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- **Commodities Outlook:** forecasting fundamentals for 2024
- **Top Projects:** delivering value to SA economy
- **Mining Indaba** celebrates 30 years



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ON THE COVER

MTN is committed to empowering mining companies with the cutting-edge technology of 5G Private Networks. See story on page 10.

What does the crystal ball predict for 2024?

In the Chinese zodiac, 2024 signals the year of the Dragon – portraying strength, power, and good fortune. In Chinese culture, the Dragon is believed to bring prosperity and success. Given the trials and tribulations of the past year, here's hoping that the year of the Dragon brings some much-needed good fortune to all.

So, what do the pundits foretell for the globe's economic outlook? According to the Organisation for Economic Co-operation and Development (OECD), the global economic outlook for 2024 is not too promising, with predictions of a mild slowdown to 2.7% in 2024 and a slight improvement to 3.0% in 2025. Goldman Sachs Research, however, is more upbeat, anticipating that the global economy will "outperform expectations in 2024 – just as it did in 2023".

On the Africa front, Economist Intelligence Unit expects the continent to be the second-fastest-growing major region, boosted by the services sector, which continues to play an important role in East Africa. However, it noted that security threats, political instability and repayment burdens are risks to watch out for in the year ahead. On a positive note, data and analytics company GlobalData noted that South Africa's economic growth, which was projected at 0.4% in 2023, would pick up to 1.3% in 2024.

However, given the slew of challenges faced, including inefficiencies at South Africa's ports, rail freight and power, achieving 1,3% is a tough ask. Coupled with these inefficiencies and lower commodity prices and higher input costs, several mining houses issued Section 189 notices last year – a precursor to retrenchments.

Commodities Outlook

Key commodities, including PGMs, diamonds and coal, have been facing headwinds, with miners in these sectors contemplating restructuring. Higher operating costs and falling palladium and rhodium prices have contributed to a decline in PGM miners' revenues.

According to the WPIC's Edward Sterck, although platinum mine supply is forecast to grow three per cent year-on-year to 5 743 koz,

the modest growth could be eroded by plummeting palladium and rhodium prices with miners now reassessing production plans and restructuring operations in response to continued pressure on the PGM basket price (pg 14).

Bulk commodity producers have been hard hit by rail freight and port woes with coal miners, in particular, facing the added burden of lower coal prices. Menar's MD Vuslat Bayoglu notes that with "things unravelling at Transnet, the Richards Bay Coal Terminal has been performing far below its 91 million tonne capacity with daily rail deliveries dropping from 32 trains to 18" (pg 18).

The global diamond industry is also in a state of turmoil and being challenged by the rise of lab-created diamonds, geopolitical instability, changing consumer mindsets, a rise in environmentalism, and global economic inflation (pg 16).

On a more positive note, though, gold is reigning in a stellar performance, with the WGC noting that gold's performance has caught the world by surprise, "as prices reached an all-time high, topping out at over \$2,100/oz in early December" (pg 12).

Meanwhile, for greater insight into how the mining sector is set to perform in 2024, the Investing in African Mining Indaba 2024 is the place to be. According to Event Director, Kathryn Barnard, Investing in African Mining Indaba 2024 will showcase the thriving African mining industry and its readiness for investment (pg 39).

On the topic of thriving, Modern Mining's Top Projects feature projects distinguished by their humungous price tags, sheer size, and value to the economy. They include Pan African Resources' Mintails assets (pg 22); Platinum Group Metals' Waterberg PGM project (pg 28); diamond miner, De Beers VUP (pg 34); and Canyon Coal's Gugulethu Colliery (pg 26).

In keeping with growth aspirations, our cover story, MTN, is intent on unleashing the power of 5G to redefine mining in Africa. According to MTN's David Behr, the company is committed to empowering mining companies with the cutting-edge technology of 5G Private Networks (pg 10).

Here's to a great year for us all in 2024.



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Kazera Global purchases pulsating diamond jig

Kazera Global, the AIM-quoted investment company, has placed an order for a pulsating diamond jig unit for its Deep Blue Minerals diamond project in Alexander Bay, South Africa. The company remains focused on advancing production at its Deep Blue Minerals Project, in which it holds a 64% interest.

The 20 tons per hour processing capacity pulsating diamond jig is expected to be

in operation in early 2024. The unit will help overcome diamond gravel processing issues at Alexkor's Muisvlak processing plant.

Dennis Edmonds, CEO of Kazera Global, commented: "Having recently inspected a pulsating diamond jig in operation, we have placed an order for a unit which will be deployed at Deep Blue Minerals' diamond mining operation in

Alexander Bay, South Africa. Historically, Deep Blue has worked with Alexkor to get its Muisvlak diamond gravel processing plant operating correctly so it and other contractors in the area can process their diamond gravel. However, despite best efforts, it has become increasingly apparent that achieving this consistently is not achievable in the short term. Deep Blue has therefore received approval from Alexkor to use a pulsating jig to process its diamond gravel and then deliver very high concentrate gravels to Alexkor for final sorting and sale. This means the volumes to be transported will be considerably reduced (so reducing costs) and also means that security of our product will be improved. Pulsating jigs are widely used for diamond recovery and, with a processing capacity of 20 tons per hour, we believe this purchase provides a cost-effective way to improve operations swiftly and dramatically at Deep Blue".

The use of the pulsating diamond jig is an attempt to unblock the diamond mining process for Deep Blue by bypassing the Muisvlak plant completely and allowing Deep Blue to deliver only very high concentrate diamond gravels to Alexkor for final sorting. ■



The pilot plant at the Deep Blue Minerals diamond project.

Andrada Mining's lithium pilot plant produces first lithium concentrate

Andrada Mining, an African technology metals mining company with a portfolio of mining and exploration assets in Namibia, has successfully commissioned and achieved first production at its lithium (bulk-sampling) pilot plant. Production ramp up to 250 tonnes a month is planned during first quarter of the 2024 calendar year.

Andrada Mining CEO, Anthony Viljoen commented: "We

believe our efforts throughout the year have the potential to place Andrada at the forefront of lithium development in Africa. The discovery of additional lithium within the company owned Lithium Ridge and Spodumene Hill also underscores

the possibility that Namibia's Erongo region could be a key participant in the global lithium

landscape, with the potential to host a cluster of significant mines. The early results from the recently commissioned lithium processing pilot facility have instilled unwavering optimism. We are also pleased by the ongoing negotiations with lithium off-takers that target Andrada's involvement in all downstream lithium markets, and we look forward to providing further details as these negotiations progress. Overall, we consider the pilot plant serves as a crucial de-risking element in the Company's lithium portfolio, further bolstering our confidence in Andrada's lithium strategy." ■



Andrada Mining CEO, Anthony Viljoen.

Bushveld Minerals inks agreement for the acquisition by Southern Point Resources

AIM-listed Bushveld Minerals, the integrated primary vanadium producer, has entered into a definitive agreement for the acquisition by Southern Point Resources - Fund 1 SA L.P., represented by its general partner SPR GP1 (SPRF), of 50% of the issued shares of Bushveld Vanchem (BV), which owns the Vanchem vanadium processing plant (Vanchem), for an acquisition price of some US\$21.3 million. The purchase by SPR of Bushveld's 64% equity interest in a subsidiary that owns the Mokopane Vanadium project for \$3.7 million, remains on track.

Craig Coltman, CEO of Bushveld Minerals, commented: "We are pleased to be announcing a definitive agreement on another piece of the overall \$69.5-\$77.5 million funding package first announced in September. We look forward to working closely with our new partners at Vanchem to unlock value in this significant asset. We hope to announce further progress on the overall funding package in the coming weeks and months." ■



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Driving efficiency and sustainability.



ARM sponsors R20 million into research at Wits University

South Africa is facing three key challenges: energy shortages, water scarcity, and lack of skills in digitalisation. A new collaboration between African Rainbow Minerals (ARM) and the Faculty of Engineering and the Built Environment at the University of the Witwatersrand (Wits University) aims to develop the high-level skills required to address these issues. Dr Patrice Motsepe,

founder and Executive Chairman of African Rainbow Minerals (ARM), a Wits University alumnus and recipient of an honorary doctorate degree, said: "ARM is proud to partner with Wits University which is a globally respected academic institution. Partnering with South African institutions of higher learning is paramount in our pursuit of knowledge, innovation, skills, and

sustainable development. Public-private partnerships are crucial in addressing the socio-economic and environmental challenges confronting our communities and country. ARM works with several top universities across South Africa, supporting young people from undergraduate to postgraduate studies, helping them to realise their dreams. Some of these students come from communities neighbouring our mining operations. We also contribute to the development and upliftment of poor rural and urban communities in South Africa by educating students from these communities."

The ARM Postgraduate Fellowship Programme at Wits University aims to develop and sharpen a critical mass of skills in South Africa through supporting a new cohort of postdoctoral fellows who will specialise in Water Resource Management and Digitalisation, and work towards a Just Energy Transition. ARM will sponsor a R20 million endowment, which will be invested into perpetuity. The investment return on the endowment will be used to support research in the Faculty of Engineering and the Built Environment. ■



ARM sponsors R20 million into research at the University of the Witwatersrand.

Walkabout Resources on cusp of Lindi Jumbo plant completion

Graphite mine developer, Walkabout Resources non-executive chairman Mike Elliot, says 2024 is shaping up to be a transformative year for Lindi Jumbo and Walkabout Resources.

"We are on the cusp of plant completion, commissioning and production ramp-up. Our customers are impressed by the quality of our product and eager to integrate regular reliable supply of product into their supply chains. We now must deliver on those expectations." He noted that the Chinese graphite export permitting system had come into effect. "Since it was announced in October, Wogen has received an increasing number of enquiries from non-Chinese market participants looking for short and long-term secure supply of graphite concentrate. 100% of Lindi Jumbo production is currently unpriced, which puts it in the enviable position of being able to capture any price premiums emerging in the market. Sales orders being prepared for end customers often start with fully priced pilot orders to check that product quality matches tested samples. From there, regu-



Construction on the Lindi Jumbo project is nearing completion.

lar shipments are expected to be made. We expect our timing of production to be ideal

to capture improved pricing as predicted by market analysts." ■



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Sibanye-Stillwater begins repositioning its US PGM operations

Precious metals miner Sibanye-Stillwater, has given notice to its employees and contractors that it will be implementing a restructuring of its US PGM operations to reduce the operating and capital cost struc-

tures and ensure sustainability through a lower palladium price environment. The restructuring follows an initial repositioning for the changing macro environment with the subsequent antici-

pated decline in the palladium price and impact of ongoing inflationary cost pressures at the operations, necessitating a reduction in the cost structures. The restructuring is expected to affect approximately 100 Sibanye-Stillwater employees, the majority of whom are at the Stillwater Mine, with the remainder spread between the East Boulder Mine, the Columbus Metallurgical Complex and Columbus offices, as well as remote work locations. A significant number of contract workers other than essential services will also be impacted, with approximately 187 contract workers (69% of current primary mining contract workers) affected across the sites. Neal Froneman, CEO of Sibanye-Stillwater commented: "We have taken decisive action to address costs at the US PGM operations, to ensure the sustainability of these long-life operations during a challenging period of lower than anticipated PGM prices. This is not a decision we have taken lightly, and we will engage frankly and candidly with affected stakeholders during this challenging period. ■"



Sibanye-Stillwater operations in the USA.

Southern Palladium appoints Roger Baxter as non-executive chairman

ASX-listed Southern Palladium has appointed Roger Baxter as non-executive Chairman of the Board, commencing on 1 January 2024. Baxter was CEO of the

Minerals Council South Africa for over eight years, a position from which he recently retired. He led the complete brand rejuvenation, reputation enhancement and



Southern Palladium appoints Roger Baxter to its board.

modernisation of the Minerals Council enabling it to become a much more effective, strategically driven, agile, assertive and capable organisation. Baxter said: "My appointment to the Board of Southern Palladium presents a unique opportunity to engage with one of the few remaining PGM development projects of significance globally. The Bengwenyama project has several stand-out attributes and is now well advanced in terms of transitioning from exploration to development. I look forward to working with the team at Southern Palladium and contributing to the advancement of the project and of the company." ■"



A view of the company's flagship Bengwenyama project.

De Beers donates diamond sorting office in Kimberley to Sol Plaatje University

Diamond miner, De Beers Group, has announced that it is donating the Harry Oppenheimer House (HOH) building in Kimberley to the Sol Plaatje University following the January 2023 relocation of De Beers' Sightholder Sales business to Johannesburg from Kimberley, where it had been operating since 1974. The donation of the HOH building is part of De Beers' commitment to continue working with the Northern Cape government, key stakeholders and community organisations to support the socio-economic development of the province, the company said. De Beers has a long-standing relationship with the University, aimed at creating a clear pathway for academically minded young people in the Northern Cape. The relationship dates back to when the province was canvassing for a university to be established in Kimberley, with De Beers providing the necessary support towards this objective. The HOH building, valued at R54 million, played a pivotal role in the sorting and valuation of De Beers South



De Beers Group is donating the Harry Oppenheimer House building in Kimberley to the Sol Plaatje University.

Africa diamond production, and supporting diamond beneficiation in South Africa. The 53-metre-high building will be used as the main administration block and will serve as the strategic headquarters of the University. ■

Bell Equipment appoints Ashley Bell as new CEO

JSE-listed Bell Equipment has appointed Ashley Jon Bell (41), grandson of the company's founder Irvine Bell, as the new Group CEO effective from 1 January 2024. This follows the resignation in July of the outgoing Group CEO, Leon Goosen, who leaves the company on 31 December 2023 after 16 years of service, five and a half of which were spent as Group CEO. Bell is well acquainted with the company having served as a non-executive director on the Board since March 2015 and has provided valuable input as a member of the Board's Risk and Sustainability and Social, Ethics, and Transformation committees. A qualified commercial helicopter pilot, Ashley holds a degree in business management and previously worked for Bell Equipment, after graduating in 2007, assisting with product marketing management of the Bell Articulated Dump Truck (ADT) and Backhoe Loader ranges. Since then, he has jointly established and managed several successful businesses in various industries.

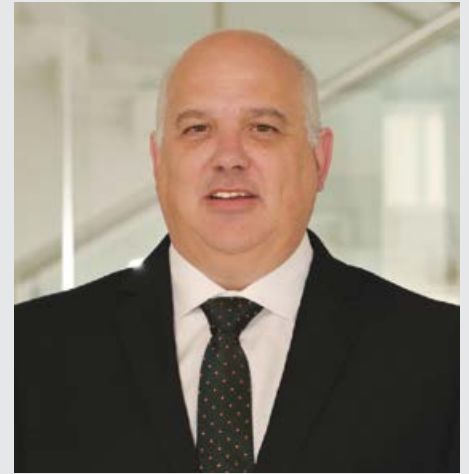
He also co-founded Matriarch Equipment with his brother, Justin Bell in



Ashley Jon Bell has been appointed as the new Group CEO for Bell Equipment.

2009. The company focused on developing innovative equipment for a wide spectrum of industries. Bell acquired Matriarch in 2019 as part of its strategy to revitalise its presence in the agriculture and forestry industries and its products now fall under the Bell brand. ■

Acquisition of Nama Copper Resources



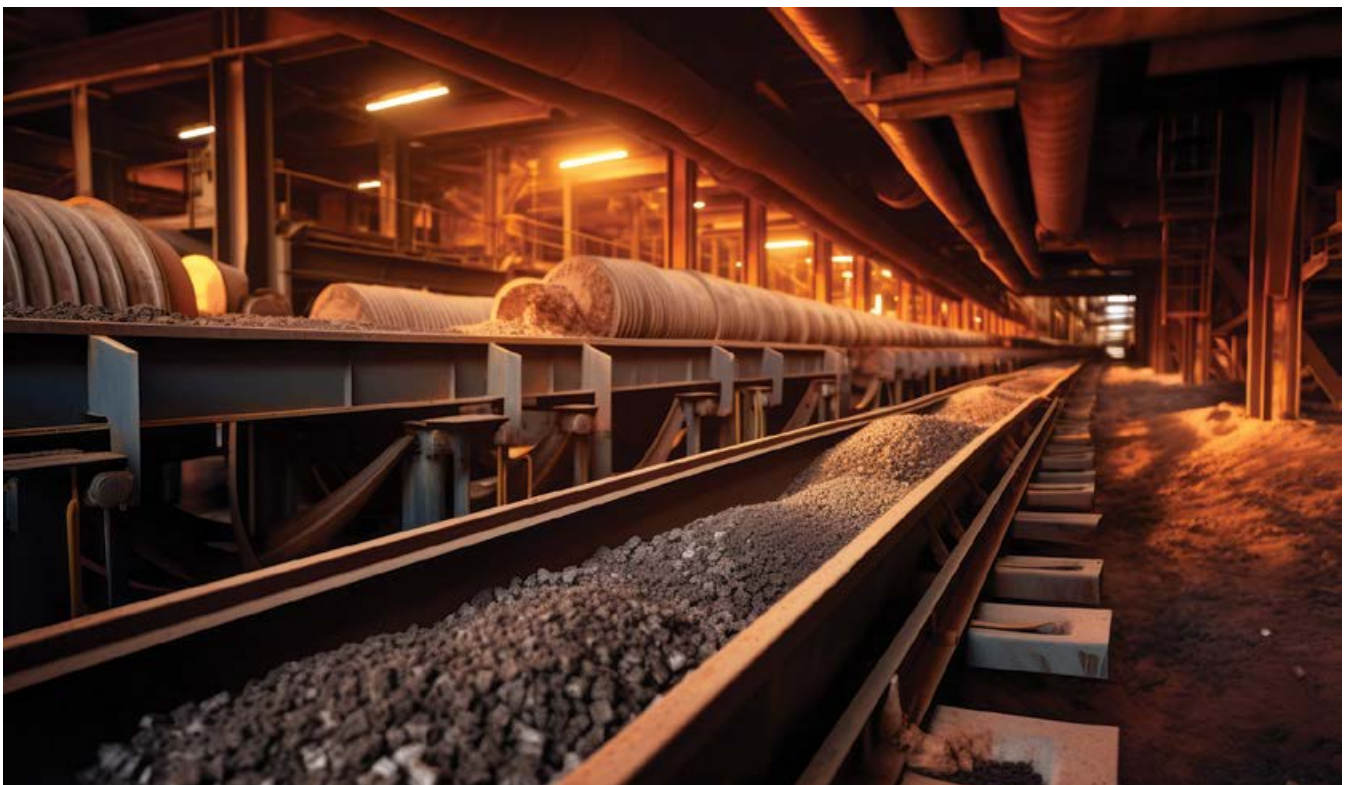
Copper 360 CEO Jan Nelson.

