wattnow

THE OFFICIAL PUBLICATION OF THE SOUTH AFRICAN INSTITUTE OF ELECTRICAL ENGINEERS

MINING

SEPTEMBER 2024

SAIEE

CONTENTS

Dear **watt**now reader

South Africa holds a treasure trove beneath its surface—a wealth of minerals waiting to be extracted and utilised for the betterment of the country and its people. Mining in South Africa has long been a cornerstone of the economy, providing valuable resources for the manufacturing and construction industries. While the industry has faced challenges in recent years, there is no denying its potential for growth and development.

In this issue, which features mining, our first feature article, "Tracking the Trends 2024," on page 20, provides more insight into how the mining and metals industry is at the centre of a complex matrix of challenges, opportunities, expectations, and demands.

One of the most significant challenges facing the Energy, Renewables, and Mining sector in the 21st century is the unmistakable need to move to renewables and a more environmentally friendly and economically sustainable future. Page 50 discusses the "Embedded costs of Lithium Batteries."

The SAIEE is hosting its 73rd Bernard Price Memorial Lecture on 26 September in the Senate Room at Wits University. Lecturer, Prof Marivate from the University of Pretoria will discuss "Charting a Path for African Low-resource Languages." Please RSVP to Gerda Geyer by 20 September. The official invitation is on page 49.

The October issue features Communications, and the deadline is 16 September 2024. Please send your articles to minx@saiee.org.za to earn 0.1 CPD credit per article published.

Here's the September issue; enjoy the read!

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Pascal Motsoasele
2024/5 SAIEE President

Dear Council Members, Fellows, Senior Members, Members, Associates of the SAIEE, and prospective members of the Institute, please lend me your ears.

These past few months, I have been inundated with enquiries from persons who have completed certificated artisanal courses or programmes in electrical engineering. Some of these people are holders of N3 – N6 certificates in subdisciplines of electrical engineering (e.g. process instrumentation and control), others have completed the electrician trade test and are holders of a wireman's license, and others have completed 1-year focus programmes in renewable energy or any other subdiscipline of electrical engineering. Their enquiry is whether they qualify to become members of the SAIEE.

This 115-year-old Institute is transforming and becoming more inclusive. During my inaugural address in March 2024, I announced the decision that the Council took to change the last "E" in SAIEE from being an acronym for "Engineers" to "Engineering". We have noted that many electrical engineering practitioners seemingly feel excluded from considering themselves for membership in the Institute simply because they are not "engineers".

Still, we are technologists, technicians, certificated engineers, artisans or any of the higher certificate-specified categories of engineering practice as defined by the Engineering Council of South Africa (ECSA). Therefore, the Council approved the name change to the South African Institute of Electrical Engineering for inclusivity and membership growth.

The logo and SAIEE acronym are, thus, not impacted by this change. We are working on a few matters, including our official registration at the CIPC, to ensure alignment with the change. Meanwhile, I encourage you to please feel free to reach out to other electrical engineering practitioners and inform them that they have a home at the South African Institute of Electrical Engineering.

I look forward to welcoming them and signing their membership certificates.

Similarly, we have been in conversations with a few corporations to woo them into taking up corporate partnerships with us and, where not feasible, get them to agree to sponsor some of the Institute's activities. We have a few corporate sponsorship packages on offer, but we are also open to tailor-making an offer based on client requirements – please feel free to spread the message far and wide.

Corporates do not necessarily need to be within the engineering industry. Because of the electrical engineering fraternity's technological wares (e.g. electricity, Internet and telephony, computers, etc.), we can tailor a mutually beneficial value proposition for any economic sector or industry. They have a home with us – I look forward to welcoming them into our ranks; together, we shall transform the engineering industry and our business models for mutual benefit through greater collaboration, leveraging each other's strengths and market growth opportunities.

Here's to the South African Institute of Electrical Engineering. May it thrive beyond another 115 years!

Yours in service of the Institute.

Pascal Motsoasele
SAIEE President

E: president@saiee.org.za

Powering South Africa's Copper Mining Future

Current Challenges in Copper Mining

- Ageing Infrastructure: Outdated equipment and facilities boosting maintenance costs.
- Rising Operational Costs: Escalating expenses impacting profitability.

Opportunities & Prospects:

Ageing Infrastructure:

- Comprehensive Audits: Conducting thorough assessments of current infrastructure to identify weaknesses and areas for improvement.

Rising Operational Costs:

- Cost-Effective Design: Developing designs that are cost-effective and scalable, ensuring that investments in infrastructure deliver long-term value.

Project Spotlight:

Khoemacau Copper Mine, Botswana:

- Project: Detailed design of Substation and Line for integration at the Magotlhwane 220/132 kV substation.
- Our Role: Providing specialised power generation and high voltage services to enhance operational efficiency and reliability.

Transform Your Mining Operations Today!
Contact us today to learn how we can support your power generation and high-voltage needs.

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Power Generation | Transmission | Distribution

an Eskom and FLUOR joint venture company

Africa gears up for a new era of Smarter Mobility Africa

Africa is on the move with rapid urbanisation, and to navigate this exciting yet challenging landscape, the Smarter Mobility Africa Summit 2024 is set to convene with industry leaders, policymakers, government representatives, investors and innovators this October, 2 - 4 in Johannesburg, South Africa.

The 6th edition of Smarter Mobility Africa summit, themed "Embracing the New Urban Era" will focus on the critical role of integrated smarter mobility solutions in shaping the future of African cities.

SMA Summit 2024 is delivering a dynamic program this year featuring:

- Keynote addresses from leading and inspirational figures in the mobility sector
- Interactive panel discussions on topics such as Expanding Public Transport, Green Fleets, Rail, Active Mobility, New Energy Vehicles, and urban planning
- Mobility Investment Pitches
- Training and Workshops
- Site visits at Gibela Train Manufacturing Plant
- Quality networking opportunities to connect with industry peers and potential partners
- A showcase of cutting-edge technologies and solutions on the exhibition floor
- Women in Mobility
- Exhibition Awards
- Smarter Mobility Africa Gala Dinner
- Ride & Drive experiences of the latest vehicles

To find out how you can get involved with the urban mobility revolution within Africa, click here to download our full program brochure.

As an SAIEE member, you receive a 15% discount off the full delegate ticket price, register here.

Electrifying achievement!

916.74 KILOMETRES ON A SINGLE CHARGE SETS NEW GUINNESS WORLD RECORDS™

From left: Richard Parker, Sam Clarke, Kevin Booker, Carl Saville (GWR adjudicator).

Webfleet, Bridgestone's globally trusted fleet management solution, has broken the Guinness World Records title for the longest journey by an electric car on a single charge of 916.74 km (569.64 miles). The new benchmark in electric vehicle (EV) performance was achieved by Webfleet-sponsored drivers Kevin Booker and Sam Clarke, supported by co-pilot Richard Parker of Webfleet, in a Ford Mustang Mach-E SUV fitted with Bridgestone tyres.

The record attempt was meticulously documented with independently verified video footage, odometer readings, GPS, and battery level data from Webfleet. Equipped with a 91kWh battery and boasting a WLTP range of 600.28 km, the Mach-E Premium Extended Range SUV RWD Auto, with 18" wheels – selected for its advanced battery technology and driver comfort – surpassed expectations, averaging 10.05 km per kilowatt hour (kWh) on England public roads throughout Norfolk, Lincolnshire, Yorkshire, Nottinghamshire, Leicestershire and Cambridgeshire.

The drive, completed over 24 hours, included a mix of urban and rural roads to emulate real-world driving conditions. Bridgestone tyres were a critical component in the world record attempt, offering outstanding mileage and low rolling resistance. "This record is a testament to the hard work and dedication of everyone involved in this endeavour," said Beverley Wise, Webfleet UKI Regional Director for Bridgestone Mobility Solutions.

"It represents a significant milestone in the electrification of road transport and demonstrates the potential of electric vehicles when supported by innovative Bridgestone tyre design and advanced fleet management technology," remarked Booker.

Clarke added, "Driving the Ford Mustang Mach-E for such a distance on a single charge was an extraordinary experience. The vehicle's efficiency and the support from Webfleet's technology made this possible."

Clarke and Booker hold previous records for fuel economy and energy consumption in electric vehicles. They have now amassed five and two driving-related Guinness World Records titles, respectively.

"We are delighted to have supported this incredible achievement with our expert patrols and backup team. The drivers and Ford Mustang Mach-E, Bridgestone and Webfleet have all used their expertise to prove that EVs can go much further than people think. Such endeavours are important to show that electric vehicles can be a major part of the future transport mix," said Edmund King OBE, AA president. wn

Relaxed about no load shedding? Think again.

