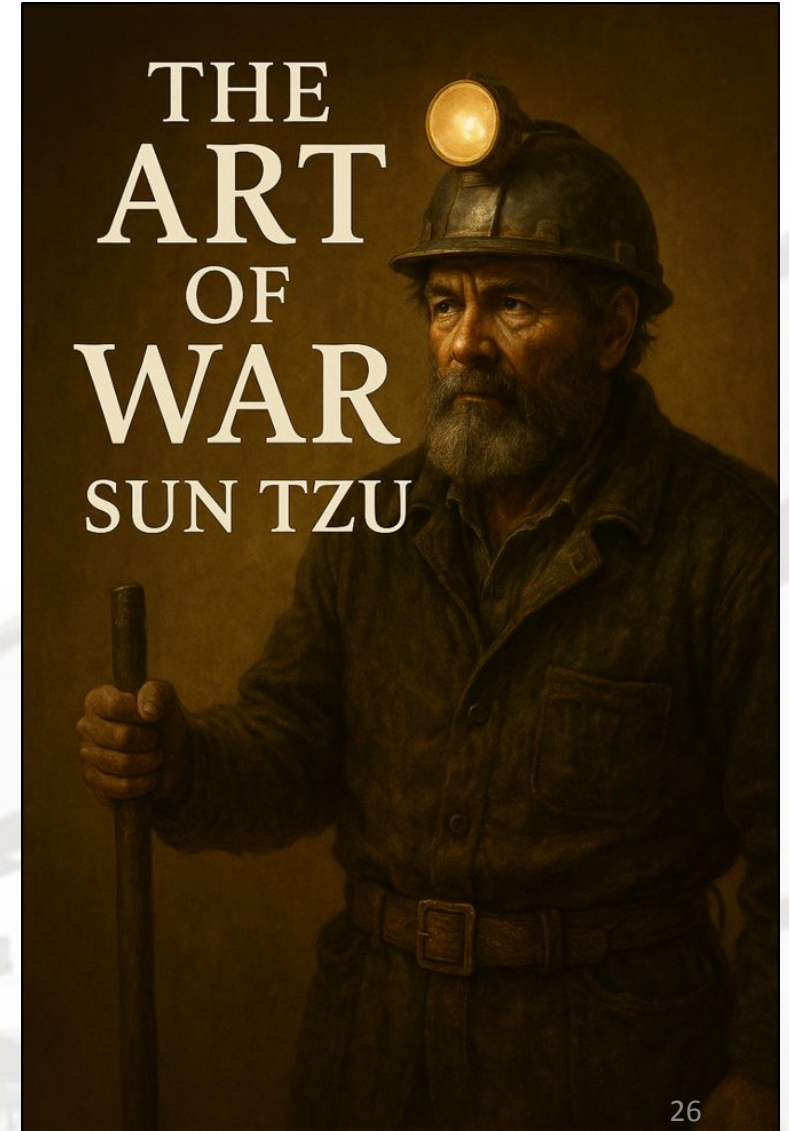


Systems thinking in Mineral Resource Management

Can Sun Tzu's Art of War be seen as an early example of systems thinking?

While Sun Tzu didn't have the modern vocabulary, The Art of War demonstrates systemic principles:

- Holistic awareness;
- Interconnections and feedback;
- Adaptability and emergence;
- Leverage; and
- Balance and flow.