Copper miner, Copper 360 and Mazule Resources (Mazule), the shareholder of Nama Copper, have entered into an agreement to acquire all the shares and claims in Nama Copper for R200 million. The key benefit of the transaction is that it will significantly increase the company's copper concentrate production capacity and output, with the 2025 output more than doubling compared to original estimates. Jan Nelson, CEO of Copper 360 commented, "The acquisition of Nama Copper is a game changer for Copper 360. It allows us to more than double our concentrate production of 3,899 tonnes of copper metal per annum planned from the current concentrate plant, which is in the final construction phase, to 7,975 tonnes of copper metal per annum. The Nama Copper concentrate plant is fully operational and will increase production by 3,595 tonnes of copper metal. The Nama Copper plant will ensure that the revenue of R2,2 billion planned for the FY 2026 will now be able to be delivered in FY 2025. The ore feed for both plants will come from the Rietberg mine. In addition, the copper tailings resource being acquired represents between R12 billion and R24 billion in copper metal in the ground at a copper price of \$8,500/t and an exchange rate of R19.00/USD. It could result in a significant increase of the company's Measured and Indicated Resource category upon further confirmatory drilling. The sellers of Nama Copper have also agreed to a commercially competitive offtake agreement through one of its associate companies with Copper 360. Nama Copper is a copper producer located adjacent to Copper 360's operations in Nababeep. The effective date of the transaction will be the date of the First Tranche Payment being made. ■



Unleashing the Power of 5G: A Vision for Redefining Mining in Africa

The African mining industry stands as a cornerstone of the continent's economic landscape, driving growth and providing employment opportunities for millions. Yet, amidst its immense potential, the industry faces a multitude of challenges, including volatile market conditions, aging infrastructure, and a scarcity of skilled labour. To navigate these hurdles and embrace the digital transformation sweeping across the sector, MTN Business emerges as a trusted partner, committed to empowering mining companies with the cutting-edge technology of 5G Private Networks.





“5G Private Networks represent a paradigm shift in connectivity, offering a blend of speed, reliability, and security that traditional public networks simply cannot match. These dedicated networks, which can be tailor-made for mining operations, provide mining companies with unparalleled control over their network resources, ensuring seamless data transmission and uninterrupted operations,” says David Behr, Chief Executive Officer, MTN Business ICT Centre of Excellence

A Technological Leap Forward

5G Private Networks usher in a new era of mining, characterised by enhanced safety, increased productivity, and reduced costs. Real-time video surveillance, enabled by 5G’s ultra-low latency, equips mining companies with unparalleled visibility into their operations, enabling them to detect and address potential hazards before they escalate. Remote control of equipment, another transformative application of 5G, minimises the need for personnel to operate machinery in hazardous environments, significantly reducing the risk of accidents.

The transformative power of 5G extends beyond safety to the realm of productivity. Real-time data collection and analytics, facilitated by 5G’s high bandwidth, provide mining companies with actionable insights into their operations, enabling them to optimise production processes, identify areas for improvement, and make informed decisions in near real-time. This data-driven approach streamlines operations, leading to increased output and reduced downtime.

“5G’s impact on cost reduction is equally profound”, continues Behr. Predictive maintenance, empowered by the technology’s ability to collect and analyse vast amounts of sensor data, allows for proactive maintenance of equipment, preventing costly breakdowns and extending asset lifespans. Remote monitoring of equipment further enhances cost savings by minimising the need for on-site maintenance visits.

A Pioneering Force in 5G

MTN Business stands at the forefront of 5G innovation in Africa, possessing a deep understanding of the unique challenges and opportunities faced by the mining industry. Our expertise in 5G technology, coupled with our extensive experience in the mining sector, enables us to deliver tailored solutions that address the specific needs of each mining operation.

“Our commitment to excellence is evident in our successful partnerships with industry leaders,” Behr continues.



Canyon Coal’s Phalann dwa Colliery in South Africa serves as a prime example of MTN Business’s transformative impact. The mine has established a 5G-connected cool mine operation, pioneering the use of 5G applications in mining solutions. Similarly, Zijin Garatau Platinum Mine in South Africa has partnered with MTN to become the region’s first 5G-enabled smart metal mine, showcasing the potential of 5G to revolutionise mining practices.

Embrace the Future of Mining

MTN Business invites mining companies across Africa to join us in embracing the transformative power of 5G Private Networks.

“We offer a comprehensive suite of services, encompassing network design, deployment and management, and ensuring seamless integration into existing operations. Our team of experts is dedicated to guiding mining companies through the digital transformation process, helping them to identify and implement the right 5G solutions to unlock their full potential. Together, we can harness the power of 5G to redefine mining in Africa, enhancing safety, boosting productivity, and optimising costs, ultimately propelling the industry towards a brighter, more sustainable future,” concludes Behr. ■

Gold holds strong strategic advantage in 2024

By Juan Carlos Artigas, Global Head of Research, World Gold Council



Gold always has ready buyers.

Gold defied expectations in 2023, outperforming commodities, fixed income and many global stock markets.

Gold defied expectations in 2023, outperforming commodities, fixed income and many global stock markets. Its performance has caught the world by surprise, with prices reaching all-time highs, topping out at over \$2,100/oz in early December; and causing some market participants to predict that the only way is down. The outlook for gold in 2024 is more nuanced than this, however, and remains anchored in many of the drivers of its positive performance in recent years as well as new, emerging risk factors.

2023: Gold remains resilient

The performance of gold in 2023 has been unexpectedly positive, especially compared to many other assets. There are myriad reasons for this, but the critical thing to note is that the majority of drivers are long-term trends and could positively impact the gold market for years to come.

It's important to remember that gold is global and benefits from diverse sources of demand. Its unique characteristic of being both a consumer good and an investable asset means it performs well – in good and bad times. During periods of economic uncertainty, it is the counter-cyclical investment demand that drives the gold price up. During periods of economic expansion, the pro-cyclical consumer demand supports its performance.

Taking stock of 2023, it's been a year characterised by uncertainty. Central banks have kept interest rates high in the battle against inflation which is typically a headwind for gold. However, despite the rate environment, gold has outperformed many other assets – primarily due to extraordinary central bank



Gold has a proven track record as a crisis hedge.

buying of gold, heightened geopolitical tensions around the world and, more recently, expectations of rate cuts in 2024. Let's dig a bit deeper into these trends.

Colossal central bank demand

Probably the most talked about topic in the gold industry this year has been the significant step up in buying by central banks since the second half of 2022. While the volumes reached new highs, the trend is not new. Central bankers have been net buyers of gold for nearly 14 years. Having witnessed the global financial crisis, central banks are well aware of the positive effects of holding gold in their reserve portfolios through volatility and economic hardship. But what has been driving their increased appetite for gold, especially given that they have been net buyers of gold for over a decade?

We know from our annual central bank survey that the top three factors driving reserve managers' decision making are inflation concerns, interest rate levels and geopolitical risks. With that in mind, it comes as no surprise that central banks and other buyers turn to gold as a proven diversifier and hedge against the effects of inflation as well as a means to mitigate geopolitical uncertainty. In fact, it is estimated that central bank demand added 10% or more to gold's performance in 2023 and, even if 2024 does not reach the same heights, above-trend buying should still offer an extra boost to the gold market.

Geopolitical risk rising

Historically, gold has a proven track record as a crisis hedge, thanks to its lack of credit risk and negative correlation to risk assets. Globally, geopolitical risks have increased significantly since the start of the pandemic. There are the obvious peaks of



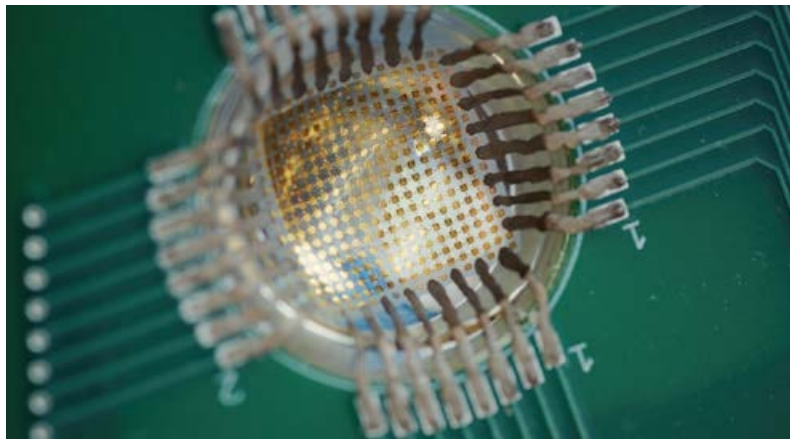
uncertainty, such as the Russian invasion of Ukraine and the more recent Israel-Hamas war. But the drumbeat of geopolitical risk in the background has increased too. International trade tensions, activity in the South China Sea and the outlook for Taiwan have also contributed to a widespread appetite for gold. With unresolved conflicts spilling into 2024 – it is likely that the geopolitical risk premium will remain in place for gold.

The end of tightening is near

High interest rates increase the ‘opportunity’ cost of holding any asset – including gold. It should come as no surprise that, historically, US Fed tightening cycles coincide with periods of lower gold returns. Of course, interest rates are not the only factor that influences gold but they certainly carry weight. On the flip side, as the Fed stops hiking rates and the market expects them to cut rates eventually, this can also generate positive momentum for gold – which is another reason supporting gold’s performance in recent weeks.

Pockets of strength in the physical gold market

Beyond the stand out factors supporting gold in 2023, we should also consider its resilience from diverse sources of demand. Again, the global nature of the gold market comes to the fore as we see some gold markets and sectors of demand offset weakness elsewhere. For example, gold bar and coin demand has declined in Europe (and in particular Germany) but in the US, Turkey and China we have seen an uptick in demand for bullion, keeping y-t-d above its 5-year average. Similarly, global jewellery demand held 4% above its 5-year average which is impressive, especially in a period of high prices and



economic uncertainty which tends to dampen consumer spending.

Gold is global and benefits from diverse sources of demand.

2024 Outlook – Is the ‘soft landing’ overplayed?

Turning to 2024, we look at the performance of gold in three different scenarios that could play out in the US, likely influencing the global economy. Currently, financial markets are banking on the idea that a soft landing – where the US Fed is able to bring inflation down to target without an economic contraction. The reality is that a soft landing is an extraordinarily difficult outcome for central bankers to engineer -- there have been only two soft landings out of nine tightening cycles since the 1970s. And while it remains a possible outcome for the US and the global economy in 2024, so is a recession, and even a ‘no-landing’ scenario.

In the event of a recession or hard landing, the outlook for gold is positive as investors seek the certainty of its diversification and liquidity. On the other hand, gold has had lacklustre returns during previous soft landings. However, both central bank demand and geopolitical risks will continue to play a role in 2024, which could make for a resilient performance from gold in a soft-landing scenario. There are fully 74 global elections scheduled in the upcoming year, with more than 40% of the world’s population set to vote. And ongoing conflicts left unresolved will mean investors will be more likely to keep hedges in their portfolios. In addition, central banks are likely to keep buying gold and, even if purchases don’t reach the same level as this year, above average demand can provide additional support to gold’s performance.

History teaches us a valuable lesson

The economic and geopolitical risks aside, history teaches us one simple lesson – gold always has ready buyers, whether amongst institutional and retail investors, or the enormous international gold and jewellery market. There are many known unknowns in 2024, but through good times and bad times, one portion of the market always finds a purpose and an attractive price for gold. ■

PGM Outlook for 2024

by Edward Sterck, Director of Research, World Platinum Investment Council



Edward Sterck, Director of Research, World Platinum Investment Council.

The platinum market has entered a period of sustained deficits, with our supply and demand data estimating a record deficit of 1,071 koz for 2023, and a second consecutive deficit of 353 koz forecast this year. Beyond 2024, WPIC's most recent Two-Five-Year Supply/Demand Outlook indicates further platinum market deficits continuing each year through to 2027.

Last year saw exceptionally strong year-on-year total demand growth of 26 per cent to 8,150 koz, far exceeding weaker supply, which dropped three per cent year-on-year to 7,079 koz, resulting in a substantial swing to a major market shortfall.

While this year will not see a repeat of the demand achieved in 2023, total demand is nevertheless expected to come in at 7,663 koz. While this is a six per cent year-on-year reduction, it nevertheless demonstrates resilience in the face of what is likely to be a continuation of the challenging economic environment of recent times and is expected to outstrip supply. Total supply is expected to show a modest three per cent growth, remaining well below pre-Covid levels at 7,310 koz, some nine per cent lower than average annual supply in the five years prior to 2020.

The stellar demand of 2023 was driven by buoyant automotive and industrial demand, which is expected to continue into 2024, albeit to a lesser extent. Last year, automotive demand for platinum grew by 14 per cent to reach 3,262 koz as a result of higher-than-expected vehicle sales alongside some 640 koz of substitution of platinum-for-palladium in gasoline vehicles and higher overall loadings, particularly in the heavy-duty and off-road vehicle categories. This year platinum-for-palladium substitution is expected to hit around 700 koz and will remain a key factor in overall platinum automotive



Platinum demand in 2023 was driven by buoyant automotive and industrial demand.

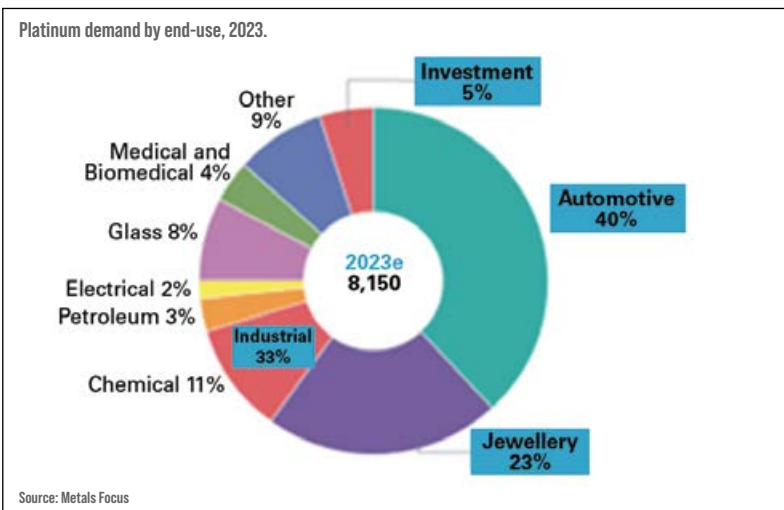
demand growth, which is expected to be around two per cent, reaching its highest level since 2016 at 3,312 koz, despite an expected decline in production of internal combustion engine (ICE) vehicles from 78 million in 2023 to 77 million in 2024. The slowing in ICE production reflects battery electric vehicle (BEV) gaining market share, albeit we believe that the pace of BEV penetration is slowing.

Looking at automotive demand in relation to the palladium market, based on our research the market remained in an estimated deficit last year at 600 koz, with total demand of 9,796 koz and automotive demand of 8,107 koz, both essentially flat on the previous year.

The palladium market is set to record a further, albeit much reduced, deficit of around 106 koz in 2024, with modest total demand and automotive demand growth of almost one per cent and almost two per cent, respectively. Thereafter, looking through to 2027, we expect the palladium market to transition to consecutive and increasing surpluses, reaching a forecast 897 koz surplus by 2027, due to a 1.2 Moz increase in palladium recycling supply between 2022 and 2027.