During the Opening of Parliament Address (OPA) recently, Electricity Minister Dr Kgosientsho Ramokgopa spoke glowingly about the radically reduced load shedding. Indeed, at the time of writing there has not been load shedding for more than 100 days. While this is the norm around the world, the fact we've gone almost a third of a year without rotating national power cuts is remarkable.

By Lance Dickerson, co-founder and MD, Revov

However, tell that to some communities in Johannesburg who face daily load reduction at best, and who, at worst, go without power for days on end, over and over again. One is not hard-pressed to find communities around the country at their wit's end through incessant and prolonged power cuts. The more things change, the more they stay the same.

While the country's electricity utility Eskom is managing to meet demand – which is substantially reduced in large part through other-side-of-the-meter solar installations – local infrastructure is so rotten that some areas barely last a day or two before being plunged into darkness again. Cynically, even this reduces demand keeping national load shedding at bay.

This is how the National Energy Regulator of SA (Nersa) defines load reduction: "Emergency Load reduction may take the form of load shedding (time-based interruption of supply to customers on a rotational basis), mandatory load curtailment (self-reduction by customers in response to an instruction given by the system operator), load limiting (a limit placed on the current or power consumed by a customer, typically enabled by smart meter technology), or customer load switching (remote switching of customer circuits to specific appliances, typically enabled by smart meter technology or ripple control technology).

Eskom provides a bit more clarity on the "why" when it states on its website: "Load reduction is a long-established process that Eskom uses in specific areas when there is sufficient electricity available, but a transformer's integrity is at risk due to overloading, whereas load shedding is used when the national grid is constrained and there is not sufficient capacity to generate electricity to meet demand. It is also a proactive measure that Eskom uses to protect human life, equipment worth millions of rands and people's livelihoods. Overloading of the transformers is recorded mainly during peak hours around 05:00 and 07:00 in the morning and 17:00 to 19:00 in the evening." In other words, load reduction is protective. To this backdrop, the City of Johannesburg recently announced it would be implementing rotational load reduction to prevent its grid from collapse.

Acknowledging the obvious is not unpatriotic, it is prudent: The state of the distribution network in Johannesburg is frighteningly close to collapse, with teams of technicians running around full time trying to reconnect communities.

While this is evident in many parts of our country, some worse off than Johannesburg, it is important to remember that this is the economic hub of the country.

A glance at City of Johannesburg's load reduction schedule at the time of writing reveals that 88 suburbs, excluding their various extensions which would increase the number, are affected today in two-hour blocks reminiscent of stage 2 load shedding. There are very clear patterns in the areas and one can colour in a map showing where the infrastructure is on the verge of collapse.

The REVOV PRISM is a compact, server-mounted, all-in-one system with pre-programmed settings to ensure a fast installation. The units contain all the necessary wiring and correct fusing, making it quick to install.

Then, not on that list are suburbs in the west of the City which suffer repeated and extensive power cuts, with reasons varying from cable faults to substation failures. Some leafy suburbs have large power cables running from mini substations, along trees and across street lights (held up by wire), and fed directly into people's homes.

Let's be clear, this is not a diatribe. This is an observation of the status quo which we know can be fixed with the right political will and public-private cooperation. The point is that we, as a country, cannot take our foot off the accelerator. We have cautioned for as long as we have been working in energy backup in the country that energy generation was only one half of the problem.

Households and businesses have no choice but to try to guarantee their own power continuity until such time as all the problems mentioned have been addressed. Households cannot let out a huge sigh of relief – they absolutely should still be investing in uninterrupted power supply (UPS) systems, be these bespoke or plug-and-play solutions. They should still, wherever possible, be investing in solar installations and demanding they are built with sufficient backup capacity.

Businesses, from small retailers inside retail centres or malls, all the way to large operations in the manufacturing, mining, construction, education and property management industries cannot listen to OPA speeches and feel secure that they'll have the power they need to run their businesses uninterrupted. Low- and high-voltage battery backup systems are still, in 2024, the only sure way businesses can secure their power supply not only to keep the lights on, but to drive industry and the economy which has suffered immensely as a direct result of the electricity crisis.

However, it is crucial for everyone, from those working at home to those on the boards of large businesses, to understand – not all batteries are built equally. Lithium iron phosphate batteries, especially those built with EV battery cells and referred to as 2nd LiFe, have proven they not only have the right chemistry and safety profile, but are robust enough to handle harsh operating conditions and the charge and discharge rates synonymous with our South African landscape. wn

SkyJacks to showcase the latest innovative powered access, material handling and lifting equipment at Electra Mining 2024

SkyJacks, a leading provider of hiring and selling powered access, material handling and lifting equipment for the construction, mining and industrial sectors, is excited to announce its participation in Electra Mining 2024, scheduled from 2 – 6 September at the Johannesburg Expo Centre, Nasrec.

As one of the premier events in the mining and construction sector, SkyJacks will be showcasing the company's latest innovations in powered access, material handling and lifting equipment across the OEM brands it represents, including Dingli, Faresin, Jekko, GEDA, and ALR with a special focus on the South African and broader SADC markets.

SkyJacks aims to leverage this platform to deepen connections with current and potential clients, industry partners, and key stakeholders. Says Alistair Bennett, MD at SkyJacks, "By showcasing our latest equipment, we will provide companies with the opportunity to identify solutions that match their unique requirements with our versatile product range, which is designed to meet the diverse needs of the mining, construction, and industrial maintenance sectors.

We are at the forefront of integrating advanced technologies into our offerings which meet the evolving needs of our markets and customers."

"The tenets of our business are built on innovation, reliability, and customer-centricity. Our equipment not only reflects our dedication to high performance but also addresses the urgent need for sustainable and efficient solutions in our industry that meet the exact requirements of our markets."

The theme for this year's event, 'Connect with your Future' resonates strongly with SkyJacks' vision. By integrating advanced technologies into its offerings, SkyJacks is empowering companies to embrace sustainable practices that boost productivity and safety in their operations.

SkyJacks will feature a selection of innovative products from its partner brands:

Dingli Mobile Elevated Work Platforms: As one of the world's top manufacturers of mobile elevated work platforms, Dingli provides a comprehensive range of articulated and telescopic boom lifts, including the revolutionary BA44RT with working heights ranging from 16m to 44m in diesel, electric, and hybrid options. They also supply electric slab scissor lifts and vertical lifts that are renowned for reliability and efficiency.

Faresin Telehandlers: The Faresin range includes models with diverse configurations catering to agriculture, construction, and mining. Notable models like the 6.26 and 17.40 Classic telehandlers, which will be on display at the event, showcase cutting-edge design paired with powerful performance and exceptional comfort.

Jekko Mini Cranes: With continual product innovation, these mini cranes feature advanced technology, such as the SPX328CL (lithium battery powered) and SPX532CDH (diesel model), that are engineered for precision in confined spaces while providing high lifting

capacity and excellent safety features. They are ideal for uneven ground or difficult to reach places.

GEDA Construction Hoists: Known for their robust design, GEDA hoists enhance worker safety and operational efficiency. Models like the GEDA 1500 Z/ZP F and GEDA Solarlift offer unique qualities in safe vertical transportation.

ALR Lever Hoists and Chain Blocks: Designed to withstand the toughest environments, the ALR range features exceptional durability and industry-leading safety standards, making them ideal for underground mining and engineering applications.

Bennett concludes, "The South African and SADC markets are ripe for the advanced technologies and sustainable solutions SkyJacks offers. With ongoing infrastructure development and an increasing demand for efficient material handling and working-at-height solutions, our showcased products promise to address critical operational needs while enhancing safety and productivity."

Visit SkyJacks at Stand YE41. wn

105 South African women graduate from EWSETA energy leadership programme

In a significant stride towards gender inclusivity and empowerment, 105 South African women have graduated from the prestigious 'Women Leading in Energy Sector' (WLES) bursary programme. This initiative, a collaboration between the Energy and Water Sector Education and Training Authority (EWSETA), Eskom, and Duke Corporate Education, culminated in a celebration of women leaders in the energy sector, including Eskom's female power station managers, marking the commencement of Women's Month in Johannesburg.

The WLES program targeted executive and middle management professionals from Eskom, Small, Medium and Micro Enterprises (SMMEs), and Technical Vocational Education and Training (TVET) colleges. Over nine months, participants honed leadership skills and prepared for an enriching global immersion experience in the USA and Germany. The curriculum emphasised personal leadership development, strategic operations, sustainable economics, work-life balance, advocacy, and building supportive networks. Academic modules delved into entrepreneurship, renewable energy trends, sustainable solutions, and policy. EWSETA CEO Mpho Mookapele highlighted the programme's comprehensive approach, "The Women Leading in Energy programme underscores the importance of local thinking, strategic application, and collaboration in skills development through experiential learning. These principles are critical in the energy transition, where creative leadership and alignment with sustainability goals are essential to addressing local socio-economic challenges and generating economic and social benefits."