Systems thinking in Mineral Resource Management

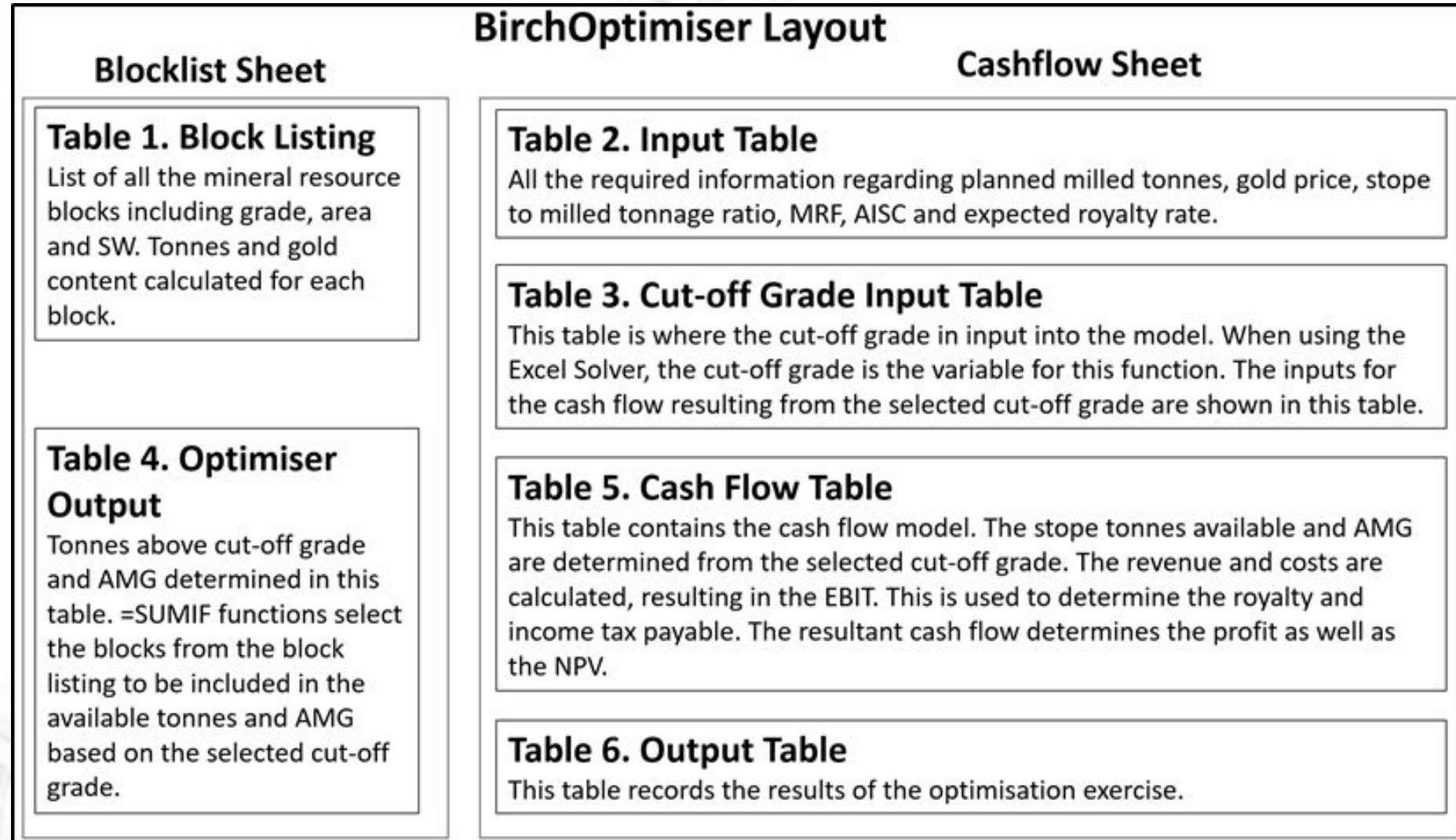
- Cut-off grades can be optimised in various ways to improve the profit or net present value (NPV) from an operation.
- These include:
 - Optimising the volumes to get the benefit of the cost-volume relationship (peak of value);
 - Heuristic cut-off grade optimisation approach; and
 - Lane's optimum cut-off grade approach.