Although there are risks to palladium recycling growth, assuming it is delivered as forecast and palladium enters a surplus from 2025, this would likely result in a reversal of current trends, with palladium being substituted for platinum in autocatalysts. Positively, this frees up platinum for use in rapidly-growing green hydrogen applications, meaning that platinum availability is less likely to be a bottleneck to the growth of this key energy transition technology.

Last year was the strongest year for platinum industrial demand on record, surging 14 per cent year-on-year to 2,652 koz, propelled by significant capacity expansions in the glass and chemical sectors. While industrial demand is forecast to fall 11 per cent in 2024 due to fewer capacity additions, it will nevertheless be the third-highest level on record





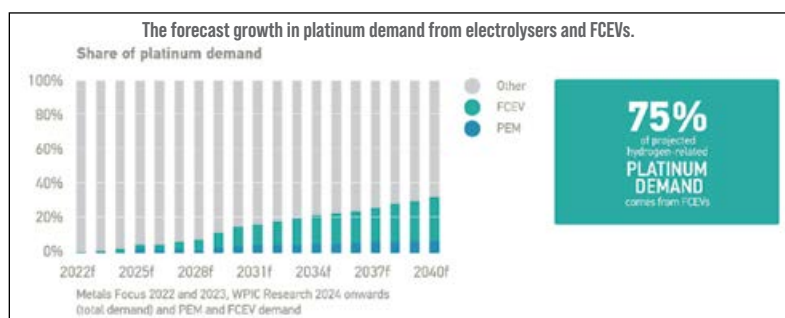
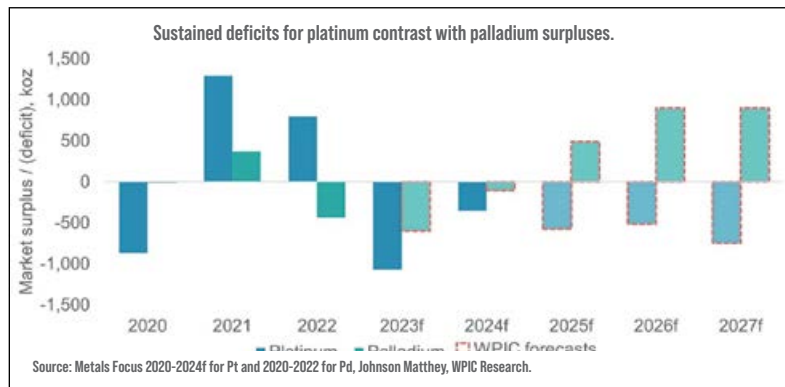
at 2,367 koz and remains some 14 per cent higher than average industrial demand since 2013. The fact that the 2024 forecast for industrial demand still represents a compound annual growth rate of 3.7 per cent since 2013 demonstrates the benefit of the built-in resilience provided by platinum's diversity of end-uses.

The platinum jewellery market continued to face headwinds in 2023, with demand declining three per cent year-on-year to 1,852 koz as growth in Japan and India was offset by weakness in the major China market, as well as North America. However, the ongoing reduction in jewellery demand is expected to stabilise this year, suggesting a floor has been reached, with a modest three per cent growth expected driven by India, Japan and China as the cost-of-living crisis abates.

Investment demand for platinum was estimated at 385 koz in 2023, a substantial improvement from negative demand of 640 koz in the previous year. In particular, bar and coin investment grew by 36 per cent to 305 koz, primarily due to a positive turnaround in Japan after three years of net disinvestment. Holdings in exchange traded funds saw net inflows of 50 koz.

The outlook for investment demand this year is more challenging and needs to be considered in the context of the prevailing high interest rate environment that has weighed on demand for non-yielding assets. A negative 170 koz swing in ETF flows and a drop in bar and coin investment to 172 koz is expected. Overall, investment demand will stay in positive territory at 82 koz, and we believe there may be the potential for upside should interest rates begin to fall more quickly than our forecast anticipates, or investors find consecutive deficits an incentive to increase holdings.

Supply constraints in mining and recycling persist. Global platinum mine supply was more-or-less flat in 2023 at 5,608 koz, remaining around eight per cent below the five-year pre-Covid average production



level. Challenges remain, such as the potential for a worsening of the electricity shortage in South Africa, but investment in processing infrastructure, as well as asset optimisation, have seen the negative impacts of this largely contained so far.

For 2024, platinum mine supply is forecast to grow three per cent year-on-year to 5,743 koz, with a five per cent improvement in South African output expected. However, this modest growth could well be eroded should miners continue to reassess production plans and restructure operations in response to continued pressure on the platinum group metal (PGM) basket price after significant declines in the price of both palladium and rhodium.

Global platinum recycling fell to 1,471 koz in 2023, 13 per cent below the already reduced level of the prior year, due primarily to a shortage of end-of-life vehicles as consumers are driving existing vehicles for longer and as scrappage yards accrued spent units in the face of weak PGM prices. While global platinum recycling is expected to increase by seven per cent to 1,567 koz this year, downside risk remains should these trends continue.

Looking further ahead, platinum stands to benefit from an emerging new demand segment as its use in the hydrogen economy grows; last year electrolyser demand alone grew by 250 per cent, albeit from a very small base. This builds on platinum's established economic importance due to the role it already plays in terms of reducing energy consumption and harmful emissions, not only through its use in autocatalysts, but also in industrial applications. By 2030 demand from platinum's use in fuel cell electric vehicles (FCEVs) and electrolysers will be meaningful, and by 2040 it could potentially be the largest segment of platinum demand. ■



The global diamond industry in a state of depressed demand

By the State Diamond Trader

The diamond industry is undergoing a significant period of change as pressure mounts from various fronts. The challenges are mostly characterised by the rise of lab-created diamonds, geopolitical instability, changing consumer mindsets, a rise in environmentalism, and global economic inflation.

Global diamond market conditions continued deteriorating through the year due to micro and macro-economic factors. External to the diamond industry has been the rise in global inflation triggering surging interest rates in most economic regions. The combination of these economic factors has weakened consumers' disposable income.

Notably, in 2022 lab-diamond jewellery surpassed

Global diamond market conditions continued deteriorating through the year.



The diamond industry is undergoing a significant period of change as pressure mounts from various fronts.

the 10% mark of total global diamond jewellery sales for the first time. This figure is expected to expand as lab-diamond jewellery sales are forecast to continue growing at an annual double-digit percentage rate in the coming years. That said, in the medium and longer term, lab-grown diamond sales as a percentage of natural diamond sales will likely be less as production of these increases and prices drop.

The natural diamond industry has also been negatively impacted by the rise in popularity of lab-grown diamonds. The threat of such an alternative market is a major contributor to falling prices, disturbance of supply and demand, and creates general confusion in the minds of the millennial consumer.

Consequently, the natural diamond industry has been overburdened by the inability to dispose of polished inventory prior to the downturn in the market. A leading diamond producer was reportedly combining its near-term sights, thereby reducing the number of sales in 2023 owing to the lackluster market demand for rough diamonds. As a result of the softened demand, another diamond miner deferred its Tender from June until August, hoping for stronger seasonal demand. This follows the withdrawal of a portion of its Tender 5 goods in May 2023, which were predominantly higher-value goods.

Despite challenges and interventions from the major producers, the festive season presented the industry with a lot of optimism, together with the anticipation of the Chinese New Year and Valentine's





India is a major diamond processing country.

Day sales preparations. However, the global diamond industry finds itself in a precarious state, following the weak 2023 Hong Kong Jewellery and Gem Show, albeit the activity was in line with participants' low expectations, the reality is that there is weak mainland demand amid an economic slump.

According to Rapaport, (a provider of independent diamond and jewellery industry news and analysis) suppliers reported minimal sales of polished under 5 carats. Larger, high-value stones saw some movement, as high-end brands and wealthier consumers continued to buy, but these deals were still limited, exhibitors said. Smaller Asian markets such as Singapore and the Philippines offered some sales. This puts a strain on the market as the Hong Kong show is generally viewed as the market check for events leading up to the festive season.

In general, trade in different diamond centres is challenged and under extreme pressure. India, a major diamond processing country, considered halting rough imports for a period of two months ending December 2023 in the hope of alleviating the polish inventory in the diamond pipeline.

Rough production

The G7 countries account for almost 70% of the world diamond jewellery consumers market and are in the process of introducing mechanisms to stop the flow of Russian diamonds from entering G7 countries as of January 2024. Industry players are concerned that this will be parallel to that of the Kimberly Process mechanism. Alrosa, the Russian rough producer accounts for about 30% of global rough production. This development has been met with mixed sentiments in the market globally and it remains to be seen whether supply disruptions will make any reasonable impact on rough diamond prices, market stability and the supply and demand curve as it pertains to the natural rough diamond industry. This development, some might argue, is not what the diamond industry needs at a time when the industry is experiencing the current sluggish state.



The natural diamond industry has been negatively impacted by the rise in popularity of lab-grown diamonds.

Forecasting

There remains an important need for differentiation between natural diamonds and lab-created ones. To counter the negative impact of the lab-grown ones, the natural diamond industry has to employ an aggressive marketing approach, but that will require a significant increase in necessary spending on this critical aspect.

The natural rough diamond industry must improve supply chain transparency, provide traceability, and promote responsible sourcing mechanisms that will drive consumers' confidence and understanding that natural polish diamonds are an investment purchase.

The price and commodity correction will require collaboration throughout the diamond value chain, ensuring that all the players in the different streams act responsibly and allow for profitability throughout. The natural diamond industry has shown its resilience over the years in the face of adversity. ■

SDT

The State Diamond Trader is a state-owned entity established in terms of Section 14 of the Diamonds Amendment Act, 29 of 2005. The company is eligible by law to purchase up to 10% of the run of mine from all diamond producers in South Africa.

Rail status will dictate the performance of

By Vuslat Bayoglu, Managing Director of Menar

South Africa's coal industry will go into 2024 carrying a bag filled with promises from government to fix the Transnet impasse and congestion at the country's ports. For the most part it appears that these issues have been a dominant factor in derailing, in the literal sense, the industry from reaching its true potential. Coal exports hit record lows during 2022 and 2023, as miners struggled to move product to the ports via rail. Shipments for coal at the Transnet terminal fell to 46.5 million tons in 2023, from 50.4 million tons in the previous year.



Vuslat Bayoglu, Managing Director of Menar.

Following his recent visit to the Transnet Port Terminal in KwaZulu-Natal, President Cyril Ramaphosa made some promises including dealing with port congestion along with the shortage of locomotives, incompetence, and a leadership vacuum.

In addition, things are unravelling at Transnet and the Richards Bay Coal Terminal has been performing far below its 91 million tonne capacity with daily rail deliveries dropping from 32 trains to 18. Ramaphosa emphasised that the private sector would play a pivotal role in finding a solution. If these promises are kept, the industry stands to be much better placed to achieve growth and stability.

The ability to resolve these impediments will be a major deciding factor in how the sector performs going forward. The impact of the rail crisis pales in comparison to other factors such as geopolitical shifts, global green energy trends and price volatility. We cannot even begin to speak about global market behaviour if we are struggling to move cargo across our shores.

In the background of South Africa's rail woes, global markets continue to assume a different shape with strong growth in Asia and dwindling demand in the US and Europe. In 2020 the International Energy



Agency (IEA) forecasted that coal's future would rely heavily on the behaviour of countries like China, India, Indonesia, and Pakistan. Fast forward to 2023 and market trends seem to support this projection, with China, India and the ASEAN region expected to account for 76% of the world's coal consumption in 2024.

The challenges associated with discarding fossil fuels like coal became apparent during the July G20 Energy Transition Ministerial Meeting in India, where Ministers from some of the world's biggest

Below right: Operations unfolding at Canyon Coa's Khanye Colliery in Bronkhorstspuit, Gauteng.

Below: Coal being loaded at the Kangra mine siding in eMkhondo, Mpumalanga.



SA's coal exports



Above: The Mngeni Shaft at the Zululand Anthracite Colliery in KwaZulu-Natal.

Left: Yellow machinery during operations at the Kangra mine in eMkhondo, Mpumalanga.

economies failed to agree on the big phaseout. Later in the year, G20 could only agree on tripling renewables by 2030, but showed no collective commitment to cut down on unabated fossil fuels. This division of opinion is telling. Beyond the statistics, there lies a genuine desire from emerging nations in Africa and Asia to achieve mega industrial growth. They too want to secure the economic growth their Western counterparts achieved over centuries, through burning coal.

It is nearly impossible to speak about coal without

mentioning green energy. This is because of a misguided narrative that, pitting one against the other, positions coal as a menace to society and renewables as the hero that will save the day.

Unfortunately, this line of thinking has influenced policy in many parts of the world, leading to planned closures of coal mines and coal-fired power stations. This school of thought denies the possibilities of maintaining a balanced energy mix that involves fossil fuels and renewables. It is an all-or-nothing approach, which is risky given the intermittent nature of renewables and the overall shortage of infrastructure to ensure the energy is delivered. Coal plays an important role as baseload. For decarbonisation to work we need baseload, which can only come from coal, gas or nuclear.

In the last quarter of 2022 and going into 2023, coal prices had begun to slow down from the hike caused by the Russia-Ukraine war. Detractors became excited, linking falling coal prices to its final demise. Nothing could have been further from the truth. Prices remained higher than pre-Covid times representing a form of predictable stability in the market. After surviving three turbulent years starting with the Covid-19 pandemic in 2020, prospects still look favourable for coal beyond 2023.

As a player in the coal industry, South Africa's export prospects were hurt by rail constraints, which have cost the country more than R350 billion in exports revenues for 2023. If the situation is not resolved, as promised, the country should expect to continue losing out on opportunities. The longer the Transnet situation lingers, the more coal exports in South Africa are prevented from leaving the country's shores at a favourable rate for producers and the country's economy. Asia is a top destination for SA coal, importing more than 80% of its product, according to data from RBCT. The country is likely to suffer further opportunity losses should rail and port issues persist, even though coal's performance globally is likely to remain strong. ■



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Setting the bar high

Modern Mining's Top Projects for 2024 are distinguished by their whopping price tags, sheer size, value to the economy and the job market. This year we have selected projects from different commodities – gold, platinum group metals, diamonds and coal – that have set the bar high.

They include Pan African Resources Mintails assets; Platinum Group Metals' Waterberg PGM project; diamond miner, De Beers Venetia Underground Project (VUP); and Canyon Coal's Gugulethu Colliery.

In a deal valued at a whopping R50m, Pan African Resources secured the take-over of the Mogale Gold and the Mintails SA Soweto Cluster in the latter part of 2022. The gold miner has an ongoing strategy to re-process historical tailings dams, which makes the area safer and greener, while generating economic benefits for the communities and generating significant profits at current gold price levels. The company anticipates a life-of-mine at Mintails of around 20 years, with annual production estimated to average around 50 000 oz/year.

Platinum Group Metals' Waterberg operation, located on the Northern Limb of the Bushveld Complex, is set to be a large scale, low cost PGM development that will deliver key metals, including palladium, platinum, gold and rhodium. The project has a number of highly attractive characteristics, such as being a shallow, bulk mineable project with significant scale and growth potential. To date, an early work programme has been implemented, which includes an early infrastructure plan intended to significantly de-risk the future construction of the project. With a projected annual production rate of 420 000 ounces, the Waterberg project has a mine life of 45+ years.

The VUP, which on 30th June achieved a major milestone with its first blast, is over 72% complete on its infrastructure development with De Beers on-target for production ramp-up and project completion by 2028. The miner is ramping-up from current production of roughly 12 000 tons achieved in October 2023 to just under 2 million tonnes in the next two years. The mine is expected to produce up to 5.9 million tonnes of kimberlite ore annually, to be used in the extraction of nearly 4.5 million carats of diamonds per year. VUP is positioned as a modern operation implementing latest technologies to meet its carbon emissions agenda.

Gugulethu Colliery in Mpumalanga – Canyon Coal's newest multi-million-rand investment – will begin first production in early 2024. The mine was among the investment projects pledged at the 2023 SA Investment Conference lead by President Ramaphosa. The first phase of the Gugulethu project is expected to produce 2.4 million t/y of coal, of which 1.2 million t/y will be export quality of 5 500 kc NAR coal. The second phase is expected to commence in 2030, after the conclusion of the open cast reserve. ■





Hethen Hira, Head of Investor Relations & Communication at Pan African Resources.

Pan African's tailings re-treatment

Having acquired the Mintails assets, Pan African's ongoing strategy to re-process historical tailings dams is expected to make the area safer and greener, while generating economic benefits for the communities and generating significant profits at current gold price levels.

Last year, Pan African Resources commissioned an independent definitive feasibility study on the Mogale Gold tailings storage facilities (TSFs), which demonstrated a compelling commercial project. In fact, it has been projected that Mintails could increase the Group's current annual gold production by some 25%.