Monde Bala, Interim Group Executive for Human Resources at Eskom, praised the programme's impact: "Eskom is committed to advancing the role of women within the organisation. We can already see the benefits of how it has revolutionised their professional and personal lives. By planting a pipeline of women leaders, we are securing a stronger, more inclusive future for future generations."

The programme's focus on SMMEs and TVET colleges reflects EWSETA's commitment to advancing human capital in the Just Energy Transition (JET) and promoting inclusive economic participation. By targeting SMMEs, a cornerstone of South Africa's energy sector and crucial for future job creation, EWSETA ensures that small and medium enterprises are well-equipped to contribute to the industry's growth.

Praise Nyalungu, a Senior Lecturer in Civil Engineering at Capricorn TVET College in Limpopo and participant in the Middle Management cohort shared her experience, "As the only female in my section, overseeing predominantly male subordinates and students, the leadership principles I gained were invaluable. The programme has equipped me to foster collaboration and pursue our common goals, regardless of gender."

The energy sector in South Africa continues to face a gender imbalance, with women making up only a fraction of leadership roles. The International Energy Agency reports that 76% fewer women than men are working in the energy sector globally. Programmes like WLES are crucial in bridging this gap and ensuring a more equitable future.

EWSETA values its partnership with Duke Corporate Education, whose expertise and educational frameworks have provided invaluable support for South African women in the energy sector. This collaboration is pivotal in nurturing a new generation of leaders who can navigate the complexities of

Penny from Eskom shared her experiences of the programme.

the national energy landscape with innovation and a global perspective.

"These remarkable women have embarked on a transformative journey that has enriched their perspectives and provided them with the tools to drive meaningful change within the vocational training system and South Africa's energy sector. Their experiences have undoubtedly inspired and empowered them to be well-rounded, proudly South African leaders in their respective spaces. This is a true reflection of justice as we transition the energy sector," concluded Mookapele.

How to Test for Continuity with a Multimeter

Understanding the role of a continuity tester in electrical diagnostics is crucial for professionals and enthusiasts alike. This guide offers a step-by-step approach to using a digital multimeter as a continuity tester, ensuring precise and safe measurements. Whether testing switches and fuses or making general electrical connections, mastering a continuity tester is critical to effective electrical troubleshooting.

SETTING UP YOUR DIGITAL MULTIMETER FOR CONTINUITY TESTING

First, properly setting up your digital multimeter for the continuity test is essential. This involves:

1. Selecting the Correct Mode: Turn the dial to Continuity Test mode. This mode often combines with other functions, typically resistance (Ω). The multimeter's display may show OL and Ω with the test probes separated.
2. Activating Continuity Mode: Some models require pressing a continuity button to activate this specific testing mode. If your multimeter has this feature, ensure this step is followed.

EXECUTING THE CONTINUITY TEST:

Step-by-Step Instructions

Once your digital multimeter is set up, follow these steps to conduct the continuity test:

1. Connecting Test Leads: Insert the black test lead into the COM jack. Then, insert the red lead into the VΩ jack. Always remove the leads in reverse order after testing: red first, then black.
2. Testing the Circuit: Connect the test leads across the tested component with the circuit de-energised. The position of the test leads is arbitrary, but ensure the component is isolated from other components in the circuit.
3. Interpreting Results: The digital multimeter (DMM) emits a beep if a complete path (continuity) is detected. If the circuit is open (the switch is in the OFF position), the DMM will not beep.
4. Concluding the Test: When finished, always turn the multimeter OFF to conserve battery life.

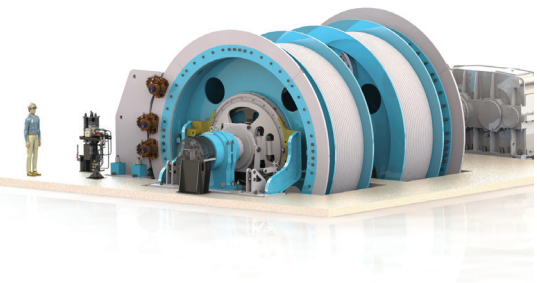
UNDERSTANDING CONTINUITY TESTING: PRINCIPLES AND PRACTICES

Continuity is the presence of a complete path for the current flow. A circuit is considered complete when its switch is closed. Here are some key points to remember:

- Applications of Continuity Testing: A digital multimeter's Continuity Test mode is versatile and suitable for testing switches, fuses, electrical connections, conductors, and other components. For example, a good fuse should show continuity.
- Audible Indicator: The beep is an audible response from the DMM when it detects a complete path, allowing technicians to focus on the test without constantly monitoring the display.
- Understanding Resistance and Beeps: The beep is triggered based on the resistance of the tested component, influenced by the multimeter's range setting. For instance, at a 400.0 Ω range setting, a multimeter typically beeps if the component has 40 Ω or less resistance.
- Optimal Range Setting: Use the lowest range setting to test components with low-resistance values, such as electrical connections or switch contacts.

For more info, visit COMTEST

ABB supplies hoist solution to Karowe Diamond Mine expansion in Botswana



Leading technology provider ABB has provided a unique hoisting solution to Botswana's Karowe Diamond Mine expansion project. Owned by Lucara Diamond Corporation through its subsidiary Lucara Botswana (Pty) Ltd., the state-of-the-art mine was fully commissioned in Q2 2012. It produces large, high-quality Type IIA diamonds in excess of 10.8 carats. The expansion project is designed to extend the mine life to at least 2040 and deliver over $4 billion in revenue.

To expand existing operations and increase the life of the mine, it was decided to sink two shafts: a ventilation shaft and a production shaft. The production shaft will accommodate hoisting production with a production winder supported by a service winder.

"Throughout the project lifecycle, we have supported the project team in finding the best solution. As an industry leader, we are committed to it," explains Danielle Koekemoer, Hoisting Sales Manager at ABB. ABB's expert hoisting team collaborated with a Canadian and South African engineering, procurement, and construction (EPC) contractor.

"Along with the project team, we determined the best way to use the existing fleet of winders and how to refurbish them," explains Danielle, including for the vertical ventilation shaft. The refurbished equipment included two kibble winders, two-stage winders, and auxiliary equipment.

All four refurbished winders were provided from the winder complement owned by the UMS Group and refurbished under the guidance of ABB by local subcontractors. The shafts are being sunk with the refurbished winders. The kibble winder used to sink the production shaft will be the permanent rock winder after the shaft sinking is complete.

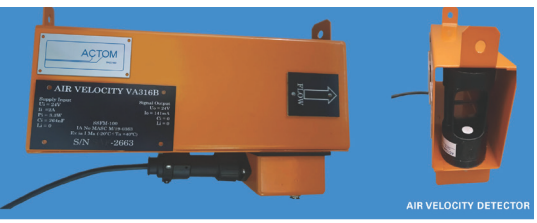
Upon completing the first part of the project, ABB was awarded a contract over R130 million to supply a new auxiliary winder and service winder to transport personnel and material to the underground works. Danielle points out that the expertise from ABB's engineering department was essential to ensure an optimal and viable solution for the client.

"We work with our customers for an extended period before they procure the equipment, which assists the project team in economising on the number of machines to be supplied and permanent hoists to be deployed to carry out the sinking. That is how we partner with the end user to ensure that by the time the procurement package is sent out to the market, the correct equipment is specified for the application," says Mike Davis, Global Product Manager for Hoisting at ABB.

With over 130 years of experience, ABB is today the market leader in the segment, with over 1,000 hoisting solutions delivered worldwide. It has the unique capability to design, supply, install, and provide long-term service and support for entire mine hoist mechanical and electrical systems. It supplies everything from friction hoists to various drum hoists and the shaft equipment necessary for productive hoisting processes.

ABB mine hoist solutions provide a low lifecycle cost, high reliability and system availability, short project execution time and a single supply source for the complete system, including service and spare parts. Its world-renowned engineering resources are also available for feasibility studies and conceptual solutions to advance a mine's hoist system by tapping into a vast network of global hoist experts. wn

ACTOM Industry unveils advanced fire detection and safety solutions for explosive atmospheres



ACTOM Industry, renowned for its expertise in mine winder hoists within the ACTOM group, is expanding its portfolio by introducing cutting-edge fire detection and safety solutions designed for explosive atmospheres. Leveraging its advanced power electronic drive, control, and switchgear technology, ACTOM Industry continues to lead by ensuring enhanced safety and protection in hazardous environments.