Systems thinking in Mineral Resource Management

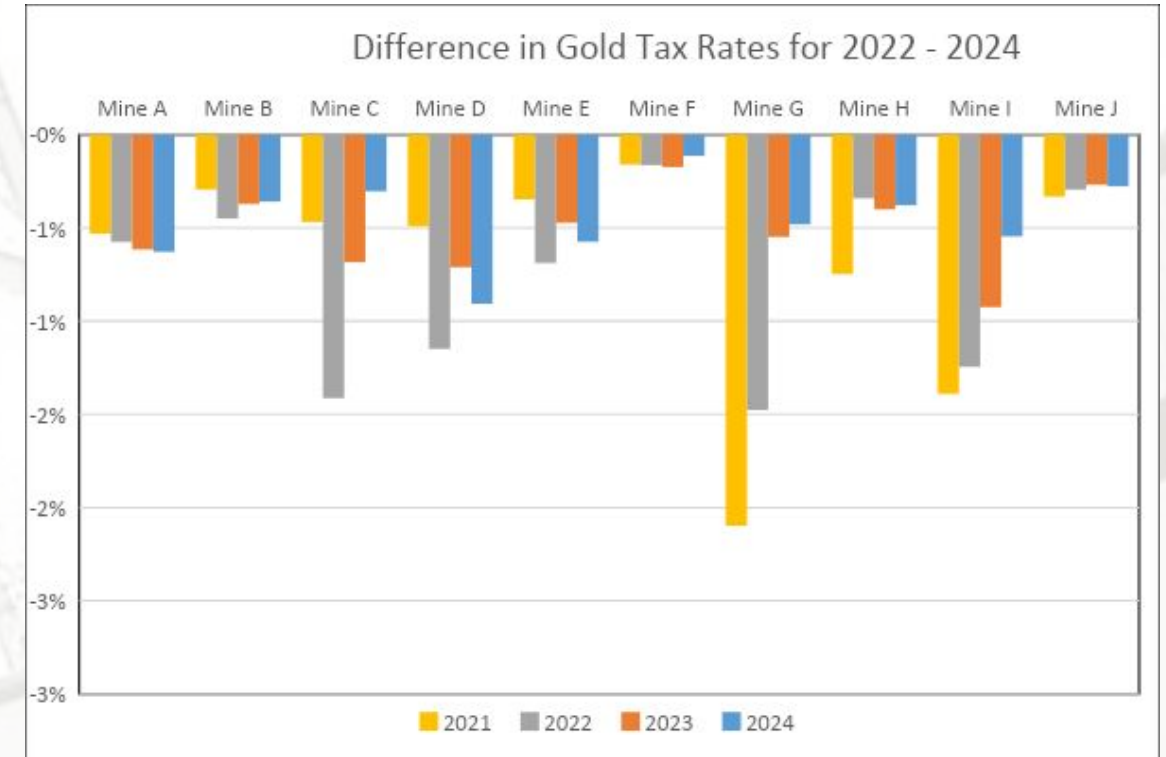
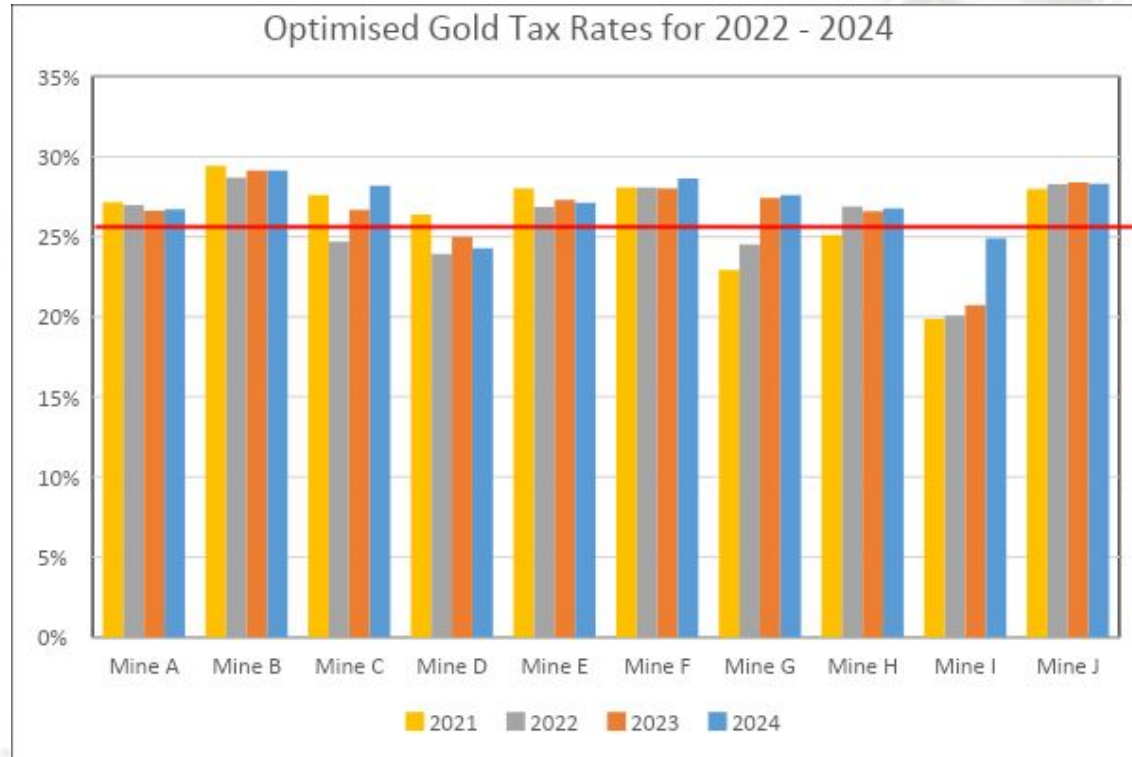
- The royalty costs are tax-deductible costs for determining the taxable income.
- This cost deduction reduces the profitability ratio used in the gold tax formula. For gold mines, the royalty cost reduces taxable income and, in turn, the tax rate.
- Can the mines optimise the cut-off grade so that the overall profit is increased by reducing the profitability, and thus pay lower mineral resource royalty and gold tax rates?