According to Hethen Hira, Head of Investor Relations & Communication at Pan African Resources, in November 2020, the company announced agreements to acquire the tailings assets for R50 million – approximately \$3 million at the time. The assets comprised historic TSFs, or mine dumps, that were the residue from underground gold mines mined in the West Rand since the early 1900s. These assets were previously owned by Mintails Mining SA, which has been in provisional liquidation since 2018.

"We have estimated, based on historical information and confirmatory drilling work, that there are some two million ounces of low-grade gold in the TSFs, contained in around 240 mt (million tons) of material, grading at 0,3 g/t of gold," he notes.

"Given the low amount paid for the resources and based on preliminary calculations for capital and processing costs around Pan African's flagship existing tailings re-treatment operations at Elikhulu,

in Evander, an expected return in excess of 20% is estimated. This should be even higher if the gold price increases."

Hira adds that the company's tailings operations are hugely profitable, given the low all-in sustaining cost (AISC) of production of around US\$1 000/oz. In addition, the company anticipates a life of mine at Mintails of around 20 years, with annual production estimated to average around 50 000 oz/year. The processing plant has a design capacity of 800,000 tons per month, similar to that of Elikhulu.

"All gold companies continually look to increase their annual production and resource base. The Mintails assets are of the last remaining surface sources for gold in the country and would add some 50 000 low-cost ounces to our annual production for the next 20 years."

More crucially, these are also mined safely, without any of the risks as involved with underground mining. And in reducing the footprint of tailings dams, there is also the added safety factor that the modern facilities will not likely be prone to structural faults that lead to dam collapses.

Fast payback

Hira reminds us that with the AISC to produce an

Pan African Resources tailings operations are hugely profitable, given the low all-in sustaining cost (AISC) of production of around US\$1 000/oz.



projects: safer, greener and more profitable



ounce of gold from Pan African's other tailings re-treatment facilities sitting at around US\$1 000, profit margins are favourable with a gold price currently somewhere between US\$1 800/oz and US\$1 900/oz.

"By our estimates, the capital cost of around US\$135 million can be paid back within three or four years. This will leave the remaining life of operation to contribute to further growth of the company, through acquisitions, as well as returns to shareholders through dividends."

"Remember that underground mining generally produces gold at a cost of around \$1 400/ounce, as the costs here are much higher due to the infrastructure and underground development required. However, the tailings are mined using hydraulic mining methods and a low labour requirement which significantly reduces the costs, leading to improved returns," he says.

The company is well placed to ensure it obtains the greatest value from this project, thanks to significant experience gained in this arena already. Initially, notes Hira, the company commenced tailings re-treatment at its Barberton tailings re-treatment plant (BTRP), where there was significant historic tailings material, left over from more than 100 years of mining by previous operators.

The BTRP commenced production in 2013 and capital costs were paid back in 18 months, with the added benefit that re-treatment and consolidation of the new tailings into a modern facility, one with a smaller footprint and up-to-date safety standards, created a win-win situation for the company, the environment and the surrounding communities.

"Since then, we have acquired the Evander Gold Mines, with its abundant historic tailings deposits. Here the Elikhulu tailings retreatment operations were constructed within a record 12 months, and

have an expected remaining life of mine of around 10 years. This operation was commissioned in 2018, at a cost of US\$120 million, and was paid back in under three years."

"With such experience already, Mintails was always on our radar, and an offer was made once there was clarity on the valuation, following the liquidation of the previous owners. This is one of the last remaining tailings deposits of its size, so we recognised the impact it would have for Pan African shareholders and community stakeholders, as well as the environment and the local and regional economy of the country."

Improved safety

These historic TSFs will be reprocessed and re-deposited into modern facilities with smaller footprints and according to modern deposition standards, he says, in line with the Global Industry Standard on Tailings Management (GISTM) guidelines.

"Modern reagents and safer treatment processes play a big part in our safety efforts. Thanks to the application of modern standards, we can say that the reprocessing of tailings today is much more environmentally friendly. For example, at Mintails much of the reprocessed material can be deposited underground in the mined out areas – while the new surface dams will be properly lined, negating any concerns around ground water contamination."

This limits the danger of breaches affecting the surrounding communities, and also reduces the current levels of air and water pollution, as shown by detailed environmental studies undertaken as part of the definitive feasibility study. Mintails has permission to deposit some of the reprocessed material back into the historic mine workings, which will result in them being made inaccessible and thus also

Pan African's ongoing strategy to re-process historical tailings dams is expected to make the area safer and greener.



The historic TSFs are being reprocessed and redeposited into modern facilities with smaller footprints in line with modern deposition standards.

reduce the threat of illegal mining activity.

“With regard to safety processes,” Hira continues, “Pan African has taken proactive measures and has conducted internal and independent external audits and studies over the past two years, to evaluate its TSF management relative to the GISTM. Subsequently, independent tailings review board (ITRB) was appointed to conduct a formal audit of the Group’s TSFs. Comprised of three suitably qualified independent members, the ITRB conducted site visits to the TSFs, followed by the issuance of an assessment report with findings being reviewed and implemented.

“Pan African prioritises effective tailings dam management across its operations. At each TSF site, a competent person within the context of a recognised tailings management company is appointed to oversee monitoring and compliance with legislation, as well as the Group’s internal codes of practice.”

In line with the GISTM recommendations, Hira points out that Pan African has appointed:

- ❑ an executive accountable for tailings management in June 2022
- ❑ a tailings facility engineer in June 2022, responsible for the robust management of the TSFs
- ❑ Barberton Mines’ engineer of record, to serve as Evander Mines’ engineer of record.

Considering that the majority of Pan African’s TSFs were constructed before the introduction of the GISTM, Hira explains that the Group has actively engaged in ongoing assessments to identify and address any compliance deficiencies to the extent reasonably practicable.

“Pan African is committed to working collaboratively with stakeholders to ensure the

implementation and maintenance of statutory TSF management standards. Action plans and remedial activities identified through internal and external reviews are continually being implemented to mitigate high-risk safety and environmental concerns. With these actions, we aim to ensure safety compliance for our mining operations, employees and the surrounding communities,” he says.

Construction and impact

Describing the initial phase of the project, Hira states that this involved the acquisition of properties for the construction of the plant, which has a capacity to process in excess of 800 000 tonnes/month of tailings material.

“There will be nine leach tanks and related plant infrastructure, including a smelt house, which will all be highly automated. Construction commenced in July 2023 with site clearing, and it is anticipated some 300 to 400 people will be employed directly during construction. These will mainly be members of the local community, except where specialist skills are required.”

All equipment and contractors will be secured locally and the overall cost is anticipated at R2.5 billion, much of which will be spent locally and in Gauteng. All required buildings and services will be contracted to local companies. Thereafter, the plant is expected to employ up to 500 people in the operational phase for the next 20 years.

“Pan African has already commenced with an engagement process with representatives from both the local community and government, with regard to the needs in these communities. These will be formulated into our social and labour plans, where



Mintails Plant Site.

community local economic development and skills development projects are concerned. We will also commence with business incubation for local small businesses,” he adds.

“In the short term, we will look at assisting local community organisations and schools in need of assistance - where we can make an immediate positive impact. During October, the company assisted two schools in Kagiso with furniture and supplies to alleviate overcrowding and assist with learning camps for the upcoming matric examinations. Engagements are ongoing. We will also seek to implement agricultural projects as land becomes available, following rehabilitation, and replicate the success we have achieved at our blueberry farming project in Barberton, which employs up to 300 seasonal workers.”

What comes next?

Hira explains that the current life of mine is anticipated as 20 years, from the end of 2024. As explained above, there will be concurrent rehabilitation of the TSF sites, and land will become available for alternate use, such as housing or agriculture.

Environmental studies by independent consultants indicate an expected marked reduction in groundwater contamination, following the re-processing and re-deposition of the tailings and neutralisation of acidic water through re-treatment during processing. The company is also looking at constructing a 10MW solar renewable energy plant on site.

“One of the key hindrances to the development of the project was the high anticipated cost of environmental rehabilitation, chiefly due to negligence

and abandonment by the previous operators, as well as from illegal mining. Pan African has come to an agreement with the authorities on the best course of action, and will concurrently rehabilitate the contaminated footprint areas,” he says.

“Extensive consultation and studies from independent environmental consultants has revised the outstanding liability requirements. Concurrent rehabilitation will see much of the area cleaned up, with a resultant decrease in air pollution, as sand will no longer be blown from the poorly vegetated old tailings deposits. Water quality will also improve, as seepage from the new tailings will be avoided. The rehabilitated land will be made available for alternate, more productive economic land use, such as a similar agriculture project to the one established in Barberton.”

He points out that at R2.5 billion, its tailings focus is one of the largest investments to take place in Gauteng in recent times. The province has attracted minimal investments of this scale, explains Hira, and there are not many foreseeable in the near future.

“Pan African has secured this amount upfront for the construction of the project, which greatly reduces execution risk. The company also has a track record of developing tailings retreatment projects as already mentioned, and is committed to using local labour, contractors and small businesses.

“This is a further economic boon to the area, which has seen very little economic stimulus in recent times. And of course, with the operation anticipated to have a life of over 20 years, we will have time to implement a number of alternate sustainable economic initiatives, to ultimately ensure the long-term economic benefits for the entire region,” he concludes. ■

Gugulethu Colliery – Canyon Coal’s newest multi-million-rand investment

South African coal miner, Canyon Coal, a subsidiary of private investment company, Menar, will begin first production from its Gugulethu Colliery in Mpumalanga, in early 2024. This will be a major milestone for the Greenfields project, which set the miner back a whopping R600 million in capital invested, Gugulethu Colliery GM Jarmi Steyn tells *Modern Mining*.

Formerly known as De Wittekrans, Gugulethu, located southeast of Hendrina, is a project acquired out of business rescue. Canyon Coal’s newest venture aligns “perfectly with the company’s overall expansion drive of developing completely new projects – this is in addition to acquiring operational mines”.

According to Steyn, Canyon Coal seeks to invest in projects that yield high-quality products to cater for export and local markets.

“The development of the mine is happening at an opportune time as export opportunities for coal miners are opening in emerging Asian markets. The high-quality washed coal from Gugulethu will be perfect for global markets,” she says.

“The project,” she adds “was developed from scratch, and we have been able to reach significant milestones in under 12 months. Moreover, in the current economic climate, where people are most in need of job opportunities, a project like Gugulethu will contribute to alleviating unemployment.”

The mine’s presence in the community will create jobs, support local enterprise development, and bring skills training opportunities, says Steyn. “We believe this investment illustrates that, despite the numerous challenges South Africa’s economy faces,

An aerial view of the box cut pit at Canyon Coal’s Gugulethu Colliery in Mpumalanga.



Gugulethu Colliery’s GM, Jarmi Steyn has led the mine’s development from inception.

it is still possible to invest in new ventures. The mine was among the investment projects pledged at the 2023 SA Investment Conference lead by President Ramaphosa.”

The first phase of the mine will create more than 200 jobs, with priority given to residents of the host community. When fully operational, the mine will create a total of 430 jobs.

Project development

Gugulethu’s operations will unfold in two phases over its 20-year life of mine, with the first phase comprising three open cast pits and processing plant and the second phase consisting of underground operations scheduled to take place in seven years’ time.

A total of R600 million has been injected into Gugulethu Colliery. Phase 1 of the mine holds a reserve of 14.3 million tons of run-of-mine (ROM) coal. It also consists of three pits, one of which has been specifically designed to gain access to the underground reserve part of Phase 2. The second phase is expected to commence in 2030 after the conclusion of the open cast reserve.

By October, the coal miner was well on track to meet its scheduled activities, having advanced work on the box cut, which it had started mining in May, 2023.

“The topsoil and soft soil have already been removed, and blasting has commenced. The construction of the processing plant, which was refurbished and transported from Canyon Coal’s decommissioned Hakhano mine in Middelburg, is also in its advanced stages and will be functional in time for us to produce Gugulethu’s first washed coal in the first quarter of 2024. Yellow equipment and first delivery of mining machinery including Volvo ADTs, 140 CAT graders, Dozers, and Volvo Excavators arrived within the first six months of the year, while a



The construction of the processing plant at the Gugulethu Colliery.

new 28 t/h filter press system, to process the slurry more efficiently, is scheduled for installation at the plant by early 2024,” explains Steyn.

The first phase of the Gugulethu project is expected to produce 2.4 million t/y of coal, of which 1.2 million t/y will be export quality of 5 500 kc NAR coal.

Once mined, Gugulethu’s product will be transported 43 kilometres to the Rietkuil siding, and then moved to the Richards Bay Coal Terminal in KwaZulu-Natal.

“All of Canyon Coal’s export allocation at the terminal,” says Steyn, “is in use, but the capacity for Gugulethu’s tonnages will free up when the company’s 1.4 million ton-a-year Phalanndwa Colliery in Delmas reaches its end of life in 2024. Canyon Coal exports some of its products through Grindrod’s Terminal de Carvao da Matola port in Maputo.”

Social labour plan

The revised social and labour plan for Gugulethu has been submitted to the Department of Mineral Resources and Energy for final approvals.

Once approved it will make way for Canyon Coal to start implementing social upliftment projects, provide training opportunities, bursaries and learnerships to benefit surrounding host communities.

“While awaiting this approval, the mine has commenced with skills development for 40 local incumbents and machine operators. Internship opportunities have been advertised and we are in



Yellow plant machinery started arriving at Gugulethu Colliery in the first six months of development.

the final stages of shortlisting. Earlier in the year we also hosted a procurement roadshow to meet local businesses and inform them about the company’s way of engaging with suppliers and potential contractors. We have established a functioning community forum that ensures the interests of the host communities and the sustainability of the mining operation are looked after,” concludes Steyn. ■

Canyon Coal's production

- ❑ On average Canyon Coal operations collectively produce above 3.2 million tons of coal a year.
- ❑ Company operations, including Phalanndwa in Delmas and Khanye in Bronkhorstpruit, have collectively produced 2 918 832 tons between the beginning of year (2023) and August.
- ❑ When Phalanndwa reaches its end-of-life next year, the additional 2,4 million per year tons will come from Gugulethu to maintain production levels.

Waterberg Mine: An economic, social and environmental masterclass



Frank Hallam, CEO at Platinum Group Metals.

With plans to fully mechanise its operation mining critical green metals, PGM's Waterberg operation is shaping up to be extremely profitable, while also significantly uplifting the surrounding communities.

Located on the Northern Limb of the Bushveld Complex, Platinum Group Metals' (PGM) Waterberg project represents a large-scale platinum group metal resource which, given its shallow nature, the company notes has an attractive risk profile. What makes the project exciting is the fact that it lends itself to fully mechanised production, meaning the mine has the potential to have one of the lowest operating costs in the PGM sector.

This is a joint venture project in which PGM holds 37.05%, Impala Platinum Holdings has 15%, HJ Platinum Metals holds 21.95% and BEE partner Mnombo Wethu Consultants holds 26%. PGM itself holds a 49.90% ownership in Mnombo, giving it an effective interest of 50.02% in the Waterberg JV. HJ Platinum Metals is a Japanese special purpose corporation comprising JOGMEC (Japan, Oil, Gas and Metals National Corporation) and Hanwa Co.

Describing the initial discovery, Frank Hallam, CEO at Platinum Group Metals, notes that it was made in the Bushveld Complex in a completely new section, as far back as November 2011, with initial exploration funded by JOGMEC.

Following this, he indicates that a pre-feasibility

study had been completed by 2016. The company then announced the results of its definitive feasibility study in September, 2019. Ultimately, he says, PGM was granted a mining right for the Waterberg project by the Department of Mineral Resources and Energy (DMRE) in early 2021.

High production, low cost

"The Waterberg JV will be a large scale, low cost PGM development that we anticipate will deliver key metals, including palladium, platinum, gold and rhodium. The deposit is palladium dominant, with a strong gold credit and a very desirable low chrome concentrate, with base metal content that is amenable to existing smelters," he says.

Hallam explains that PGM drilled around 490 mother holes, with a hit ratio of around 99%, demonstrating that it had a very predictable and well-understood deposit. Exploration included airborne geophysics, ground mapping and sampling in a series of studies that culminated in a definitive feasibility study – indicating a life of mine of 45+ years, and an annual production at peak of some 420 000 ounces.

Core samples from the Waterberg project.





The Waterberg project camp site.

“From a bulk mechanised point of view, the reef is very shallow and thick, dipping at around 35-38 degrees. Moreover, the deposit itself starts just 140 metres from the surface. It is a massive ore body, with huge width. By comparison, the Complex’s Merensky Reef is between 1.5 and 2 m in thickness, whereas the F Zone at the Waterberg deposit is over 100 m thick in places.

“As a result of being such a shallow deposit, we’re afforded the opportunity to access the deposit by way of multiple decline ramps which, when compared to deep vertical shafts, will lower overall capital and operating costs. The thickness of the reef also lends itself to bulk mechanised mining, which is a cheaper, easier and safer method of mining.”

At this point, Hallam indicates that an early work programme has been implemented, and includes an early infrastructure plan intended to significantly de-risk the future construction of the project. As this programme is being executed, PGM is seeking a third-party concentrate offtake agreement for Waterberg. Also, as a possible alternative, the company is assessing the potential establishment of a new smelter and base metal refinery business – jointly with third party investors – capable of processing Waterberg’s concentrate.