ACTOM'S INTRINSICALLY SAFE FIRE DETECTION SYSTEMS: SETTING THE STANDARD

Our fire detection systems, rigorously tested and certified by the South African Bureau of Standards (SABS) to meet the stringent criteria of SANS 1515, are intrinsically safe for use in explosive atmospheres. This approval underscores our commitment to safety and quality. Among our comprehensive range are:

- Air Velocity Detectors
- Carbon Monoxide Detectors
- Methane Detectors
- Particle Smoke Detectors

EXCLUSIVE OWNERSHIP OF CRITICAL DETECTORS

In 2023, ACTOM Industry acquired sole ownership of the Safdy Air Velocity Detector and the Safdy Methane Detector, consolidating our position as the premier safety solutions provider.

This acquisition grants us exclusive rights to manufacture, market, and distribute these essential products.

ACTOM AIR VELOCITY DETECTOR: ENHANCING MINE SAFETY

Formerly known as the Safdy flow meter, the ACTOM Air Velocity Detector features a solid-state airflow sensor designed to monitor airflow rates in challenging environments typical of mining operations. Utilising the reliable VORTEX method ensures precise measurements independent of small particles, ensuring optimal performance even in dusty or high-moisture conditions.

REAL-TIME MONITORING FOR ENHANCED SAFETY

Proper air circulation is vital for safety in underground mining. Our Air Velocity Detector swiftly detects any decrease in airflow, alerting operators within seconds through SCADA systems. Housed in a robust metal enclosure, it withstands impacts during handling and minimises the effects of crossflow, ensuring consistent and reliable performance.

PROVEN PERFORMANCE IN RIGOROUS CONDITIONS

Extensively tested within the South African mining sector, our Air Velocity Detector has emerged as the top choice for underground applications. Boasting an impressive accuracy rate of approximately 89%, it remains unmatched in durability and precision. Its resilience against water mist and dust minimises maintenance demands, ensuring continuous safety in hazardous environments.

ACTOM Industry reaffirms its commitment to safety and innovation in industrial settings by providing cutting-edge solutions backed by unparalleled performance. wn

Loop CEO: More women in tech means more girls pursuing STEM careers

Kimberley Taylor
Founder and CEO, Loop

Kimberley Taylor, founder and CEO of Loop, a delivery management platform that supports the Checkers Sixty60 operations, is an outlier in her field. Women comprise only 29.2 % of Science, Technology, Engineering and Maths (STEM) workers and 12.4% of C-suite executives globally. In South Africa, just 13 % of STEM graduates are women.

Taylor may be part of an elite club of female tech start-up founders, taking inspiration from the likes of Whitney Wolfe Herd of Bumble and Sheila Lirio Marcelo of care.com. Still, the Loop founder is determined to break down barriers and open doors for more women in the predominantly male-dominated tech industry, known for its gender disparity. "The tech industry shapes much of our daily lives", she explains. "When we exclude women from leadership and decision-making roles in this field, we're not just holding back the industry - we are also slowing progress for everyone".

DYNAMIC DELIVERIES

Taylor's brainchild, Loop, an innovative delivery management platform, revolutionised the South African delivery and logistics sector. The company started trading as Cowa-Bunga and launched its services in 2017 but scaled in 2020 during the pandemic when online deliveries surged.

In 2021, it rebranded as Loop, introducing improved technology to enhance the driver-to-customer delivery experience. Today, Loop connects businesses with suppliers, delivery service providers, and customers. It handles more than 3 million deliveries monthly, serving major retailers like Checkers and their Sixty60 App and smaller SMEs looking to streamline their operations.

Clients praise Loop's effectiveness, reporting:

- A 30 per cent increase in delivery volume
- A 20 per cent reduction in kilometres driven
- A 15 per cent decrease in customer interaction time

STEM LACKS GENDER DIVERSITY

At the helm of Loop, Taylor wants to create more opportunities for women in South Africa's tech industry. "Some people find Women's Day and Women's Month campaigns repetitive or even misused. But I think they're important for highlighting the lack of women in STEM jobs," she says.

Despite global progress in closing the gender gap in STEM, South Africa continues to struggle. " Women are vastly underrepresented in STEM careers.

We must address this to promote gender equality and boost the economy", she adds.

Only 13 %of STEM graduates in South Africa are women, well below the global average of 35 %. In the broader workforce, women hold just 28 % of STEM-related jobs. Specific sectors like engineering show even lower participation, with less than 25 % of candidate engineers being women and only 6 % achieving professional status.

She argues that substantial investment in STEM education is the most effective way to reduce gender inequality. According to her, excellent teachers are indispensable for establishing a solid groundwork in maths and science, especially for students pursuing tertiary studies.

START THEM YOUNG

Taylor encourages parents to nurture their daughters' interest in maths from a young age. She credits her own strong maths skills to early lessons with her father. "My dad taught me basic maths before school, which gave me confidence in maths from a very young age and made me love it for its conceptual, logical foundation. You learn maths by practicing and solving problems, not memorisation. Practicing it helps you understand it better and build on what you know."

Girls often demonstrate better mathematical and scientific abilities, outperforming boys in maths and science at school. However, only a tiny percentage pursue these subjects at the tertiary level. Studies attribute this to persistent stereotypes suggesting that men are inherently better suited for STEM fields and a lack of female role models.

'To truly close the gender gap in STEM, we must encourage girls' interest in maths and showcase successful women in diverse roles', Taylor explains. "Whether it's science, business, or politics, we need more female leaders. Even movies like 'Legally Blonde', where Elle Woods, a law student, defies everyone's expectations about what a criminal attorney looks like, inspire girls to pursue ambitions they would not ordinarily consider", she says.

WHY ROLE MODELS MATTER

"Women's Day and Women's Month are opportunities to celebrate women's successes and those who supported them. Seeing successful women like themselves inspires girls to reach their full potential," Taylor says.

She credits her mother's entrepreneurial spirit as a primary motivator for her career in a male-dominated field. "She was a single mum with her own catering business and exuded confidence, fearless of failure or judgement. Her boldness inspired me. I thought, "My mum could do this. I can, too. I can work hard and not be afraid to fail."

Nevertheless, Kimberley acknowledges the challenges of pitching one's company to potential investors. Despite her mother's apparent fearlessness, she realises entrepreneurs often face the fear of rejection or embarrassment.

"Even now, I struggle with this', Kimberley admits. 'It gets easier over time, but some days the challenge feels as daunting as ever. However, I remind myself of the woman I aspire to be: someone who creates opportunities for others. Achieving my goals requires fearlessness, and when my confidence wavers, I reflect on the achievements of female role models like my mother for strength."

WHY DIVERSITY BENEFITS EVERYONE

She attributes Loop's success to its inclusive workplace culture, which has proven critical in an industry struggling with female employee retention. According to a 2023 survey by the British career advice site womenintech.co.uk, 56 % of women leave the tech sector between 10 and 20 years into their careers—double the rate of men.

Taylor emphasises that a diverse workforce is imperative for innovation and effective problem-solving.' "At Loop, we've prioritised creating an environment where all employees, particularly women, can thrive long-term."

This approach includes targeted strategies such as mentorship programmes, flexible work arrangements, and clear paths for career advancement. The results speak for themselves: Loop's workforce has doubled since 2021.

Taylor notes that this diversity wasn't initially a deliberate policy. "Our inclusive culture evolved organically, attracting individuals who shared our values of hard work, intelligence, and compassion—both for colleagues and clients".

This organic growth has led to a team that Taylor describes as "incredibly hardworking and intelligent, with a genuine care for each other and our clients".

Her advice to other tech companies is straightforward, she says. "Prioritise diversity and actively work to close the gender gap.

Not only is it the right thing to do, but your company will also reap significant benefits in innovation, problem-solving, and overall success", she concludes. wn

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Tracking the trends 2024

NAVIGATING GLOBAL CHALLENGES AND OPPORTUNITIES IN MINING AND METALS

The mining and metals industry finds itself at the center of a complex matrix of challenges and opportunities, expectations, and demands.

With supply shortages looming in metals that are critical, not just to the energy transition but to global urbanization and industrialization, stakeholders are acting strategically to secure their supply chains (copper, for instance, is expected to see a supply deficit of 9.9Mt by 2035[1]).

With supply source alternatives such as urban mining still in their infancy, downstream companies and even governments are striking deals with miners and metals providers in a reshuffle that has seen some traditional value chains realign over the past 12 months.

Organizations also remain under pressure to improve the efficiency of existing assets and operations by embracing generative artificial intelligence (gen AI), leveraging third party delivery models with specialized back office capabilities and to unlock new value in assets. Additionally, the need for mining and metals companies to collaborate with industry peers, suppliers, and competitors to tackle productivity and environmental issues, all while upholding environmental, social, and governance (ESG) expectations in day-to-day operations remains a priority.

With strong business strategies in place and 2050 sustainability targets as its North Star, now is the time for the mining and metals industry to accelerate growth. However, with heightened uncertainty in the global geopolitical sphere and volatility in commodity markets, to do so may not be easy. Companies that navigate uncertainty, work with governments to address permitting issues for new projects, rethink the strategic value of exploration, work with regional players to address skills shortages, and drive toward becoming more purpose-led organizations are most likely to prevail.