The BirchOptimiser

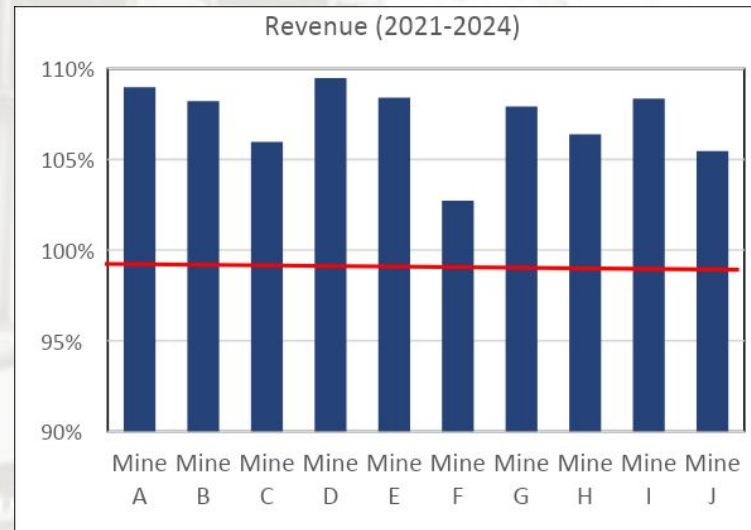
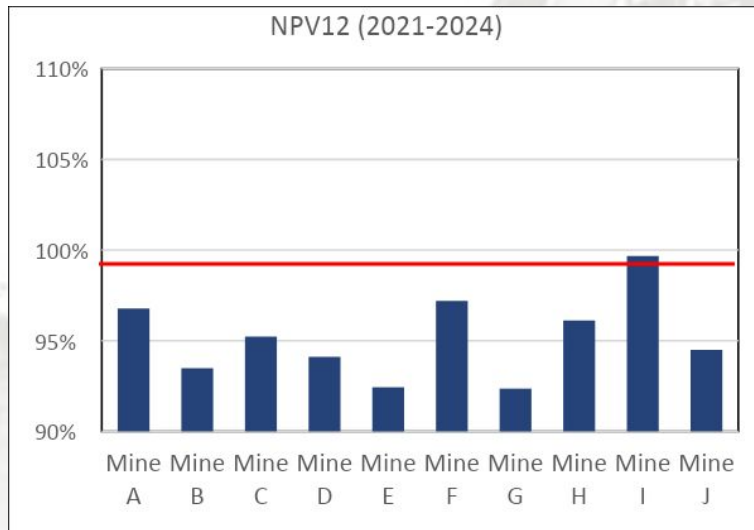
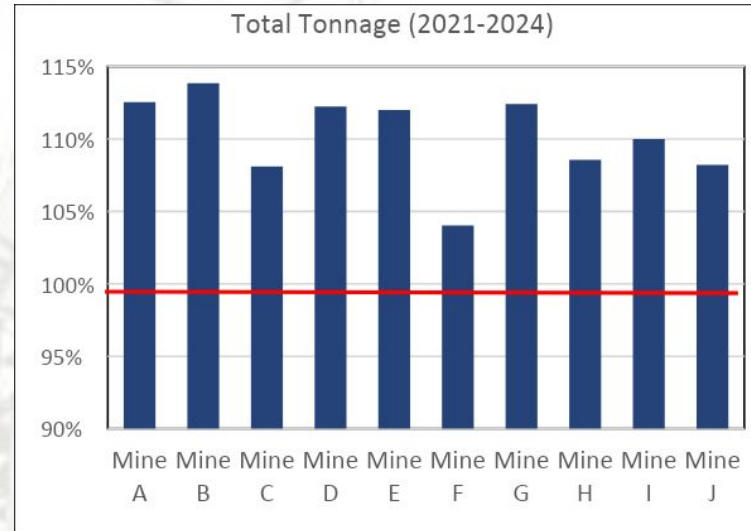
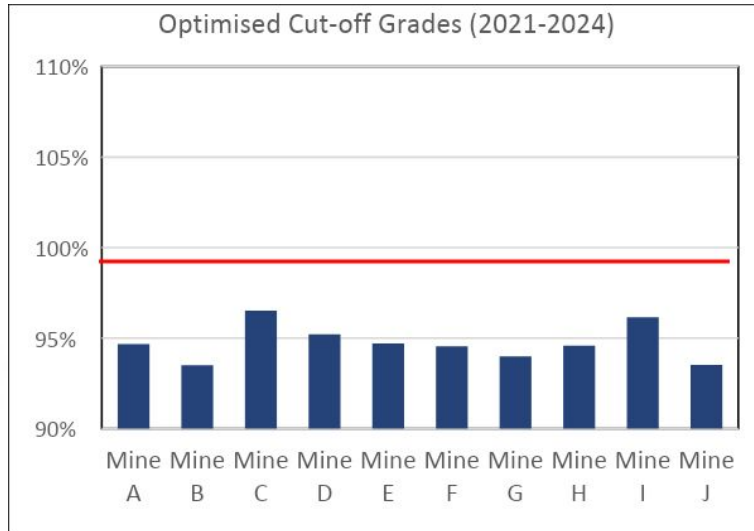