“The work we are talking about in this early programme is essentially pre-construction, namely, we plan to upgrade the local infrastructure and roads,

bringing in temporary power and water, and laying down the necessary rock pads for early infrastructure. Basically, we are gearing up to make the eventual execution easier, when we begin construction of the collars for the declines and of course the sinking of these.”

Development, training and safety

He notes that the decline access and mechanised mining approach means the mine is estimated to produce close to 35 ounces per employee, per

A view of a Waterberg core assay.





Drilling underway at the Waterberg project.

month. This is significantly more than conventional narrow reef platinum group metals mines in South Africa, most of which require vertical access.

“We will begin with 20 m stopes, which allow us to drill in only one direction, thereby giving the crews involved time to grow and develop their skills. The mechanised mining method, and the use of paste backfill, allows for higher extraction ratios, increases safety and reduces geotechnical risk,” he states.

“There are a multitude of benefits to be gained from mechanising in this manner, including: reduced risk to production; maximising mineral resource extraction; increasing flexibility via stope sequencing; improved safety and reduced geotechnical risk; and high productivity alongside low operating costs.”

“By mechanising the mine, we improve safety, because workers can operate the drills and muck the ore remotely rather than at the rock face itself. Once fully operational, we expect to have a workforce of around 1 100 skilled operators, in a total workforce of around 1500-1800. To operate such specialised equipment clearly requires a lot of training and to this end, we have partnered with NORCAT to provide the requisite skills training to our staff.”

NORCAT, he explains, is a skilled, non-profit labour training and development organisation that has an operating mine known as the NORCAT Underground Centre. This provides integrated, hands-on, and practical training programmes for new and existing miners.

“We will begin by training our shift bosses, supervisors and mine managers, taking some of them to NORCAT’s centre in Ontario, Canada, to train them in relevant physical conditions. They will then return to SA, so they can pass these skills onto other workers at Waterberg. Training in South Africa will include the use of simulators”

A mechanised mine

Although the mine will be fully mechanised, he suggests that there is nothing particularly unusual about this approach.

“We will, for example, be using off-the-shelf technology – from OEM companies like Sandvik and Epiroc – such as twin-head jumbos that are operated remotely or are at least computer-aided, as well as remote muckers in the stopes, to scoop material and bring it out. The dump trucks being used will initially be standard, but some of these may be automated over time and, once steady state production is achieved and fleet replacements begin, we plan to switch them to battery-electric drives.

“Then there are the conveyors and drills, most of which, with computer assistance, have the capacity to be operated remotely. We are simply leaning into the concept of digital transformation, which enables us to keep human beings from having to undertake brutal and dangerous work. Remember, if a rock falls on a machine you simply dig it out and fix it, there is no injury crisis,” he says.

Asked whether automation might destroy jobs, Hallam explains that operators at Waterberg will be highly skilled and well paid. So, these jobs provide skills to people that they can leverage in future, while the money they earn is generally ploughed back into the local economy, which helps to create additional jobs in the community. He adds that machines need maintenance, so mechanics will also be required, adding to the skills that are being developed at Waterberg.

“I have already mentioned how we will be producing nearly 35 ounces per employee, compared to the average of three to five ounces per employee produced by manual based conventional mining. Essentially, what this means is that our

mechanisation is a force multiplier, i.e. to achieve similar production manually would require us to hire around 6 000-7 000 employees.”

Noting that advanced technologies such as artificial intelligence (AI) and Internet of Things (IoT) are still being studied, he definitely sees a place for these in the future – either to bring material to the surface without drivers in the trucks, or to more effectively automate the mucking process. As for the IoT, he says the benefits this offers in terms of predictive maintenance and improved fuel efficiency means it is another technology that will be key, moving forward.

Community upliftment

The company has already been involved in a significant number of consultations with surrounding local communities and has been since the project was first conceptualised.

“Interestingly,” he says, “the first question we get from these communities is, ‘when can we get started?’ They are at least as keen as we are to get the project underway”.

“It is worth mentioning that the area being developed for this project has a sparse population, supported by minimal infrastructure, and the water and power supply are dubious at best. Therefore, right from our first efforts at initial infrastructure implementation, we have been demonstrating the kind of upliftment this project can offer.”

Infrastructure that is either already being improved or that will be massively upgraded by the mine, includes roads, power facilities, schools and healthcare services, along with the addition of jobs and skills.

“The improved infrastructure will help stimulate an economic engine in these host communities. We have already begun with a skills and needs



An aerial view of the Waterberg core shed.

assessment, and have some local people currently undertaking basic skills training. The training provided here – such as carpentry, plumbing and electrical skills – is taking place under the auspices of our social labour plan.

“We are particularly pleased with this project, because not only is it helping to drive social upliftment in the region but, more broadly, the metals being mined are uniquely suited to the green economy and the solutions proposed to fight climate change. With so many economic, social and environmental benefits, this is definitely a project we feel pretty good about,” concludes Hallam. ■

Waterberg estimated assets*

- **Reserves:** 19.50 million ounces of PGMs and gold
- **Mine life:** 45+ years
- **Projected Annual Production:** 420 000 ounces

*Based on 2019 Definitive Feasibility Study. See October 4, 2019 technical report
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Ralf Hennecke, Managing Director of BME.

Blasting shows African mines the power of positive disruption

As we prepare for another exciting Investing in African Mining Indaba in 2024, the theme of ‘positive disruption’ could not be more appropriate for the directions being forged in the field of mine blasting and explosives.

According to Ralf Hennecke, Managing Director of Omnia group company BME, mining has been facing the same winds of change that are impacting all sectors of the global economy, but has simply not been adapting to new demands. Rather, the sector has been applying technologies that are taking safety and productivity to new levels.

“From our perspective as mining technology partners, BME can certainly attest to how mines are ‘Embracing the power of positive disruption,’” said Hennecke. “We have no doubt that this is a critical element of African mining’s bold new future.”

Sustainable ramp-up?

He highlighted that one of the many questions to be posed at this year’s Indaba relates to how Africa will respond to the increased demand for battery minerals, and whether the continent can sufficiently ramp up production while sustainably managing environmental and social impacts.

“This is a challenge to be faced as much by the mining companies themselves as their entire value chain, and calls for long term partnerships dedicated to innovation and constructive problem-solving,” he said. “In the blasting space, we feel well-positioned to play our part – as our continuous improvement strategies have pushed the boundaries in terms of sustainability and productivity.”

Quality blasting is all about streamlining

downstream processes for mining customers. This invariably means efficiency, which impacts on cost and carbon emissions.

Right fragmentation

In blasting, good rock fragmentation is key to unlocking early-stage efficiencies on mines, which are doubly significant because the loading, hauling and comminution phases that follow are among the mine’s most energy intensive. Making these functions smoother means less energy is consumed, and therefore costs are cut and the operation’s carbon footprint reduced.

“It has been a long journey towards improving fragmentation,” he said. “While BME entered the South African market in 1984 as a pioneer in cold emulsion explosives, this was followed by decades of investment in emulsion technology and our range of electronic and digital solutions – as well as equipment and accessories.”

Electronic detonation

This allowed the company to constantly leverage its offering with emerging technologies over time, which it embraced by building in-house expertise and capacity. Among BME’s most valuable lines of development has been electronic detonation, which continues to enhance blasting outcomes through its safety, accuracy, reliability and flexibility.

“By allowing milli-second delays between detonations, and by lengthening our firing window, mines are now able to design increasingly intricate blasts to suit their geological conditions and production requirements. Mines have also been able to initiate ever larger blasts, thereby limiting their pit disruptions and blast-related downtime.

“Underpinning this capability has been BME’s own electronic initiation system – AXXIS – which is steadily evolved by our dedicated team of engineers, technicians and operators,” said Hennecke.

Software has of course been central to the positive disruption in the blasting space, and a key application has been in the planning of blasts. Today, mines can use blast planning programs such as BME’s Blastmap to prepare each blast to the finest detail of complexity – and then even simulate the results.

BME’s commitment to safety and continuous improvement is transforming the blasting space, streamlining downstream processes for efficiency, cost reduction, and lower carbon emissions.





Safe blasting

A non-negotiable in Africa's mines is the prerogative of safety, he pointed out. A high point for BME was its recent dual safety innovation in its flagship AXXIS Titanium system, where testing can be conducted at a lower voltage than detonation.

"Expanding our operations into Africa, we have applied our safety commitment to the same global standard," he said. "As an active member of Safex – the international industry body focused on the safe application of explosives – BME applies the highest standards across our operations. This is reflected in our zero recordable case rate (RCR)."

BME has even made a contribution beyond the technical arena, and into explosives-related regulatory development in Africa. As a blasting pioneer in Africa, it was the first explosives company to be licensed in Mauritania and Sierra Leone. Its experience meant it could assist government authorities there in drafting legislation that would pave the way for the responsible application of explosives.

Preventing oil hazards

In addition to supporting the mining sector's drive towards lower carbon emissions, it has also been vital for mining stakeholders to protect the environment in every way possible. Where innovatively applied, he explained, these efforts should also lead to positive social impacts – a key element of the environmental, social and governance (ESG) priorities that are growing in importance.

"BME has managed such an achievement with our used oil initiative," he said. "By systematically and responsibly collecting used oil from customers and other sources, we remove this hazardous substance from the economy and prevent possible contamination of water and land."

By embracing the circular economy approach, BME treats and re-uses this oil as a fuel agent in its quality emulsions, ensuring that it is safely disposed

of during its high energy blasts. The benefits extend further, as the company has designed the collection network to include small businesses in local economies around mines. This assists the social responsibility efforts of mines as they work towards promoting economic diversity and livelihood resilience in their host communities.

Innovation in blasting

To support the global move to lower emissions, BME's parent company Omnia Holdings has entered into a partnership with Swedish-based Hypex Bio Explosives Technology, which is at the forefront of innovative and sustainable civil explosives solutions.

"Hypex Bio has developed a ground-breaking emulsion using hydrogen peroxide (HP). This first-to-market non-nitrate explosive emulsion reduces the carbon content of blasting by 90% over traditional sources. The technology has the potential to change the explosives supply industry completely," said Seelan Gobalsamy, CEO of Omnia.

Bold future

"It is widely accepted that the bold new future for African mining cannot be business as usual," said Hennecke. "While companies like BME root their success in an operational foundation of secure supply chains and reliable delivery to customers across the continent, we also embrace the need for innovation and change."

This certainly applies to services and solutions, but also to how companies create the waves of success that generate opportunities for African economies all the way down the supply chain.

"With Africa as our base, BME demonstrates what the continent has to offer other mining regions of the world," he concluded. "Africa is responding actively to the revitalised search for minerals critical to the energy transition, and can leverage a more sustainable future from this opportunity." ■

BME's bold future vision for African mining involves not only innovation in services but also creating waves of success that benefit economies across the supply chain.

To support the global move to lower emissions, BME's parent company Omnia Holdings has entered into a partnership with Swedish-based Hypex Bio Explosives Technology, which is at the forefront of innovative and sustainable civil explosives solutions.



Kobus van den Berg, General Manager Underground Production at De Beers Venetia Mine.

VUP delivers first production, targets project completion by 2028

At a time when several major open-cast mines are transitioning from open-cast to underground, De Beer's poster child, the Venetia Underground Project (VUP) – in the Limpopo Province – which on 30th June achieved a major milestone with its first blast, will in many ways offer a blue-print as a modern mechanised underground mining operation implementing initiatives to meet its decarbonisation agenda, Kobus van den Berg, General Manager Underground Production at De Beers Venetia Mine, tells *Modern Mining* in an exclusive interview.

As part from its contribution to the global economy in the form of its precious stones, the VUP enhances the country's coffers with its tax contributions and promotes the agenda for a cleaner environment through decarbonisation.

While the \$2bn dollar outlay to develop VUP is a major investment on its own, the mine's drive to implement the latest technology and meet the highest levels of safety is not the only reason this project has been chosen as a top project. Its contribution to the local economy in the Limpopo Province sets it apart as a project making a significant impact on the lives of the local community.

"Successful mining operations are built on strong relationships with local communities. The Venetia Underground Mine has prioritised community engagement through ongoing communication, consultation, and collaboration. Community engagement programmes, social initiatives, and economic development projects are sustained to create a positive and lasting impact on the region. The mine's initiatives focus on socio-economic development, education, healthcare, and infrastructure upgrades, ensuring the benefits of mining extend beyond the operational footprint," says Van den Berg.

VUP employs 4 300 people, from the De Beers stable and its contracting business partners, with the



Moses Madondo, Managing Director of De Beers Group Managed Operations, congratulates the Venetia Underground Project production crew on a successful first blast.

majority of employees sourced from the local communities of the Messina and Blouberg districts in the Limpopo Province.

"We are committed to making a positive impact on the lives of our host communities, and have launched the Building Forever Sustainability Strategy, comprising 12 goals that focus on leaving a lasting legacy, one of which includes establishing the means to ensure that host communities thrive. We have also partnered with the International Youth Foundation to ensure that graduates from TVET (Technical Vocational Education and Training Colleges) are equipped with the right skills sets for available jobs. De Beers has rolled out the programme to benefit 12 000 students and lecturers in the Limpopo Province. In fact, through digitisation, it has been possible to extend the programme to all 50 TVET colleges across the country, which I believe is a significant milestone in itself. Moreover, for communities to thrive it is essential that they have access to necessities such as water and healthcare, and we have been working with many villages surrounding our operations to provide infrastructure related to access to water closer to the communities. We also sponsor various sporting codes as this promotes a healthy lifestyle for communities."



Kobus van den Berg, General Manager Underground Production at De Beers Venetia Mine, provides an update on the Top Of Mine development progress.



Project development

Infrastructure development at VUP is ~72% complete with the miner on-target for production ramp-up and project completion by 2028. To date, the miner, which initiated its first blast at the end of June, is in the early stages of production.

“We achieved a highly anticipated milestone of first production on Friday, 30 June. This monumental event marked a new chapter in the history of diamond mining at the Venetia Mine, showcasing the dedication, innovation, and collaborative efforts of all involved. The investment in taking the world-class Venetia Mine underground enhances De Beers Group’s global production for the long-term and is an indication of our commitment to South Africa. Our incredible team of employees and business partners pulled together fantastically to achieve this major milestone of first production from the underground operation,” says Van den Berg.

The miner is busy with ramping-up from current production of roughly 12 000 tons achieved in October to just under 2 million tonnes in the next two years.

The mine is expected to produce up to 5.9 million tonnes of kimberlite ore annually, to be used in the extraction of nearly 4.5 million carats of diamonds per year.

VUP will be an automated operation that will use latest technological advancements to optimise production and improve safety, while unlocking significant cost savings.

“We are also busy developing our second ore body, K02, from which we will start production in 2026. Production is currently focused at the Top of Mine (TOM), which is located between 450 m–500 m below surface from 46 Level to 54 Level,” says van den Berg, who explains that the main infrastructure is located 900 m to 1000 m below surface.

Remaining infrastructure development yet to be completed includes the installation of water management systems, such as pump stations on 56L to cater for excess water during the rainy seasons, as well as the construction of a primary crusher on 54L.

Further to this, shaft deepening on the service shaft, which is currently at roughly 1000 metres, will be deepened by 60 metres followed by the



Above: Venetia Underground Project employee uses simulation machines at the Skills Development Centre.

Left: Venetia Underground Project employees in the control room witnessing the first production blast.

equipping of the service shaft.

“Roughly 30% of infrastructure development still needs to be completed – this is earmarked for completion by 2027/2028.”

VUP – a modern operation implementing latest technologies

According to Van den Berg, the objective for Venetia Underground Mine (VUG) is to have a number of autonomous mining systems performing multiple mining processes by 2027.

“Our primary technology partner is Sandvik Mining and Rock Solutions, which manufactures a full range of ‘intelligent’ mining machines that can operate independently underground within access-controlled safety zones or be remotely operated from control rooms on surface. The implementation of automation at the VUG will be carefully phased-in on an incremental basis, starting with automated machines (which still require an on-board operator although many functions are automated). This will be followed by the introduction of autonomous machines, which do not require an onboard operator as they are equipped with automated machine navigation and tramping and can perform – while stationary in one location – most sets of routine functions without operator input required during the cycle. The final phase of implementation will see the ushering in of full autonomous mining systems,” says Van den Berg.

Autonomous mining not only creates a safer and

Skills development programme graduates (construction) at De Beers Venetia Mine.





Underground drilling at Venetia Underground Project.

healthier environment for workers as it removes them from potential high-risk areas of the mine but, if implemented correctly, also delivers increased efficiency compared to traditional techniques when measured in terms of output against available operating time.

Venetia - a poster-child for decarbonisation

In line with achieving its carbon neutrality target, the miner is implementing several key efficiency projects, including the ventilation-on-demand, mine digitalisation and automation, adoption of energy

efficient motors and variable speed drives (VSDs) on key equipment.