In this, the 16th edition of Deloitte Global's Tracking the trends, a team of professionals from around the world provides insights and examples as well as practical ideas to help mining and metals companies rise to the challenges that lie ahead and capitalize on new opportunities.

TREND 1
PUTTING PURPOSE AT THE HEART OF MINING AND METALS: CREATING SOCIAL MOMENTUM

Despite mining companies taking significant action over the past decade to change the narrative surrounding the role they play within society—for example, through enhanced transparency and focusing on responsible mining methods—the industry remains undervalued.

Research from GlobeScan across 27 countries saw mining ranked second-to-last when asked how well different types of companies fulfill their responsibilities to society.[1] However, demand for certain critical metals will outstrip supply in the near term, and to meet this shortfall, the industry will most likely need to develop greater capacity, often in previously unmined regions. As they seek to expand, companies will therefore need to put even greater effort into building trust.[2]

WHY IS PURPOSE IMPORTANT?

A clear purpose is vital to an organization. It articulates why the organization exists, what problems it exists to solve, and who or what it wants to be to

each human it touches.[3] Increasingly, businesses are living out their purposes in ways that create deeper connections with customers, to do more for the communities with which they work, and to attract and retain talent. At the heart of this effort can be powerful collaboration across many players, and in the process, they're achieving greater results and impacts.[4]

Examples from the consumer products sector include Lego, lululemon, and Starbucks. These are companies that, through their work, aim to go beyond making money to becoming agents of human idealism and societal progress. When brands become a force for their ideals, they give people a compelling reason to care about and contribute to their successes. And when people genuinely care about a company and the change it is bringing about in the world, that company becomes more valuable and advantaged.

Not every organization sees purpose as an all-encompassing ideal. Some consider it a tool to advertise what they do and stand for and to capture more market share. However, research from Deloitte US[5] has shown that what separates purpose-driven businesses from the rest are longevity and authenticity.[6] Purpose-driven companies can witness higher market share gains and grow, on average, three times faster than their competitors, while achieving higher employee and customer satisfaction.[7]

For example, outdoor clothing brand Patagonia, the ownership of which founder Yvon Chouinard famously placed into a trust for the benefit of the planet in 2022,[8] is purpose-led. The company is ranked number one in its US$12 billion market[9] and scores higher than its main competitor on many employee satisfaction metrics.[10]

PURPOSE CAN HELP BUSINESSES NAVIGATE CHANGE

While purpose is important to every organization, it's particularly pertinent in mining and metals because the products of this industry touch the lives (directly or indirectly) of humans in even the remotest reaches of the planet. Mining and metals providers are already influential forces for economic development in many regions and, if they can harness the powers of their purposes, they have the chance to not only help secure their own sustainability ambitions, but also drive social development and environmental restoration, too.

This is not the only change that mining and metals organizations face. As discussed in trend 7, today, employees want more than a job; they want to be emotionally invested in doing something that they believe is meaningful through their daily work. This is particularly evident with Generation Z, a generation characterized by people who are highly driven to make career decisions in ways that align with their personal values.[11]

Downstream consumers of metals also want to know what companies in their value chains stand for, and expect them to create a better world for the communities in which they operate as well as deliver their own sustainability goals. Additionally, governments want to see that operators are good corporate citizens, and investors are demanding the aggressive management of environmental, social, and governance (ESG) risks.[12]

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Putting purpose at the heart of a company could help to address these challenges. However, it requires more than just good storytelling, ESG reporting, or financial handouts to communities. Purpose-led growth requires new value to be created for stakeholders, rightsholders and operations; plans and strategies to be rearchitected toward common goals; and leaders and employees to demonstrate that intention consistently (figure 1). Most importantly it requires commitment and alignment over time.

Bringing purpose into mining and metals
Due to the cyclical nature of the mining and metals industry, sustaining transformation programs through commodity cycles requires unequivocable buy-in from leadership and a commitment to their resourcing and investment, whatever the economic weather.

Also, while the industry prides itself on meeting quantifiable operational metrics, such as production targets, ESG efforts in recent years have proven that it's much harder to address nonfinancial stakeholder expectations.

The industry isn't alone in finding this difficult; research from Deloitte Canada across various sectors found that while 86% of companies have stated a "purpose beyond profit," only 18% showed any evidence of associated change.[13] However, there are some early case studies that could offer valuable lessons.

Worley is investing AU$100 million (approximately US$65 million) over three years to target and develop solutions for customers in high-growth areas aligned with its purpose.

The company has put in place initiatives focused on the education of its workforce, challenging traditional approaches and identifying innovative ways to meet sustainability challenges across the company and its customers' operations.[14] In FY2023, 41% of Worley's total revenue was sustainability-related, up from 35% in FY2022, and by FY2026, the company aims for 75% of its total revenue to be sustainability-related. To date, more than 40,000 sustainability-related learning modules have been undertaken by Worley people, and the company now boasts 700 sustainability champions.[15]

FUELING FUTURE GROWTH AND LONGEVITY

There is a tremendous opportunity for forward-thinking mining and metals companies to reorient their corporate brands and to become instruments of progress and idealism, increasing their profit growth and product demand as a result.

The environmental and social challenges that we see today are the harbingers of change, and society is asking more of businesses. The question is, Which organizations will rise to the challenge?

Figure 1: Steps to operationalizing purpose

FROM IDEAS TO ACTIONS

- **Ignite a founders fire:** A CEO can become the founder of an era within their company. The key lies in identifying the ideals that they value most and how these values could align with the company's values and business model and be leveraged to drive value. This process could take the form of a simple interview with the board or could be much more complex. It will look different for every business. Either way, test the outcomes with the wider leadership team to ensure their commitment.
- **Establish a reputation team:** Organize a subset of the executive leadership team whose responsibility is to infuse purpose into the actions and communications throughout the company. Clear governance helps ensure oversight and delivery.
- **Think about branding:** This will act as a creative platform to cohere communications, actions, and ESG efforts of the company. Give people reasons to join in support of the company and the change it aims to lead through linking these reasons to important human ideals, such as equality, freedom, and peace.
- **Create a social momentum strategy:** Social momentum strategies can make a company an active agent of idealism and progress in its programs, policies, and impact. For example, Starbucks created a "Third Place" for its customer—we all have home and work (our first and second places), but we also need a place for "me time."[16] This experience enhances the company's value proposition, making its strategy about more than just selling coffee. To unlock next-level value for their stakeholders, mining and metals providers could determine what's required to methodically earn their trust and support, show enthusiasm following patterns of social movements, and create strategies based upon them.
- **Use horizon planning to make change tangible:** Assess interactions between the organization and its stakeholders to determine whether they demonstrate the company's stated purpose, the potential cost to innovate or reconceive each interaction, and its ability to create momentum among stakeholders. Based on these answers, actions to reorient or realign each aspect of the business can then be prioritized across different time horizons to meet the company's overall transformation strategy and budget.
- **Develop a socialization plan:** Develop communications plans for key stakeholder to spark enthusiasm for the progress the company can bring about. Build enthusiasm by adding meaning, humanity, and purpose to transactional interactions.

END NOTES

TREND 2
NAVIGATING GLOBAL UNCERTAINTY:
BUILDING CAPACITY TO THRIVE IN THE FACE OF DISRUPTION

During 2023, the level of uncertainty that mining and metals businesses were required to handle—economic, geopolitical, environmental, and more—reached new heights. The Russia-Ukraine war continued to disrupt commodity markets, impacting global supplies of nickel, pig iron, and fertilizers, to name a few.[1] This, combined with an escalation of conflict in the Middle East, could affect the commodity market further over the next 12 months[2] as well as create wider security implications for raw material supply chains. Trade allies around the world hastened to secure critical resource supplies, navigating the outsized influence of Russian and Chinese investments in mineral-rich central Africa—an area that could prove pivotal to future metals production.[3] There was the constant threat of conflict in the South China Sea, which houses some of the world's busiest shipping routes.[4]

A notable increase in extreme weather during the year[5] also underscored the human and environmental risks posed by climate change and the need for urgent action at a global scale—a matter that was reiterated at the United Nations Climate Change Conference (COP28) held in Dubai in November 2023. This level of uncertainty and its complexity shows no signs of abating. Navigating it and ensuring that businesses have the people and tools they need to not only survive but thrive is a key focus for executives. Dynamic strategizing, building greater optionality through portfolios, incorporating long-range sensing into business planning, increasing supply chain resilience, and elevating risk on the board agenda can play a role. In this trend, we'll explore a few of these options and the advantages they can bring.