Impact on Gold Tax Rate with Cut-off Grade Optimisation



Similar effects are noted in the mineral resource royalty rates

Impact of (Profit) Optimising Cut-off Grades

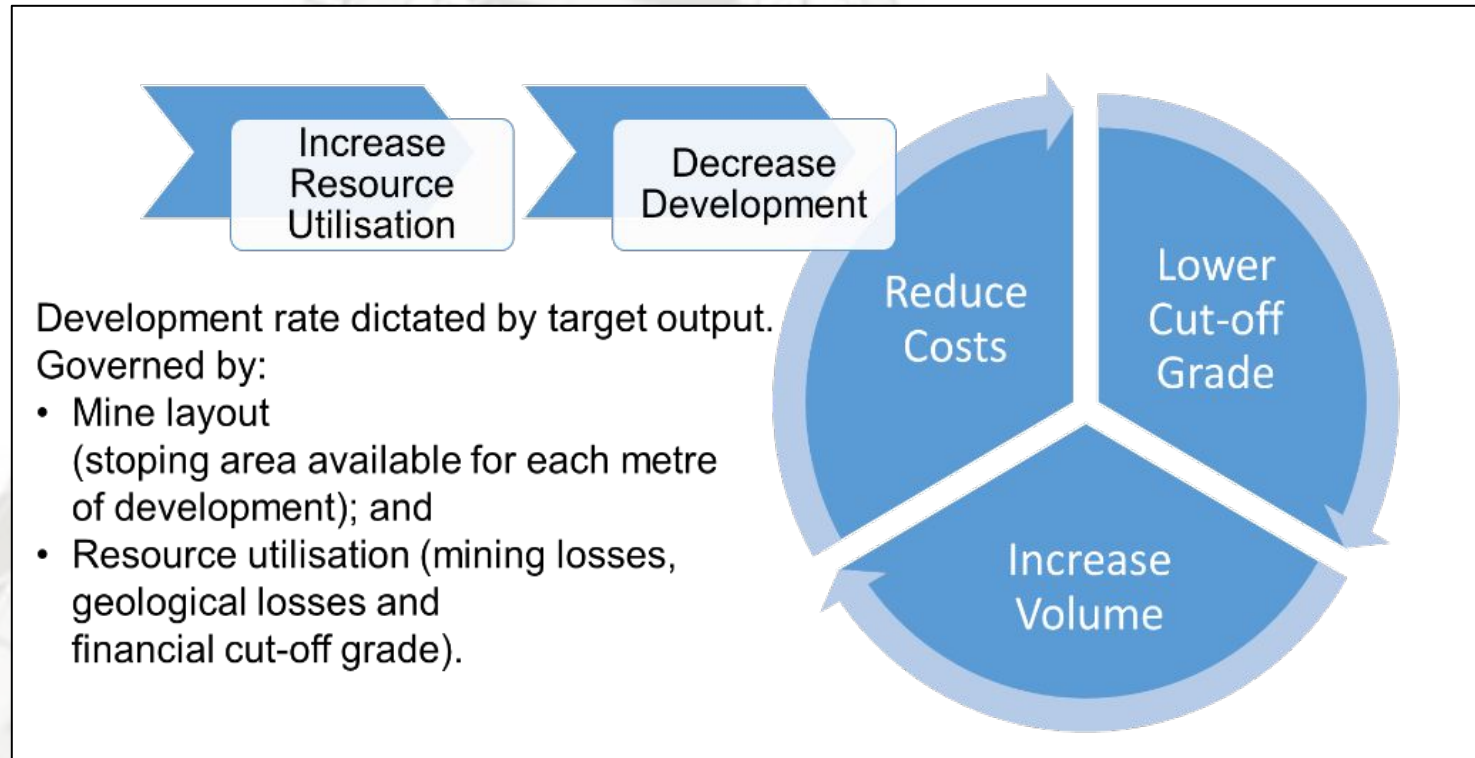


Observations

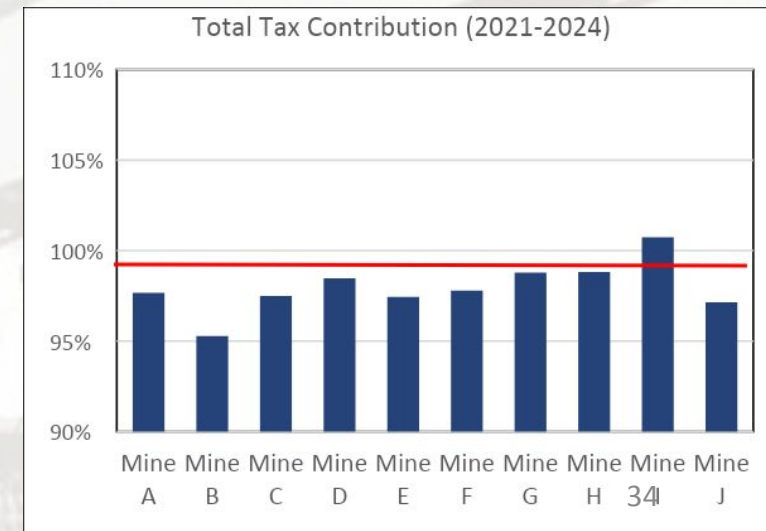
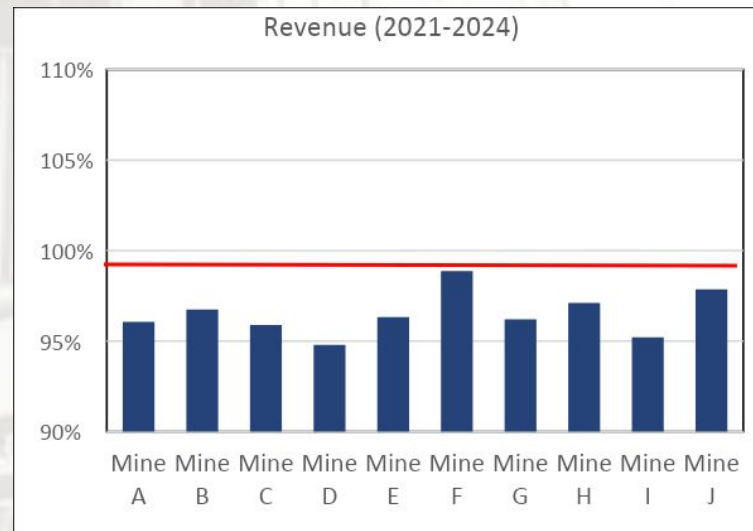
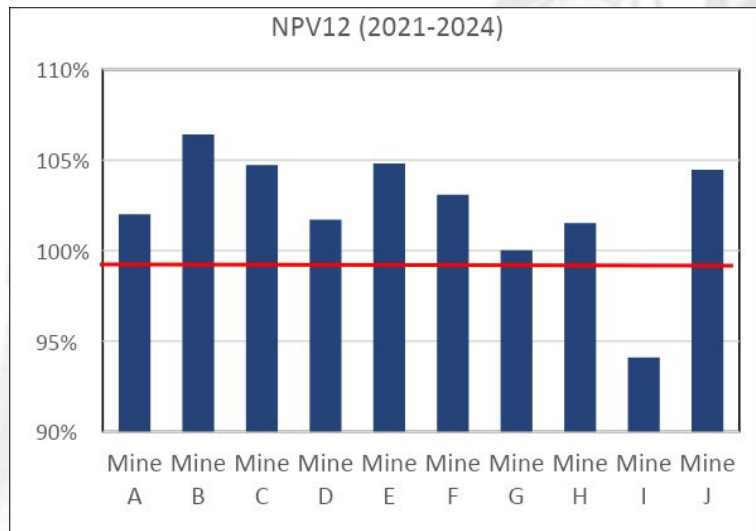
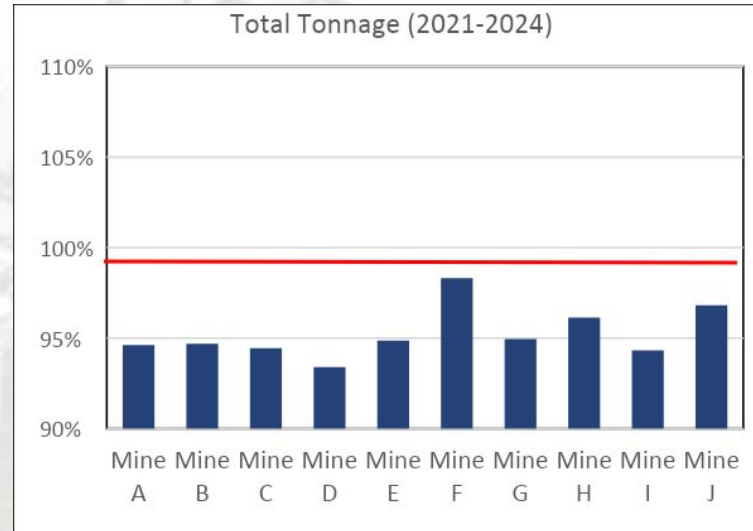
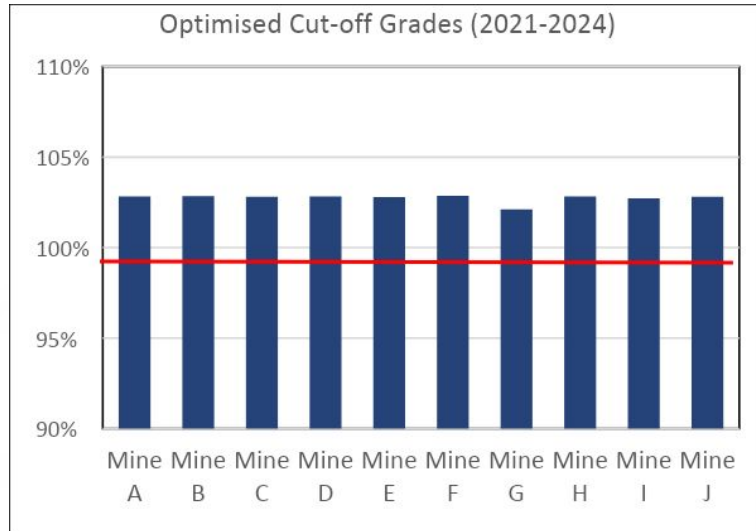
- The cut-off grade decreases on average 5.1% for the 10 mines.
- The total tonnage mined increases on average by 10.2%.
- There is a slight increase (0,8%) in the average profit, however, the NPV_{12} decreases by 4.3%.
- The total revenue increases by 7.3%.
- There is an average 4.0% increase in the total tax contribution from the 10 mines.

Observations

- Additional benefits would be realised by increased resource utilisation due to the lower cut-off grades.



Impact of Changing to 27% Income Tax with Cut-off Grade Optimisation



Observations

- The cut-off grade increases on average 2.7% for the 10 mines.
- The total tonnage mined decreases by 4.7%.
- There is a slight decrease (0,4%) in the average profit for the 10 mines, however the NPV_{12} increases by 2.3%.
- The total revenue drops by 3.5%.
- There is an average 2.0% decrease in the total tax contribution from the 10 mines.

Observations

- If cut-off grade profit optimisation is not taking place, the impact of changing from the gold tax formula to the standard 27% corporate income tax rate would be negligible.
- However, there are benefits for the mines to optimise their cut-off grades, considering the unique mineral resource royalty and gold tax formulae applicable to South African gold mines.
- Under these circumstances, altering the gold tax formula to the standard 27% corporate income tax would have a negative outcome for the profits from the mines, as well as on State revenue.

Observations

- The gold tax formula protects the gold mines when prices are low, yet allows the state additional revenue when prices are high.
- This form of taxation should be considered for other mining operations, too.

Thank you

Questions?