According to van den Berg, with the mine transitioning from open pit to underground mining, the site has become far less reliant on energy from fossil fuels and it is projected that by the end of the decade, 85% of all energy consumed will be electrical, with only 6% of on-site emissions attributable to diesel.

“The VUP has determined that although development and waste tramming make up the majority of its diesel consumption at present, without additional electrification, 75% of fossil fuels energy would be consumed by production loaders and trucks by 2030. This has allowed the site to prioritise its focus on developing electrification options for its primary production fleet, whilst maturing viable green fuel considerations for its ancillary equipment.”

Electrification considerations include battery electric LHDs and trucks, trolley-assist hauling loops and possible tethered electrical loading in some areas.

A detailed concept study is in process, which will inform the site on the viability of these options in the near future.

In addition to electrification possibilities, the Venetia Mine is reviewing several alternative fuels strategies and carbon offset options for the VUP as part of its carbon neutrality pathway. ■

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Louwill Lefa: pioneering excellence in modern mining

For over three decades, Louwill Lefa has been a driving force in the steel fabrication and construction industry within Sub-Saharan Africa. Specialising in a multitude of areas such as steel and plate work fabrication, piping, civils, electrical, corrosion protection, construction management, detailing, commercial management, planning, and procurement, Louwill Lefa stands as a beacon of expertise and innovation in the mining sector.

With an impressive track record spanning numerous years, Louwill Lefa brings unparalleled skills to the mining landscape. Its expertise in steel fabrication and construction has been pivotal in delivering high-quality, reliable services to the mining industry. The company's commitment to excellence is evident in its attention to detail, precision in fabrication, and comprehensive management of construction projects.

Headquartered in Springs, South Africa, Louwill Lefa has expanded its reach far beyond its roots. Providing invaluable services to mining houses across Sub-Saharan Africa, the company's influence extends to countries such as Botswana, Zambia, the Democratic Republic of Congo, Madagascar, and Namibia. This extensive geographic footprint underscores Louwill Lefa's dedication to supporting mining operations across diverse regions, contributing significantly to the industry's growth and development.

Strategic Growth and Vision

From humble beginnings as a small team in 1992, Louwill Lefa has seen remarkable growth, currently boasting a workforce of close to 1000 dedicated professionals in 2023. This expansion has been driven by a strategic approach focused on maintaining maximum control over the turnkey process. By emphasising comprehensive



Louwill Lefa has been a driving force in the steel fabrication and construction industry for over three decades.

oversight, the company has ensured the quality and efficiency of its services, positioning itself as a leader in the mining support sector.

Beyond VUP: Diverse Projects

While the VUP project has been a flagship endeavour for Louwill Lefa, the company's involvement extends across various other impactful projects. Its diverse portfolio showcases its adaptability and expertise in catering to the multifaceted needs of the mining industry. From infrastructure development to cutting-edge technological advancements, Louwill Lefa continues to pioneer innovative solutions across different projects, contributing significantly to the industry's evolution.

In conclusion, Louwill Lefa's unwavering dedication, expertise, and strategic vision have propelled the company to the forefront of modern mining infrastructure services. Commitment to excellence, coupled with a proactive approach to growth and innovation, ensures it remains a cornerstone in shaping the future of the mining sector across Africa and beyond. ■



Louwill Lefa built and erected gantries for the VUP project.



Investing in African Mining Indaba celebrates 30 years

As Investing in African Mining Indaba celebrates its 30-year anniversary in 2024, the much-anticipated event is targeting a bigger and more interactive conference.

“Mining Indaba turns 30 in 2024, and the excitement around this milestone is high, with a large contingent of our loyal participants and stakeholders keen to share in this landmark achievement,” says Laura Cornish, Mining Indaba Head of Content.

According to Kathryn Barnard, Event Director, Investing in African Mining Indaba, next year’s event, which takes place from 5-8 February 2024 in Cape Town, aims to showcase the thriving African mining industry and its readiness for investment, making it a significant event to attend.

“We are excited to bring together stakeholders from across the mining industry to drive positive and long-term change in the sector. Mining Indaba 2023 attracted a record number of attendees, and we expect to welcome an even larger contingent of global mining executives at our 30th anniversary event. Our audience will include more than 900 investors, 1200 mining company executives and over 85 ministers and senior government officials,” says Barnard.

Mining Indaba 2023 was the most successful Investing in African Mining Indaba conference to date, with delegate numbers of just over 8 000 including numerous early-stage explorers, over 900 investors, around 470 junior miners and just over 700 mid-tiers and major miners.



“We attracted an extremely large delegation of mining ministers who rounded out the key stakeholders that gather under our roof to collaborate and network. Moreover, the exhibition floor – larger than it has been in the past – is a combination of loyal repeat clients and new clients. This demonstrates the value our stakeholders see in positioning themselves at Mining Indaba year after year, while simultaneously being supported by new clients who are eager to experience what Mining Indaba has to offer,” says Portfolio Director, Investing in African Mining Indaba, Eve Harper.

Investing in African Mining Indaba celebrates its 30-year anniversary in 2024.

Focus in 2024

With the focus being on increasing the number of attendees at Mining Indaba 2024, organisers have put together a strong line-up of ‘must attend’ events across multiple focus areas to appeal to the diverse mining sector, and a highly appealing content line-up.

The 2024 theme: “Embracing the power of positive disruption: A bold new future for African mining”.





A number of heads of states have confirmed their attendance at the event.

Among the heads of state who have confirmed their attendance, is President of Angola, João Lourenço, who will deliver a keynote address to delegates. Further announcements of heads of state who have confirmed their attendance are expected in the run up to Mining Indaba 2024.

“These distinguished leaders will deliver a keynote address and share their insights on the mining industry, highlighting the importance of collaboration and sustainable development in this sector. Their presence reflects the global significance of the event and reinforces its reputation as a premier platform for discussing critical issues in mining,” says Cornish.

Since its inception in 1994, Mining Indaba has continued to push the boundaries to provide delegates with an unparalleled experience in terms of content, targeting inclusivity while tackling hard-hitting topics.

According to Cornish, the event has evolved over the years to include a variety of content streams and special sessions addressing diverse subjects of relevance.

“These additions aim to support the theme of the event and provide valuable information to attendees. The 2024 theme: *Embracing the power of positive disruption: A bold new future for African mining* aims to elevate the audience experience for our panel discussions and all content elements within our programmes. To support this, our main stage has been rebranded *Disruptive Discussions* to further emphasise our content objectives. Our priority is for

Distinguished leaders will deliver keynote addresses and share their insights on the mining industry.

our panellists to move away from typical corporate messaging and start engaging on real challenges in mining to find solutions – in other words, showcasing how they are disruptive in the industry. Our aim is for stakeholders to feel inspired and connected with these messages.”

Cornish says that what makes the event more relevant is the race to secure critical minerals as the world looks to contribute towards the overarching need to deliver an energy transition across the planet.

“Africa remains the last truly untapped continent with the greatest prospect for delivering vast quantities of critical minerals and so this remains an underlying feature throughout our content. We will have strong representation from international governments and investors including the United States, Europe, Saudi Arabia and India, amongst others, all contributing their ideals for supporting the development of critical minerals industries in Africa. Importantly, our discussions will explore how the continent can best utilise its own minerals while still contributing towards global needs.”

Events on the agenda – bigger and better

According to Cornish, new on the 2024 agenda is a Junior Miners’ Day programme which caters specifically to juniors –an audience that has not experienced the strongest visibility in the past few years but is a target audience that has become a focal point.

“Junior miners are the drivers of the next generation of mining and we want to ensure our content and our junior mining presence reinforces and explores this. Likewise, the addition of an Investor Day emphasises the need to hear directly from our investors and understand the parameters on which junior companies need to focus to better position themselves for funding.”

Further to this, organisers have adapted programmes to reflect areas of greatest interest to stakeholders.

First is the Intergovernmental Summit – a single day programme that has now been extended over three days, starting from Monday and is, in essence, an extension of the closed-door Ministerial Symposium, but in a public forum environment. The summit has become the hub for government



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Investing in African Mining Indaba aims to showcase the thriving African mining industry and its readiness for investment.

The event brings together stakeholders from across the mining industry to drive positive and long-term change in the sector.

networking, conversations, and content delivery at Mining Indaba.

Moreover, the sustainability programme – rebranded to the Sustainability Series – has been extended to two days. “This is the event organiser’s response to the industry’s need to talk about sustainability at length. It is a driving factor for the mining industry at present and forms one of the most important programmes we offer in 2024,” explains Cornish.

The organisers have also placed great focus on its technology programme, which has been an evolving programme for the past few years and has become a platform to showcase future mining technologies.

The *Tech and Innovation Hub* – which takes place on the show floor – is designed to speak to technology providers and exhibitors, with the aim of exploring the future of mining at a deep and meaningful level to help the industry process its own technology journey faster. The programme will include technologies in action, providing a visual and sensory experience that enables the audience to better connect with the technology and its potential.

“Our youth day, which takes place on Thursday, could perhaps be seen as an outlying element to our event but we have recognised the role youth will play in tomorrow’s mining industry. For 2024, we are working to integrate younger generations into Mining Indaba across the full event and look at how we can support young students financially to engage in a career in mining,” says Cornish.

As Mining Indaba 2024 is primarily dedicated to



Mining Indaba CSR initiatives supported by Hyve Group Plc

- ❑ As a multi-national event company, Hyve places a strong emphasis on selecting local suppliers and provides opportunities for entrepreneurs. This not only creates jobs and supports economic growth but also ensures grassroots benefits.
- ❑ Hyve’s events have contributed to society by supporting young people through donations to Cotlands charity and student sponsorship programmes.
- ❑ Mining Indaba specifically has

partnered with Breadline Africa to build a school in Masonwabe, providing quality education for hundreds of children in the Western Cape.

- ❑ Investing in education empowers individuals and contributes to Africa’s development, driving innovation and sustainable growth.
- ❑ The Mining Indaba team collaborated with South African supplier Jane&Paul to create a sustainable exhibition infrastructure. The flat pack modular

solution, with a low carbon footprint, reduced environmental impact and set a new standard for sustainability. The team used CNC technology for precise manufacturing, enhancing the units’ sustainability. Any graphics not reused by clients were donated to Cape Town-based manufacturer Sealand Gear, who used the old fabric graphics to create inners for their responsibly-made bags. This partnership promotes the circular economy and sustainable products.



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Organisers are targeting a bigger and more interactive conference.

‘giving back’, Barnard explains that organisers will advance several projects that provide greater support to areas of mining.

“We will also be introducing an *Icons of Women in Mining* award, in partnership with Women in Mining SA to shine a spotlight on the road women have travelled to become meaningful contributors to our industry. Our event truly strives to connect industry experts while making a positive social and community effect. By linking their mission with social and community benefits, we are promoting change that transcends beyond the bounds of the event itself.”

Moreover, the largest ever African mining

investment conference will also feature the following concurrent special sessions and showcases:

Explorers Showcase

The Explorers Showcase is an opportunity for exploration and early development mining firms in Africa. It aims to help explorers find the right partners and generate capital for their projects through exclusive deal-making networks.

Responsible Resourcing Awards

Mining Indaba introduced the Junior ESG Awards two years ago to honour junior mining companies for their sustainable development initiatives. Having rebranded as The Responsible Resourcing Awards, it continues to celebrate and recognise companies for their efforts in reducing carbon emissions, improving access to clean water, and promoting sustainable economic development in their regions.

Investment Battlefield

The Investment Battlefield is an annual competition for Africa’s top junior mining companies, held in partnership with Mining Indaba and 121 Cape Town events. The relegation-style format sees non-relegated juniors advance to the finals for best exploration and development projects.

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❑ Mining Innovation and Research Battlefield

The return of the Mining Innovation and Research Battlefield aims to empower new leaders and uplift fresh ideas in African mining, while promoting cross-sector collaboration for catalysing and achieving real-world impact in the industry.

“As Mining Indaba enters the next era of its journey, we are excited to take this event in a new

direction. We are exploring new audience sectors to bring to the event that will add to the value chain of mining and continuously expand our offering to further support our need to be the platform that enables the African mining industry to develop and advance. We believe the greatest change that happens within industry is thanks to the content and conversations that take place under our roof,” concludes Harper. ■

Organisers expect to welcome a large contingent of global mining executives at its 30th anniversary event.

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Reflections on mining in Africa, and its bold new future

Considering the theme of the Investing in African Mining Indaba 2024 – *Embracing the power of positive disruption: A bold new future for African mining* – the term ‘disruption’ has come to describe a raft of rapid technological and other advancements that have significantly changed the way we do business today.

“Perhaps not many mining commentators would suggest that the traditional mining sector would embrace disruption, but there have indeed been various forms of disruption in the industry – several of them positive,” said Andrew van Zyl, Managing Director, SRK Consulting (South Africa).

Van Zyl pointed out that disruption is invariably associated with risk, and most stakeholders in mining spend a good portion of their days working to avoid or mitigate such risk.

“This is as it should be,” he said. “As engineers and scientists providing technical solutions to the sector, we must be as skilled in developing innovative answers as we are in helping clients apply them practically and responsibly.”

SRK Consulting will be celebrating its 50th year in business as it attends and exhibits at the Indaba in Cape Town, and there is much to be discussed at the forum that resonates with the company’s history and vision.

Recognising context

He highlighted that a fundamental aspect of mining’s evolution in recent decades has been the growing recognition of its context – within the natural environment, within the host communities where it operates, and within society in general.

A focus on responsible sourcing in Africa’s battery mineral revolution, SRK Consulting explores the ethical supply chain and collaboration with the European initiative RE-SOURCE.



Andrew van Zyl, Managing Director of SRK Consulting (South Africa).

“These themes have been well ventilated in previous years of the Indaba and deserve ongoing attention,” he said. “Indeed, the global effort to slow the pace of climate change is affecting not just the way we mine, but what we mine.”

Leading mining companies have committed to reduce carbon emissions as part of their role as good corporate citizens, he continued. This has led to initiatives to decarbonise mine sites, and to meet ambitious sustainability targets; the testing of a hydrogen-powered mining truck in South Africa typifies the commitment of industry to innovate and test possible solutions.

“Forging a lower carbon future has also meant a renewed focus on renewable energy, and the explosion in battery technology to store this energy has sent ripples into commodity markets and mining itself,” said Van Zyl. “The search for minerals critical to the manufacture of batteries has affected commodity prices, exploration programmes and production plans. As battery technologies compete for acceptance, the market value of the minerals required has become unusually volatile. This in turn has complicated the task of project valuation and planning.”

Responsible sourcing

For Africa, the search for battery minerals is generally good news. The continent is a well-established producer of some of the key minerals required by the energy transition – such as copper and cobalt.

There are also signs that many other battery minerals are to be found here in economic quantities, such as lithium. There is another important factor to consider in the battery mineral 'revolution', however, and that is the growing attention to responsible sourcing.

"Among the world's consumers of battery minerals, there is a concern that such commodities be extracted and processed responsibly, and that their provenance be carefully tracked to prove this," he said. "In Africa, like elsewhere, this puts an onus on the producers, and on governments and other stakeholders. They must all ensure that conducive conditions are created to allow such an ethical supply chain to be established and maintained."

He explained, however, that this is not a one-way street. As part of SRK's commitment to mining in Africa, it is working with an important European initiative, RE-SOURCE, to find ways to avoid unintended consequences of such responsible sourcing policies. If not carefully considered, these efforts could inadvertently disadvantage those constituencies – in Africa and beyond – who they were meant to assist.

SRK reflections

"Reflecting on SRK's contribution over the five decades, we are proud of many aspects of our technical and strategic input; among these have been those related to ESG," he said. "While this focus was once limited to mining's local environmental impacts, it now extends into the global issues related to climate change, and to social issues from artisanal mining and human rights to localised supply chains and responsible sourcing."

As consulting engineers, SRK has walked this journey with its clients for half a century. Much has changed since Oskar Steffen, Andy Robertson and Hendrik Kirsten established their practice in Johannesburg in 1974, offering services in soil and rock mechanics and tailings disposal. Today, SRK's clients' requirements have broadened substantially beyond the narrow technical demands of mining operations. The demands of ethical exploration and responsible extraction mean ongoing and systematic engagement with a wide range of stakeholders, for instance – which remains a challenging task.

"At SRK, our development has mirrored the evolving demands of the industry – and our success has been built on foresight into how to prepare for such demands," he said. "In 1995, for instance, we employed our first social and developmental specialist – a move that was championed by SRK's founders, who could see how important this facet was becoming. It is now almost 30 years later, and the industry has come a long way in terms of ESG practice, but we still have much to learn."

Managing future risks

Van Zyl's view is that mining, as a pioneer industry in Africa, has shown it has much to offer as a catalyst for



SRK is embracing positive disruption and responsible sourcing for a sustainable future amidst the changing landscape of the mining industry in Africa.



economic growth. "Ensuring the benefits of mining are optimised in host countries and local communities is another vital theme at successive Indabas, and has increasingly occupied our minds at SRK.