DISRUPTION SPREADS FAR IN AN INTERCONNECTED WORLD

There are four key areas of uncertainty that have converged to create the environment in which mining and metals businesses find themselves today:

- Rising geopolitical tensions and global shifts in power;
- The rise of artificial intelligence (AI), specifically gen AI;
- A change in the availability and requirements of talent; and
- The urgent need for progress toward net-zero.

continues from page 23

Next-generation mining equipment and processes that harness AI, data analytics, and automation are changing the nature of work in the sector and increasing pressure on the workforce to adjust to new skill requirements and different workplace roles and personnel structures.[6]

According to the World Economic Forum, 50% of all employees will need reskilling by 2025 as adoption of technology increases.[7] However, technologies like gen AI could also play an important role in reskilling or upskilling the workforce.

For example, algorithms could help to personalize training programs that build on workers' existing skill sets to prepare them for future opportunities that leverage technology.[8]

At the nexus of global geopolitical uncertainty and net-zero sit critical mineral supply chains. The mining of critical minerals is highly concentrated in specific geographical locations. For example, Australia is the world's main producer of lithium, China of graphite and rare earths, Chile of copper and lithium, and the Democratic Republic of Congo of cobalt. Processing is even more geographically concentrated, with China accounting for the production of more than 50% of the world's refined supply of natural graphite, dysprosium, cobalt, lithium, and manganese.[9]

While the energy transition requires a dramatic increase in the supply of these critical materials, their supply chains remain vulnerable to a range of geopolitical risks. Additionally, supply disruptions could impact the speed of the energy transition in the short-to-medium term unless urgent steps are taken to diversify them.[10]

> "Uncertainty doesn't remove the need for companies to develop five- o 10-year strategies, but it does mean that they need to become more agile in their planning. It makes sense to develop a market scanning capability so that, if disruptions start to manifest, the company can spot them early and choose whether to pivot to a different strategy."
>
> *Patricia Muricy, partner, Energy, Resources & Industrials leader, Deloitte Brazil*

Businesses have begun to shift their focuses away from vertical integration toward an ecosystem approach in recent years, and as those networks have grown and become more intricate, changes in markets, politics, and regulation, as well as their impacts, are now transmitted further. Moreover, the boundaries that traditionally existed between industries and sectors, geographies, businesses, and suppliers are blurring so that changes in one domain can resonate across many others.[11]

For example, there are concerns that investment portfolios intended to uphold environmental, social, and governance (ESG) principles may be exposed to human-rights abuses and environmental damage via mining and metals supply chains. This could affect downstream consumers such as automotive or clean energy tech manufacturers.[12]

It's these factors and the fast-moving nature of today's digitally supported business environments that require mining and metals companies to become more agile if they are to capture opportunities created by disruption and minimize or manage associated risks.

PREPARING FOR CHANGE THROUGH STRATEGY AND SCENARIO PLANNING

One way to prepare for change is through the development of more dynamic strategic planning. A dynamic strategy is one that enables a business to proactively adapt to changing scenarios, making it possible to minimize operational threats and seize new opportunities. These strategy features offer a framework that allows mining and metals leaders to respond appropriately to shifting demands, building flexibility and innovation into decision-making and strategic planning exercises.[13]

There are many ways that this capability could take shape, but the most obvious is to harness a combination of people and technologies (AI-based sensing, for example) to understand important changes in the markets. The information gathered and its proliferation throughout the organization could allow leaders and the workforce to be more agile in their choices from the enterprise level through to regional or local operations.

Scenario planning is another tool that encourages executive teams to explore different business situations. By challenging assumptions and testing different strategies in a hypothetical environment before making decisions, companies can better equip themselves to handle different challenges. Additionally, there can be immense value in getting executives to "live in" hypothetical, but plausible, worlds for a few hours to test how their organization might have to adapt if the world panned out as simulated.

Shell has been using scenario-based planning to help inform its strategy since the 1970s. The company's scenarios team has expertise in a range of fields including economics, politics, energy analysis, climate policy, sociocultural change, and competitive intelligence. The team's work explores possible versions of the future by identifying drivers, uncertainties, enablers, and constraints, and unearths potential issues and their implications.

As part of this, the team has developed two long-term models of the world's energy system that test, quantify, and explore possible future scenarios. When viewed together, they offer a perspective on the current global energy landscape, as well as the ability to model a number of futures.[14]

ING Bank is another example. The company's research team uses scenario planning to scan the "highly uncertain future of the energy transition" to better understand the trends that are driving the global energy market and, thus, predict demand for metals.

The scenarios generated help corporate decision-makers to better understand the factors that drive opportunities and risks in the global energy transition. This knowledge helps them to make better investment and lending decisions and minimize the risk of stranded assets.[15]

While we have seen several mining companies use these techniques in creating more robust strategy processes, the industry could benefit from thinking through the wider uncertainties in a more structured way.

FUTURE-PROOFING COMPANIES THROUGH OPTIONALITY AND GOVERNANCE

Embedding optionality within an organization's strategy and portfolio could also help it prepare for the future by allowing the business to exercise different options to meet its overarching goals as situations and priorities change.

For instance, in a speech at the Gold Forum America's event in September 2023, Mark Bristow, president and CEO of Barrick Gold, said that the miner projected a 30% increase in production by the end of the decade on the back of the growth options embedded in its asset portfolio. The company has built various levels of optionality into its five and 10-year base cases through its portfolio of current operating assets to help ensure sustainable growth in the face of change.[16]

As the forces shaping the mining and metals industry evolve, and transparency and accountability become ever-more important to stakeholders, companies should have the best possible governance at the board level. Scenario planning can help identify the skills and experiences that may be required of board members, and regular independent board reviews could allow boards to open themselves up to a more diverse range of people from different functions, sectors, and skills.[17]

For example, establishing a position for one or more ESG professionals on the board of directors and bringing in expertise from the worlds of technology, robotics, and AI could offer new perspectives that may help businesses to reduce costs, increase efficiencies, and lessen the environmental and social impacts of operations.[18] This is something that companies including Barrick Gold, Anglo Gold Ashanti, and Vale have done in recent years.[19]

Preparing today for a volatile tomorrow

As the world continues to grapple with change and businesses race to stay on top of evolving challenges and opportunities, it's important that leaders in the mining and metals industry lay the foundations for greater agility and optionality to prepare for lack of productivity in the future.

FROM IDEAS TO ACTIONS

- **Develop a sensing function to stay ahead:** Have team members attend important industry events, engage with think tanks, and stay on top of the latest news. Deploying AI-based technologies to conduct online research and understand a particular political development via the media is another option. This effort will look differently for each company depending upon its scope and available resources.

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- **Rethink the annual strategic planning process:** Shift away from a linear and incremental view of planning to build in scenario planning and scenario discussions at the executive table. Not to be confused with risk, mining and metals companies should develop views on the key uncertainties that could shape the markets and regions in which they operate and use these to create long-range scenarios.
- **Assess where the optionality lies in the portfolio:** It is important for companies to look at the explicit and implicit options that are built into the portfolio and how they might exercise them at some stage. Optionality often comes at a cost, so understanding the upside and degrees of freedom that the option gives is key.
- **Join forces to address wide-scale disruption:** The nature and scale of some changes mean they are best tackled collaboratively. For example, the skills shortage that mining and metals companies are currently experiencing is so pervasive that it cannot be effectively addressed by companies individually.

  For example, in Saskatchewan, Canada, members of the province's mining and resources ecosystem (including government, industry bodies, organizations, Indigenous communities, and academic institutions) are exploring ways to focus their collective labor efforts on critical skills. The aim is to better fill gaps in workforce requirements and help the province to fulfill its 2030 economic goals.[20]

END NOTES

TREND 3
DEALMAKING FOR FUTURE-FOCUSED GROWTH:

RETHINKING MINERALS AND METALS INVESTMENTS

As the energy transition continues to shift the bedrock of the mining and metals industry, companies are seeking new ways to maintain their competitive edges, increase access to resources that could prove critical to growth in a sustainability-conscious future, and accelerate new production capacities.

For some, capital allocation into mergers and acquisitions (M&A) is helping to shape a portfolio of assets that provide exposure to critical minerals and metals. For instance, BHP acquired OZ Minerals in May 2023 to gain greater exposure in nickel and copper.[1] While, for others, organic growth into new markets is the order of the day. For example, in May 2022, Rio Tinto began producing tellurium at its Kennecott copper operation in Utah, becoming one of only two miners operating in the United States producers of this critical mineral, which is used in photovoltaic solar panels.[2] Companies like these could garner greater interest from investors going forward, and many are looking to trade at premium multiples.

Alternatively, companies whose portfolios contain higher carbon commodities are exploring ways to create more attractive investment options. For example, in February 2023, Teck Resources announced the reorganization of its business.