"While we work with clients on stakeholder engagement and related issues, we also put Africa's priorities into practice," he said. "Our offices around Africa – including Ghana and the Democratic Republic of Congo – are staffed and owned by local professionals, and we invest substantially in knowledge sharing across our global network to promote professional development."

He said that this year's Indaba comes at a time when commodity prices have tempered and mining costs are rising, while expectations among host countries and communities are high. The sector's trajectory into the future, he emphasised, needs to manage the risks of today while embracing positive disruption and continuing to build sustainable responses to the demands and obligations of tomorrow. ■

SRK's reflections over five decades include a commitment to ESG practices, addressing global issues from climate change to responsible sourcing in the mining industry.

Mind The Gap

By Jaco Lotheringen MD of Ukwazi

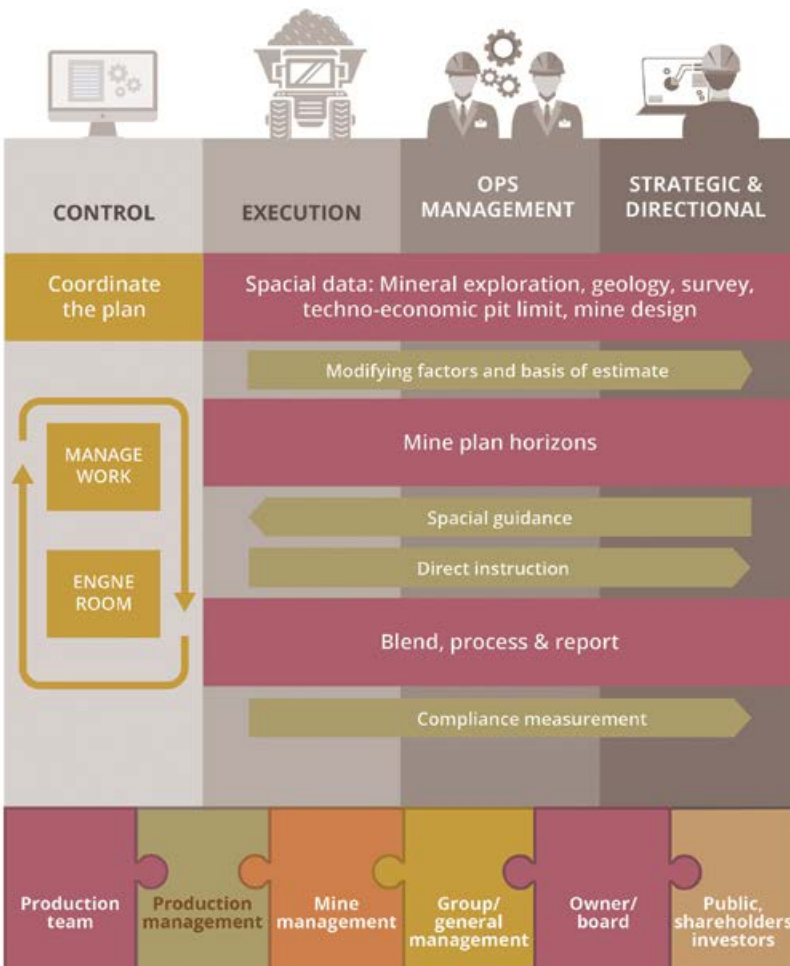
A well-known fact about mining businesses is that they are highly susceptible to the cyclical environment of the supply of, and demand for, commodities – something that is unlikely to change. When examining decreasing commodity prices over the last three years, uranium yellowcake has been the exception, with a recent upward trend. Gold has remained relatively stable, but platinum group metals (PGMs) and copper have seen a substantial decline from the highs achieved in early 2021. Bulk commodities such as manganese ore, iron ore, bauxite and specifically coal, are materially down from the peaks reached late in the Covid-19 pandemic, while chrome has not regained its pre-2017 commodity crisis levels.



The gold price has remained relatively stable over the past two years.

Many operations, particularly across Southern Africa, are currently facing significant challenges. These difficulties can be attributed to logistical hurdles associated with Transnet, alongside considerable post-Covid-19 production cost escalations and the added pressure of lower commodity prices. As a result, most mines are facing inward, prioritising cost control and aligning produc-

Mind the gap infographic.



responsibility for consistently meeting the strategic plans communicated to the market, investors, and stakeholders, therefore, rests squarely on the shoulders of the mine’s production team.

Bridging the gap

Whenever you travel on the London subway there are signs that warn you, “Mind the Gap”. In recent years, the disparity between strategic mining plans and the practical, implementable mining plans accessible to mining operational teams, has grown considerably. This gap subsequently fosters widespread uncertainty within the execution environment i.e., what must be done and the how of what can be done practically.

In the same vein, while most mining organisations do adhere to well-defined planning horizons and put notable effort into producing these plans – in a sequential manner and at specific intervals – they often lack practical guidance. The plans formulated as the foundation for the mine budget should provide comprehensive and practical direction to mine management, aiding the implementation plans and serving as a benchmark for evaluating the mine’s performance and the efficiency of its operational teams.

At Ukwazi, we strongly believe that when a plan serves as a benchmark for evaluating a mine’s performance or its operational team, it should be tailored for those specific purposes; aligning with the business’ strategic objectives while also providing clear, instructional guidance. Simply put, it must extend beyond providing spatial guidance alone. Attempting to mitigate the resulting execution risk within the short-term operational planning horizon through rolling monthly and weekly plans is insufficient for most complex mining operations. This approach simply does not guarantee the sustainability of safe and high-quality production, as mines operate in a highly sequential and spatially controlled manner.

Closing the gap

As you increase uncertainty by imposing top-down strategic models for operational control, frustrations will mount, and needless stress will burden an already demanding production environment; making

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Mining is highly susceptible to the cyclical environment of supply and demand.

A higher degree of certainty can be attained by applying mine activity design principles within a suitable planning timeframe.

it progressively more difficult to retain outstanding operational and mining management teams. As such, the uncertainty gap between organisational objectives and operational targets needs to be reduced by developing pragmatic and cohesive mining budget plans that are audience-driven and outline sufficient practical requirements. It should be all about creating certainty.

The result? A production team well-positioned to perform in line with its respective KPIs and organisational incentives. Moreover, a higher degree of certainty can be attained by applying mine

activity design principles within a suitable planning timeframe. This involves shaping consecutive mining activities to correspond with a business' strategy, streamlining pit preparation and practical deployment.

To support our clients and their operational management teams, we have established an expert team to focus specifically on the mining budget plan horizon. These plans align with strategic mine plans to fulfil a mine owner's objectives, including shareholder returns. They also offer a level of detail that provides clear and practical instructions for crafting short-term operational execution plans and designs to notably reduce the levels of frustration in the mining production environment.

So, how do we effectively close the gap? Well, ultimately mining engineering and mine planning constitute pivotal technical and organisational disciplines. The effective implementation of the budget mine planning horizon requires active engagement from the intended audience, the operational team in this case, and a technical team that has insight into the strategic objectives of the mine and an in-depth understanding of the sequential nature of mine deployment. Further to this, the operational teams should receive outputs that equip them with the practical tools needed to adequately meet their requirements. At the end of the day, cultivating this collaborative approach should be a standard practice in every mining organisation. ■





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A journey of innovation and dedication to customer satisfaction

At Invincible Valves, activity is constant and dynamic as the company continues to make significant strides in the valve manufacturing and reconditioning industry. The company's recent endeavours showcase a commitment to quality, efficiency, and self-sufficiency. Managing Director Pam du Plessis tells us more.

The Invincible Valves management team has been bustling lately despite challenges such as ongoing power cuts, water shortages, and a not-so-great economic situation. Instead of backing down, the company saw this time as a chance to expand and improve its business as part of a broader growth strategy. Consequently, it has acquired a new factory near its current premises in Knights Germiston and has established a new machine shop.

Du Plessis emphasises the importance of diversification in the business landscape. "Operating a



Managing Director Pam du Plessis.

business in South Africa is challenging, requiring the ability to navigate various obstacles at any moment. We are exploring new sectors by diversifying our business, expanding our service offerings, and broadening our product range. This approach helps mitigate dependence on a single market or industry, contributing to our resilience."

She says an integral part of the expansion and diversification strategy has been to reduce the company's reliance on third-party suppliers, addressing customer demands for quicker turnaround times and absorbing some of the associated overhead costs.

"Our customers now demand faster turnaround times, and our new factory and machine shop enable us to meet those expectations. By handling more processes in-house, we absorb some of the price overhead and reduce outsourcing, resulting in improved turnaround times. This approach also grants us better control over the entire process and more effective cost management," she explains.

For months, the Invincible Valves team has been working diligently to renovate and upgrade the new factory. "We added to the building, creating a space conducive to reconditioning and manufacturing. The final certificates are being obtained, and the facility will be fully operational in 2024."

Du Plessis says despite the challenging conditions, she remains steadfast in her belief that through ongoing investment in their business and operations, they are making a difference, contributing positively to the economy, and providing employment and high-standard services in South Africa, across the African continent and globally.

Growing footprint

According to Du Plessis, the company has always been focused on having as broad a footprint as



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possible. “We don’t just operate in South Africa but across Africa and the rest of the world. Our move to diversify, innovate and invest speaks to growing this footprint significantly.”

The goal for 2024, she says, is to expand the business even more. And already, they are on track to do just that. The company recently completed a noteworthy project involving reconditioning valves for a uranium plant in Namibia. Invincible Valves’ expertise saved the client a substantial 42% by reconditioning valves, making them fit for purpose and ensuring efficiency comparable to brand-new valves. This success reflects the company’s dedication to cost-effectiveness and its ability to deliver on a global scale.

With the market going through ups and downs, price remains a crucial consideration for project owners. “The valve industry is extremely price sensitive and, in the current economic climate, we forecast that reconditioning of valves will see an increase, particularly in South Africa where this has not been a trend.”

She says the company has also expanded into the rubber lining aspect of the business and is increasingly being used by other manufacturers for rubber lining valves. Having purchased a 10-metre-long

autoclave, Invincible Valves can now rubber line pipes, addressing a need in the market. The acquisition of this equipment and the expertise and skills to rubber line further emphasises the company’s commitment to diversification.

“Moving forward, our strategy remains centred on diminishing our dependence on external sources,” Du Plessis elucidates. “This involves bringing the production of our actuators in-house. Considering the challenges at the ports, it’s evident that we need to enhance our self-reliance. Waiting weeks for containers to clear is not viable. Passing such costs to customers isn’t always feasible, so we aim to minimise risks as much as possible.”

The company has also invested in generators and is looking at various solar solutions to reduce the impact of loadshedding on its business.

Strong outlook for 2024

Du Plessis expresses optimism for 2024. Despite South Africa gearing up for elections and the metals industry engaging in negotiations with unions over wage increases, she asserts that Invincible has a resilient and dedicated team that is steadfastly committed to delivering products of exceptional quality.

“We have confidence in our ability to attain our established goals. Our investments extend to both our facility and our team. With the right organisational culture in place, we are diligently working towards achieving our growth targets,” she says. “We are incredibly customer-centric, dedicated to providing the best product, optimal pricing, and efficient lead times. When we talk about the customer being king at Invincible, it’s not mere rhetoric; it’s a philosophy we live by. Our Invincible range boasts a superior product, verified through extensive testing, including weight testing, where our product surpasses standard steel. Numerous successful projects substantiate our confidence in the superiority of our product, each speaking for itself in the long run. The recurring business we attract is the true testament to our quality.” ■



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TOMRA Mining XRT technology delivers significant grade improvement at Saloro's tungsten mine



Pedro Jiménez, Plant Manager at the Barruecopardo mine.

TOMRA has installed a first X-Ray Transmission (XRT) sorter at Saloro's tungsten mine in Barruecopardo, Spain. Implemented in the beneficiation stage, the sorter is consistently delivering a much higher head grade to the processing plant, significantly reducing costs.

Tungsten is an essential industrial metal with unique properties used in the production of hard metals, specialist steels and super alloys, as well as aerospace, electronics, and military applications. Its production is concentrated in China, where 80% of the world's tungsten is mined. For this reason, it is considered a strategic commodity and is categorised as a "critical raw material" by the EU. The Saloro mine in Barruecopardo is one of the most important in Europe, and one of the few outside China that produces concentrate with high tungsten grade with limited impurities, making it a high-value product in the industry.

Saloro approached TOMRA Mining to explore ways to further improve the head grade to the processing plant: "We were looking for equipment capable of sorting ore with scheelite content in order to remove the non-mineralised product from the feed line," explains Pedro Jiménez, Plant Manager at the Barruecopardo mine.

TOMRA XRT technology: high-grade feed and cost savings at Barruecopardo

TOMRA proposed its XRT ore sorter, which has the capability to identify fine, high atomic dense tungsten inclusions with a detection technology developed in-house. "Our 'Inclusions Technology' is the perfect combination of a high-resolution XRT sensor with tailored sorting algorithms," explains Carolina Vargas, Area Sales Engineer at TOMRA Mining. "At the Barruecopardo mine, this technology enables the detection of 1-mm, or even smaller,



TOMRA sorting solution being implemented at Barruecopardo mine.

tungsten inclusions, which is unique in the market."

TOMRA conducted test work with its XRT technology on 10-30mm and 30-60mm particle sizes at its Test Centre in Wedel, Germany in 2019, which yielded positive results. "We chose TOMRA because of the reliability of the equipment in the tests and the time required to supply it," adds Jiménez.

In July 2023, TOMRA installed a COM Tertiary XRT ore sorter in the beneficiation stage. It is fed with raw material in the 8-25mm size range at a rate of around 45 tons per hour. The sorter achieves +90% recovery of scheelite and removes 85 to 90% of host rock prior to downstream processing through gravity concentration, magnetic separation and flotation. By only processing the material with scheelite content, the plant achieves significant cost savings.

The sorter has clearly demonstrated the value of this technology for the Barruecopardo mine. "The tests and the results achieved so far are positive and favourable. We are convinced this sorting technology will help Saloro to improve efficiency and production at the plant significantly," says Jiménez.

In fact, Saloro has decided to purchase additional TOMRA XRT sorters for the mine: "By purchasing more sorters, we aim to further increase the feed grade to the plant to remove material that does not contain scheelite."

TOMRA's hallmark collaborative approach stands out

TOMRA has developed a solid reputation for its collaborative approach to helping mining operations add value to their mines. This project was no exception, and Jiménez has found that TOMRA stood out for its involvement with Saloro. "Communication with members of their team is fluid and fast. Their willingness to solve problems that have arisen has been very effective. From the beginning, they have kept a close eye on the status of the project and monitored its progress on an almost daily basis." ■

TOMRA Mining

TOMRA Mining designs and manufactures sorting technologies for the global mineral processing and mining industries.

Saloro's tungsten mine in Barruecopardo, Spain.



MDS introduces mobile heavy-duty rock trommels to SA

Mobile heavy-duty rock trommels have hit the local market and are about to change the mining and quarrying landscape where their screening mechanisms will unlock mineral bounty faster and more efficiently.

As a result of its rotating barrel design, the minerals bearing materials can be manipulated to process easier and, in the case of coal and diamonds, the action of the trommel can be used to liberate the minerals and reduce the need for further processing. The action also suits sticky materials and those prone to clogging gravity fed incline and other types of screens.

Terex-owned MDS recently concluded an exclusive distribution agreement with the country's largest multi-franchise distributor, ELB Equipment, where it will be sold among the likes of Powerscreen, Terex Minerals Processing and other mining OEM suppliers. Wakefield Harding, ELB Equipment divisional director for mining, says the addition of the MDS range of tracked trommels effectively closes the screening loop for its customers with a full range of equipment for any application.

Although static trommels are used in the industry, the MDS tracked trommels provide flexibility to move the machine to suit the changing landscape of a mine and reduce handling. With aperture sizes up to 450mm the trommels can be fed large rock sizes and screened to three different streams if needed. Although the trommels are application specific, they are suitable for the coal, diamond, quarrying and borrow pits, and recycling industries.

The MDS trommels are also efficient in run-of-the-mill work wherever speed and efficiency is required.



Customers and staff gather as the covers are drawn off ELB Equipment's latest screening solution.



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Dr Ross Harvey, director of research and programmes at GGA.

The hidden (and not so hidden) injustice of coal

By Dr Ross Harvey, director of research and programmes at Good Governance Africa (GGA)

A new class action lawsuit being brought against Exarro puts the role of coal in our society firmly in the spotlight. Depending how one measures it at any given time, South Africa depends on coal for over 80 percent (or 42 GW) of its electricity needs. The national transmission grid is almost wholly configured to ingest coal-fired power from Mpumalanga. This explains why the roughly 6 GW of renewable energy potentially available from the last bid window (6) of the Renewable Energy Independent Power Procurement Programme (REIPPP) has not come onstream. Investments in grid upgrading are essentially non-existent. There are insufficient ingestion points in the regions producing complementary wind and solar power (Northern Cape and Eastern Cape). Six GW would have alleviated roughly 30% of the current 20 GW deficit and push the electricity availability factor back up to manageable, if not acceptable, levels. Unless things change rapidly in the policy landscape, we are stuck with coal for the foreseeable future. This raises a serious conundrum in the context of climate change and talk of a ‘just energy transition’, especially with climate change negotiations at COP28 in Dubai in November/December 2023.

On one hand, those who see justice primarily in terms of pro-poor industrialisation often seem tempted to argue that coal is just a necessary evil on the road to prosperity. The fact that South Africa is the 14th highest emitter of carbon dioxide in the world is a flash in the pan compared to emissions from China and the US combined. Moreover, it is hardly comparable to the rich world’s

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The national transmission grid is almost wholly configured to ingest coal-fired power from Mpumalanga.

consumption-driven ecological footprint. Without electricity, industrialisation is not possible. As it is, South Africa, along with the rest of southern Africa, is experiencing deindustrialisation. In other words, we are seeing a reduction in manufacturing value-add, and a declining share of employment in manufacturing sectors. This is happening earlier, and at lower per capita income levels, than it did with our industrialised counterparts. The latter moved out of manufacturing into high value-add services once manufacturing had generated broad-based wealth. Premature deindustrialisation, in a nutshell, relegates a country to perpetual middle-to-low income status and high levels of inequality. Coal-fired power, in this argument, is a driver of ‘re-industrialisation’ that will create wealth. We can worry about emissions later – the West, China and India must reduce emissions while we industrialise, as this is only fair. Moreover, the coal mining industry supports thousands of relatively well-paid jobs. Without that income, in a context of serial structural unemployment at around 40%, how could we possibly think of shutting down coal and leaving it in the ground?

On the other hand, those of us who take a more nuanced view of justice object to the above argument along the following lines:

We accept that re-industrialisation is a development imperative. However, it is too simplistic to argue that coal is a necessary evil to accomplish that end. The ends do not justify the means. Mining coal carries extensive negative externalities that still go unaccounted for. Negative externalities are the divergence between social costs and private returns. Coal mining (and burning) carries perhaps the most intensive social and environmental



externality burden of any economic activity on earth. Ten years ago, I reviewed a book by physician Allan Lockwood called *The Silent Epidemic: Coal and the Hidden Threat to Health*. What still haunts me is his point that coal-related deaths are never recorded on death certificates as “coal-induced pneumoconiosis” or related ailments that precipitate early death. While the income from coal jobs keeps extended families alive, the costs of early death directly related to those jobs are devastating and often conveniently ignored. This is tricky terrain. How does one measure whether coal jobs are worth the hidden social and environmental costs, especially when we consider the deleterious impact of coal mining on fresh water supplies in Mpumalanga?

The first step to resolving the conundrum is to recognise the false dichotomy. It is not a matter of coal jobs or poverty. However, it is true that a loss of coal jobs has acute, concentrated impacts. The gains to society from cleaner energy and a more diversified supply from renewables (including small modular nuclear reactors) are diffuse. Foreign investment would flow, which would in turn give confidence to local equity and debt investors to support new projects across all sectors. Investment into new mining exploration pipelines for minerals and metals required to power global energy transitions would also flow, provided we managed to fix our mining governance landscape.

However, any jobs created in renewables are likely to be far away from the areas affected by downscaling coal. And even if we were to solve load shedding tomorrow with large-scale renewables, the immediate loss of coal jobs and the negative impacts

on those families would cause socio-political grief and potential instability in the absence of a practicable anticipatory plan.

The second step, therefore, is to anticipate the effects of downscaling coal and simultaneously build up renewable projects and a critical raw materials (minerals and metals) exploration pipeline. Anticipating the effects of coal job losses requires significant investment in re-skilling coal workers and transforming the Mpumalanga region into a tourism and agricultural hotspot, fully cleansed from the negative impacts of coal. The tourism potential of the region is under-appreciated and therefore under-developed. Of course, this new economic vision requires radical governance transformation at local municipal level, but that is a column for another time.

We must move away from easy “whataboutism” and not tolerate the toxic effects of coal’s negative externalities or hidden costs. The environmental and social costs are offloaded onto poor communities who can least afford it. Arguing against coal is hardly unjust to the poor, especially given the suffering coming to light through the Exarro case. We must simultaneously give serious thought to what an appropriate alternative economic vision might look like. With COP28 in action, and the reality of humanity having cooked six of our nine planetary boundaries, the argument against coal could not be more urgent. Justice is nuanced; a reductionist view provides a smokescreen behind which coal apologists hide. We have to move beyond this and take some tough decisions that ensure a more sustainable future for all of us. ■

The gains to society from cleaner energy and a more diversified supply from renewables are diffuse.

Bold, decisive and urgent reform needed to save the steel sector

By Tafadzwa Chibanguza, COO of SEIFSA

Much has been reported in assessing the likely impact of the potential closure of ArcelorMittal SA's operations in Newcastle and Vereeniging, as well as ArcelorMittal Rail and Structural on the South African economy. Several alarming outcomes are emerging, all of which point to the fact that the country cannot allow this scenario to play out. Bold and aggressive reform, even at the local level, is urgently required.

What is not disputed is the extent to which the steel sector is integrated into the South African economy. The point, although obvious, only hits home when the country is squarely faced with the prospect of losing this critical asset. The long steel products that are at risk feed into the construction, heavy engineering, railways, automotive, fasteners manufacturing and mining sectors, and include the structural steel sections required for electricity transmission. The reach is vast, the consequences dire, and the cost immeasurable. Downstream businesses that rely predominately on supply from AMSA would also be irrevocably affected by the closure.

Some of the most alarming initial estimates relate to employment losses to the wider economy. Estimates for the first order and immediate impact are around 20 000 to 25 000 jobs, while the longer-term impact of second round effects is likely to be multiples more than this. The automotive sector has been reporting the adverse local content implications of this development, which amount to another second order proxy for local economic activity and jobs. Logistics costs, including longer lead times, and exchange rate provisioning, are likely to add anything between 20% to 30% to the cost base and domestic logistics challenges will only serve to compound this, rendering domestic manufacturing uncompetitive



Long steel products feed into the construction, heavy engineering, railways, automotive, manufacturing and mining sectors.

and infusing higher costs into the economy.

The extensive reach of the steel sector across the economy and the number of affected products will induce inflationary pressures, which will open up interest rate considerations throughout the entire economy. Moreover, once this domestic capacity is lost to import channels, which will invariably happen, a considerable segment of the country's industrial sector will be lost permanently.

The reality is that this localised development will have countrywide, immediate and long-term implications. What is urgently needed are bold reforms at the local level to prevent these scenarios from playing out. All options, including Negotiated Price Agreements (NPAs) for electricity, special dispensation, dedicated rail capacity, a levelling of the playing field with regard to uplifting the scrap metal ban and, in the long-term, exploring options for preferential pricing on iron-ore, amongst others, should be tabled and critically explored in a rational and collaborative fashion. Not to do so, would at best be irresponsible and at worse amount to economic suicide.

Organised business and industry bodies including the Steel and Engineering Industries Federation of Southern Africa (SEIFSA) are willing to stay the course and participate in urgent efforts to avert an economic disaster of unimaginable proportions.

The undeniable fact is that many of the levers to ensure this scenario does not play out are in the hands of the government. We call on government to stand and make these bold and aggressive reforms at both local and national levels. South Africa's steel industry must be saved. ■

Tafadzwa Chibanguza, COO of SEIFSA.

Downstream businesses are predominately reliant on supply from AMSA.



Tega Industries explores the future of minerals processing

Mining experts from across the continent recently attended a technical conclave hosted by minerals beneficiation supply specialist, Tega Industries. The event was aimed at sharing global research on the improvement of milling circuits and extending their viable lifespans. The conclave presented papers from experts across four continents and covered topics including optimisation and maintenance, innovations in mill liners and understanding the influence of design and operating variables on mill performance.

This was the second Mineral Processing conclave hosted by Tega Industries in South Africa and underscores the company's commitment to improving the

beneficiation process through research and development, as well as listening to the input of its many customers, and adapting to their unique needs. During the conclave the company made two significant announcements. First was its entrance into the equipment manufacturing market with a full range of crushers, screens, feeders, dry/wet grinding mills, slurry pumps, thickeners, floatation cells, filter presses, scrubbers, mobile crushing and screening plants. And second, was the announcement of the introduction of hand lining services that will be available to all customers using the company's advanced equipment for cold and hot bonding of liners to metal parts. ■



Tega Industries recently held a technical conclave for the mining industry.

Hägglunds Drives provides drive solution for RBCT stacker reclaimer

Hägglunds Drives South Africa, a Bosch Rexroth Company, recently commenced with a retrofit project on the bucket wheel of a stacker reclaimer at Richards Bay Coal Terminal (RBCT). The project, acquired via a tender process and realised late in 2022, entailed replacing a gearbox drive solution with a direct drive solution from Hägglunds Drives SA. Installation of the drive unit commenced at the end of August 2023 with commissioning conducted in late September. In addition to supplying the equipment, Hägglunds Drives SA's scope of work involved fitting the motor to the main shaft of the bucket wheel and positioning the drive unit on the slew with all relevant piping installed. "While we were awarded the contract via tender," says Ashley Mohun, Sales Engineer at Hägglunds Drives SA, "we have a long-standing relationship with RBCT, having provided solutions and services to them over the years." ■



Hägglunds Drives provides drive solution for RBCT stacker reclaimer.

Bell and Overlooked Group hand over houses

Bell Equipment Sales South Africa (BESSA) and the Overlooked Group (OVL) joined the Govan Mbeki Local Municipality recently to hand over four houses that have been built for indigent families as part of an approved low-cost housing project in the Municipality's eMzinoni area. OVL, a 100% black-owned diversified South African-based resources company with vast experience in housing projects of this nature, facilitated and provided project management expertise. BESSA provided over R1 million in funding for the project as part of its socio-economic development initiatives.

In his address, Bell Equipment Group Chairman, Gary Bell, said: "Some people don't realise that Bell Equipment is a fully South African company; our products are designed and built here from the ground up with our team of around 4 000 people. This type of project fits in well with what we do around the country. We work in hundreds of different regions and have many such projects." ■



Bell Equipment and Overlooked Group hand over houses in Bethal.

Weir Minerals Africa unlocks effective dewatering

Before the predicted high rainfall for most of South Africa expected in late-spring (November-December), mines and quarries should start assessing their dewatering needs. Given that each operation's requirements vary and present unique challenges, Marnus Koorts, General Manager Pump Products at Weir Minerals Africa, stresses that dewatering solutions should be adapted or customised to suit site-specific conditions. Koorts advises that for every dewater-



Weir Minerals Africa offers effective dewatering solutions.

ing project it is important the customer works with an OEM that understands the environment and site conditions, and specialises in dewatering solutions.

Several factors are worth considering before selecting and installing a dewatering solution, and this should start with a thorough assessment to facilitate the design and build of a fit-for-purpose dewatering solution that is site-specific, cost effective and manageable. "Each operation's dewatering requirements are different," says Koorts. "Consequently, we believe that dewatering solutions should be customised to suit the site conditions. At Weir Minerals, we don't supply a dewatering solution without first going to the site to assess the different parameters that determine an optimal solution for the operation." Another critical factor to consider is the head pressure required to pump the water out of the pit. Many of the pits are very deep, which means additional booster pumps are needed to overcome the large vertical lift. Based on the mine site configuration and whether an open pit or underground operation, these could be positioned at multiple levels to help raise the water.

"It is critical that the preferred dewatering system OEM be able to integrate all the various components into a single system. At Weir Minerals we have a large portfolio of in-house and external components that allow us to provide a fit-for-purpose dewatering solution and take responsibility for the entire system's performance," concludes Koorts. ■

WEG motors and drives are key players in SA's energy solution strategy

With the continued energy poverty being experienced in South Africa, motors and drives are set to play an ever more crucial role in industry's energy solution strategy.

The manufacturing and processing sectors, which include minerals processing plants, are energy-intensive industries, and finding ways to reduce energy consumption

while increasing efficiencies is essential for economic and environmental reasons. This is according to Jaco Brits, Projects and Technical Manager at WEG Africa, who says the company has the knowledge, expertise and technology solutions to assist operations in reducing their operating costs and increasing their productivity while guarding their energy security. "Advancements in motor and drive technology, underpinned by WEG's extensive research and development, have seen substantial improvements in energy efficiency, both equipped with advanced control algorithms to optimise motor performance based on real-time conditions," he explains.

"These algorithms assist in ensuring motors operate at peak efficiency levels, even in complex processes." "By upgrading to newer technology and installing higher efficiency motors such as the WEG IE3 or IE4 electric motor, customers can significantly lower their energy consumption. In addition to this," he adds, "by combining high efficiency motors with WEG variable-speed drives (VSDs), better control and optimisation of equipment can be achieved. ■



WEG motors and drives are key players in the country's energy solution strategy.

Multotec eyes environmental clean-up projects

Environmental restoration is an important consideration for Multotec, a leading mineral processing equipment manufacturer. The company recently undertook several environmental clean-up projects that have yielded positive outcomes. Faan Bornman, Technology Manager at Multotec, explains that the company had been approached by several clients to see whether it could provide solutions to specific environmental issues. Initially, Multotec was contacted by a company based in Spain that specialises in crushing and milling accident-damaged cars that have been written off. The client required a solution that would separate the metal and plastic parts of vehicles to recycle the metal.

“We conducted test work using spirals – equipment usually used in mineral processing – to establish if we could separate the materials, and we were successful. Apart from being able to distinguish the plastic from the metal, we took it a step further and used magnetic separation to extract the iron from the samples,” says Bornman. “Secondly, a South African electronic recycling company, DESCO Electronic Recyclers also approached us as they required PC components to be recycled. An important element of this process is to separate the metals from the plastics and non-valuable waste. Enrico Airaga, Technical Director at DESCO Electronic Recyclers, adds that by attempting to separate the unwanted plastics from the metals, the material is upgraded to a much better quality. This enhances the product and the profitability of the fraction. Bornman mentioned that while these were once-off



Multotec eyes environmental clean-up projects with test work yielding successful results.

projects, they proved that Multotec could use its existing mineral processing equipment for environmental rehabilitation work, an area the company is eager to explore.

“While we have not commercialised our environmental clean-up processes, this is an area where we could potentially make a significant contribution. This forms part of our drive to enhance the performance and efficiency of our products to maximise the separation of valuable materials from non-valorables, thus addressing many customers’ primary challenges,” Bornman concludes. ■



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Sandvik launches its most advanced top hammer tool systems

Featuring an industry-first curved thread design, Sandvik’s new CT55 and CT67 top hammer tool systems are the most advanced the company has launched. The unique design increases efficiency and reduces cost while saving fuel and simplifying automated drilling in surface bench and



Sandvik launches its most advanced top hammer tool systems.

underground longhole applications. The new multi-patented, first-of-its-kind curved thread design from Sandvik reduces stress levels by distributing them over a larger area inside the tool. This enables the system to handle higher drilling power and a drill rig’s full potential. “We are proud to offer an innovation that delivers significantly increased efficiency, since higher drilling parameters are allowed with fewer stops for breakages,” said Anders Brungs, Vice President Product Line Top Hammer at Sandvik. “Our design increases productivity by 15 percent while reducing fuel consumption by 15 percent, as faster drilling means less flushing time.” Sandvik’s unique new

curved thread CT system is designed to increase drilling productivity and reduce underground and on the surface costs.

“Surface drill rigs have much more power than current standard tools can handle,” said Fredrik Björk, Product Manager for Top Hammer Surface Tools at Sandvik. “This means the full potential of the drill rig cannot be used. Our new CT system radically increases the fatigue strength and we’ve also seen 30 percent longer tool life together with better hole precision in our product evaluation tests with early-adopting customers. This is a fully optimised system that includes the drill rig, the rock drill and the rock tool.” ■

Martin Engineering celebrates 20 years of growth in Africa

Bulk material handling solutions manufacturer, Martin Engineering, has celebrated its 20th anniversary of growth across Africa. The company, which works with mining and mineral processing companies to improve safety, efficiency and productivity, first entered Africa in November 2003 with



Martin Engineering celebrates 20 years of growth in Africa.

the acquisition of South African business Scorpio Conveyor Products. Two decades later Martin Engineering has grown significantly, with employee numbers increasing 10-fold to almost 200 people, and a customer base spanning 10 countries and a range of industries across Africa. The business has plans for further growth thanks to an ambitious team of technical experts and an innovative range of products that deliver cleaner, safer and more productive materials handling. Joining the 20th anniversary celebrations was global CEO Robert Nogaj, who said: “The African continent is a global supplier of essential minerals and metals, and an important market for Martin Engineering, so I am delighted to be

spending time with colleagues to celebrate 20 years of supporting producers here in South Africa, and across the continent.

“Over the past two decades we have made substantial investments in our production facilities and introduced new technologies that have helped our African business to grow and evolve. Yet the most important investment we have made is in supporting and developing our people, fostering talent, and promoting diversity in the workplace.” ■

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