In creating Teck Metals Corp and Elk Valley Resources, the company said it would "provide investors with choice for allocating investment between two businesses with different commodity fundamentals and value propositions."[3] This paved the way for a full sale to Glencore to take a 77% interest in Elk Valley Resources in November 2023, and for two major steelmakers to take the remaining shares in the deal.[4]

Most, if not all, major energy, resources, and industrial (ER&I) players now have firm net-zero emissions targets in place for 2050 or sooner and, as such, greenhouse gas (GHG) emissions statements are fast becoming a key investment criterion. In this trend, we'll explore how strategic investments can fuel growth in fast-changing and sometimes fickle markets, while bringing important metals supplies online faster.

M&A FOR CRITICAL METALS EXPOSURE HEATS UP

The fourth quarter of 2022 heralded a run of M&A transactions in mining and metals the likes of which have not been seen in a decade. This resulted in a total of 288 deals worth US$88.2 billion for the year.[5]

Recent rises in commodity prices have left big players with plenty of cash and opportunities to invest it, whether through purchasing mines that align with their core growth strategies or by diversifying into new metals. Companies are also increasingly open to innovative pathways, such as joint ventures, alliances, and partnerships, to secure long-term, ESG- friendly growth.[6]

Lithium and nickel have seen the greatest volume of activity, with companies both big and small looking to grow their competitiveness through economies of scale. For example, in May 2023, US-based Livent Corporation and Australian company Allkem Limited, agreed to combine their stock in a US$10.6 billion

deal to create the world's third-largest producer of lithium.[8]

ALTERNATIVE CAPITAL EXPEDITES PROJECTS

Mining and metals companies aren't the only ones with an agenda in critical metals. For a metal to be designated "critical" it must be both important to a specific purpose (i.e., the manufacture of green energy technologies) and carry a certain level of supply risk. With supply shortfalls predicted in many commodities, including lithium and copper by 2030,[9] there has been a notable increase in downstream consumers, including automotive manufacturers and defense companies, considering direct investments in mining, refining, and precursor materials in addition to offtake commitments.[10]

For example, Contemporary Amperex Technology Co., the world's largest battery cell maker, has made the acquisition of critical mineral assets a central element of its strategy. Other examples include General Motors' US$650 million investment in Lithium Americas Corp,[11] and Tesla breaking ground to build a new lithium refinery in the United States.[12]

Even governments are beginning to play a more prominent role; for instance, the US Department of Defense (DOD) signed an agreement with Alaska-based Graphite One in July 2023 to secure graphite for the production of large-capacity batteries. Access to this funding is expected to allow Graphite One to fast- track its feasibility study by a full year.[13]

While many large mining companies are able to self-fund project developments, the majority of junior project owners, and some mid-tier mining companies, are searching for investment to finance projects through construction and into operation.

> "There have been some big deals in mining and metals over the past year, and most of the activity has been critical minerals related. The US Critical Minerals list details 50 elements,[7] and there's a race on to gain access to those."
>
> *Nicki Ivory, partner, Mining & Metals leader, Deloitte Australia*

Current mining and processing of certain metals is highly concentrated in specific geographies. China, for instance, dominates the global supply chain for rare earth elements (REEs)—around 70% of global REE extraction and 90% of processing takes place in China.[14] Building supply chains exclusive of that capacity poses practical challenges and will likely take time and a significant injection of capital.

For example, Botswana's transparency, and regulation of taxation and policies have been highlighted as one success story where in-country beneficiation has been implemented. Downstream beneficiation could create jobs through increased labor requirements. However, beneficiation of high value-add products from unprocessed materials requires skilled labor, of which southern African countries have a shortage.[15]

Multi-user infrastructure models for metals processing that allow users to share their knowledge and pool their resources could help to bring supply online faster and more inexpensively, irrespective of competition. These "hub"-type business models are already proving successful in the hydrogen sector (many of which benefit from government funding), and there's similar potential in critical metals.

GOVERNMENTS AS A FORCE FOR CHANGE

Governments around the world have an increasingly important role to play in expediting the commercialization of critical metals projects. Their funding not only supports development but helps to lower the risk associated with projects that could, in turn, encourage more cautious investors to get involved.

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The US government has been the quickest off the mark, making vast sums available through its 2022 Inflation Reduction Act (IRA).[16] This provision extends to companies based outside of the United States, too, but with operations that are critical to US supply chains. For example, in August 2023, Australian REE miner Lynas Rare Earths, which is the world's largest producer of REEs outside of China, signed a contract with the US DOD for the construction of a heavy REE processing facility in Texas.[17]

The European Union is also looking to secure supplies through its Critical Raw Materials Act,[18] and the European Raw Materials Fund, which will invest in critical minerals needed for a transition to zero carbon emissions, is due to launch in 2024[19] with around €2 billion (approximately US$2.1 billion).

In Australia, the federal government announced a AU$2 billion (approximately US$1.3 billion) expansion in critical minerals financing in October 2023, doubling the capacity of the critical minerals facility to finance Australian critical minerals mining and processing projects[20].

Funds such as these have dramatically changed the investment landscape in certain countries. Australia, for example, thanks to its wealth of natural resources and attractive ESG profile, proved lucrative for dealmaking through 2022–2023[21].

Canada, and particularly Saskatchewan with 22 of the 30 Canadian-designated critical minerals, especially potash and uranium, is receiving global investment and interest from many players across the value chain, not just the large mining and agricultural companies.[22]

Investors and explorers are also considering Africa. Ghana, for instance, gave its first lithium mine (Barari DV Ghana's Ewoyaa operation) the green light in October 2023.23 With its vast mineral endowment (Africa is home to about 30% of the world's mineral reserves24) but less mature risk profile, there are questions as to the reliability and transparency of supply chains based there. Nevertheless, it's a promising destination for future deal activity.

FROM IDEAS TO ACTIONS

- **Put an ESG lens over deals:** Due diligence with a view to environmental, social, and governance (ESG) issues is essential to help ensure that investments fit the organization's needs over time and work with its wider portfolio of assets and interests. Thorough due diligence will help ensure that any potential conflicts of interest are identified and resolved in good time.
- **Consider your own organization through an ESG lens:** Targets looking for capital may also want to demonstrate their ESG credentials for due diligence purposes, including how they will solve any potential issues—for example, which energy sources they will use to mine (renewable and/or sustainable sources will likely be front-of-mind).
- **Think outside the traditional investment box:** Joint ventures, alliances, and other collaborations can all be harnessed to gain exposure to critical metals. Ownership need not be outright.
- **Create attractive investments:** Companies looking for capital could prepare by considering their assets through a potential investor's eyes. Taking the time early on to highlight synergies with investment criteria, answer any potential questionnaires, and, where necessary, seek out alternative forms of capital to help ensure a smoother process.
- **Look for different investor types:** In addition to thinking creatively about investment structures, think more widely about where to look and who to approach for investment. Governments, OEMs, and others throughout the supply chain are now making minerals and metals part of their security agendas.

END NOTES

TREND 4
WORKING TOWARD NET-ZERO:
BUILDING CAPACITY AND FUTURE-PROOFING ESG STRATEGIES FOR A CREDIBLE TRANSITION

According to the United Nations, while global greenhouse gas (GHG) emissions are trending downward, countries' efforts remain insufficient to help limit global temperature rise to 1.5°C by the end of the century. In fact, the combined climate pledges of 193 parties under the Paris Agreement could put the world on track for 2.5°C of warming by the end of the century,[1] a scenario that could result in severe consequences for both people and the environment.

Research by the Deloitte Economics Institute has found that, if left unchecked, climate change could create US$178 trillion in global economic losses between 2021 and 2070.[2] In contrast, a coordinated effort in climate change mitigation could deliver an additional 300 million jobs by 2050[3] and boost the economy by more than US$43 trillion by 2070.[4]

The private sector has a role to play in helping accelerate a credible energy transition with shared outcomes for all stakeholders. As providers of the raw

materials needed to create sustainable infrastructure, low-carbon technologies and electrify transportation, mining and metals companies should be positioned to lead the way, and organizations that act swiftly could be rewarded through enhanced resilience and value generation opportunities.

In this trend, Deloitte looks at some of the practical ways that companies can help build their climate leadership capacity, ensure their transition action plans are set up for transformative success, and wield their influence to inspire coordinated actions across business ecosystems.

Creating a climate transition action plan
According to the Climate Leaders Coalition, "a credible, responsible and equitable transition is a transition to a net-zero economy that is grounded in integrity by bringing together organization, government and community perspectives".[5]

To help achieve this may require organizations to move beyond tackling emissions as a standalone challenge and apply a broad and forward-thinking approach to help mitigate climate change.

A Climate Related Transition Plan (CTAP), which the International Sustainability Standards Board (ISSB) describes as an "aspect of an entity's overall strategy that lays out the entity's targets, actions or resources for its transition towards a lower carbon economy",[6] can provide an architecture for this.

Unilever was one of the first multinational companies to implement a CTAP. In March 2021, the organization made history by announcing, of its own volition, that it would put its plan to a shareholder vote; a move that garnered much respect. The company committed to providing an annual report on its progress in reducing GHG emissions and to submitting an updated plan for a shareholder vote every three years.[7]

"Effective transition planning requires companies to understand their role with respect to all of their stakeholders, and then to evaluate climate-related risks and opportunities from the perspective of each stakeholder group."

John O'Brien, partner, Sustainability & Climate leader, Mining & Metals, Deloitte & Touche LLP

Good CTAPs feature science-based net-zero targets supported by goals over short-, medium- and long-term time horizons. These should be informed by achievable decarbonization pathways with steep emissions reductions in the near term supported by enabling capital allocation frameworks, operational and organizational impacts and portfolio optimization. They also integrate with corporate strategy, actions and investments and provide transparency on the data and methodologies used.[8]

In September 2021, BHP published its first CTAP, which sets out the company's strategic approach to help achieve its long-term GHG emission reduction targets and goals, and its commitment to additional actions. As part of this, BHP has embedded decarbonization into its capital allocation framework. This means that each major investment decision requires an assessment of investment viability under BHP's 1.5°C scenario. Ultimately, by taking a strategic approach to analyzing future scenarios, the global challenge of decarbonization has been turned into a potential growth opportunity for the company and its portfolio is aligned to help support the global response to climate change.[9]

Making actions credible and meaningful
In addition to growing alignment on what a CTAP should look like and contain, thought leadership is now focusing on what truly counts as "credible" and how companies can uphold leading practices. This will likely vary by sector and geography

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to accommodate technological and physical dependencies, as well as just and equitable transition principles.[10]

For transition plans to stand the test of time, it's expected that mining and metals leaders understand evolving external regulatory frameworks and socio-environmental shifts in the jurisdictions in which their organizations operate.

In areas where IFRS S211—the latest ISSB standard on climate-related disclosures—applies, companies are required to disclose their CTAP along with its critical assumptions and dependencies.

For example, Brazil intends to adopt the standards on a voluntary basis starting in 2024 before mandatory use comes into play in 2026.[12] The UK Transition Plan Taskforce Disclosure Framework,[13] launched in March 2022, has also been designed to align with IFRS S2 and is recognized globally as a leading practice for transition plan disclosures.[14]

There is growing scrutiny on corporate climate disclosures globally and varying sentiment with regard to environmental, social, and governance (ESG) in certain geographies. Many European markets continue to help drive forward on ESG, raising the bar for companies, while others, like the United States, have started to avoid the term as it has become highly politicized.[15]

These growing policy disputes have seen ESG- focused companies and funds come under fire over the past year, at shareholder meetings and in the media. Data from fintech, Broadridge, showed that 44 sustainable funds removed the label from their brand name during the first half of 2023.[16]

> "In understanding their ecosystem, mining leaders should recognize that many of their client base will be looking to transition to a low-carbon business. These companies will likely start to examine their supplier relationships more closely, look for collaborative action on climate change and make purchasing decisions accordingly. This could present risk but also opportunity for mining and metals organizations"
>
> *Celia Hayes, partner, Risk Advisory, Deloitte Australia*

Now more than ever, companies should think beyond disclosure and target-setting to real actions that can demonstrate credibility and integrity and ultimately help drive value for shareholders and other stakeholders through ESG.

BUILDING LEADERSHIP FOR CLIMATE ACTION

The transition to a low-carbon economy demands synchronized transformation of multiple, interdependent systems and, as such, mining and metals organizations could look to collaborate with their customers, suppliers, regulators, traditional owners, and competitors to help create material change and, where necessary, act as an orchestrator for joint projects and activities.[17]

To do this, leaders should understand who the various actors are within their ecosystems, including those who may be less obvious or may affect competitive positions, as well as their differing priorities and values. From there, they could identify common goals and opportunities for collaboration and use systems thinking to help understand the impacts and opportunities created through every interaction, including noticing potential intervention points.[18]

Schneider Electric has a good example of this in action. In 2022, carbon emissions from its procurement of goods and services amounted to 7.6 million metric tons of CO_2, making it the largest contributor to the group's scope 3 upstream emissions. In response, Schneider developed The Zero Carbon Project. This saw the organization collaborate with more than 1,000 suppliers, who were responsible for 70% of its upstream carbon emissions, with the goal of halving its collective carbon footprint by 2025. The project

enables leading practice exchange with peers and partners to access solutions for decarbonization. More than 1,000 companies have joined, and 1,300 supplier participants have now undertaken technical training about decarbonization.[19]

At the organizational level, leadership for climate transformation usually involves bold decision-making and directing resources and efforts toward a unifying net-zero ambition. This requires leaders to define and commit to that ambition, innovating and changing the organization's products and/or services to transition to a low-carbon revenue model.

It also requires courage to take decisive actions with regard to suppliers, employees, customers, and communities in adapting to and mitigating climate change. Leaders who are cautious with regards to climate change, may find themselves and their business lagging as the economy transitions.

For example, in 2022, Deloitte launched a globally coordinated learning program to help increase the sustainability, climate knowledge, and skills of its more than 450,000 people across its businesses. The effort stems from Deloitte's Sustainability & Climate practice, which is dedicated to guiding clients as they redefine their climate strategies; embedding sustainability into their operations; meeting tax, disclosure, and regulatory requirements; and accelerating the transformations of their organizations and value chains.

This learning program aims to enhance the skills and capabilities of Deloitte professionals, enabling them to address sustainability and climate topics while advising clients and other stakeholders—creating one of the largest networks of sustainability specialists.[20]

NO TIME TO LOSE

Climate change is one of the greatest challenges of our time. However, with the right plans, strategies, and leadership in place, mining and metals companies have the potential to help lead at each step, paving the way for a safe, prosperous, and opportunity-filled future for people and the planet.

The action points—based on steps from the Climate Leaders Coalition's seminal report Credible transition to net zero,[21] which was delivered by Deloitte Australia—provide ideas for companies that are keen to supercharge their ESG efforts.

FROM IDEAS TO ACTIONS

- **Get comfortable asking questions:** Laying the foundation for a credible CTAP begins with leaders asking questions of their teams, boards, and investors. Creating mechanisms for this and maintaining an open and constructive dialogue and encouraging the challenging of long-held assumptions, throughout the process can be vital to helping produce meaningful outcomes.
- **Foster ecosystems thinking:** The ability to think across ecosystems—both business and natural—is a critical skill for the future and one well worth investment. Organizations that adopt a strategic and rounded approach to collaboration across a network of vendors, clients, and peers should be able to better recognize their impacts on and dependencies upon nature, communities, and society. This can inform opportunities to add value over time and help mitigate or manage any potential threats to a business.
- **Leverage relationships:** The scale and urgency of climate change requires a coordinated effort. Timely and impactful actions require organizations to work within, and beyond, their historic sectors and ecosystems, with governments, peers, and communities to help identify synergies and overcome potential barriers. Industry associations and working groups often convene thought leaders to discuss shared challenges and can provide critical mass to help accelerate plans and actions.
- **Take action strategically:** Embedding credible actions toward the climate transition into an organization's strategy and capabilities is critical. To do this, identify, prioritize, and resource key actions in line with targets that reflect areas of focus, stakeholder engagement, and value-creation opportunities. From there, determine the governance mechanisms, leadership, and team capabilities that may be needed to help operationalize the transition.
- **Be clear on the importance of ESG:** Effective ESG programs should be underpinned by a materiality assessment whereby a company looks at its business and strategy through an ESG lens. Identify key ESG factors that can impact the business from the perspective of its stakeholders and ensure that ESG-related activities are structured around these. By clearly linking actions to business objectives and purpose, the company should be better positioned to respond to both pro- and anti-ESG crowds.[22]

END NOTES

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TREND 5
COLLABORATING WITH GOVERNMENTS TO RETHINK REGULATION:

UNLOCKING CRITICAL RESOURCES THROUGH PERMITTING

As the source industry for raw materials that underpins global socioeconomic growth and decarbonization, the prosperity and sustainability of this world depends heavily upon the regulatory environments that surround mining and metals projects.

According to the Energy Transitions Commission (ETC), there's no fundamental shortage of raw materials needed to support the global transition to a net-zero economy— geological resources exceed the total projected cumulative demand from 2022–2050 for key materials (figure 1). The key matters are, therefore, ramping up supply fast enough to decarbonize economies before crucial climate tipping points are exceeded, and ensuring that mining occurs in a sustainable and responsible way.[1] Project evaluation and development are central to both.

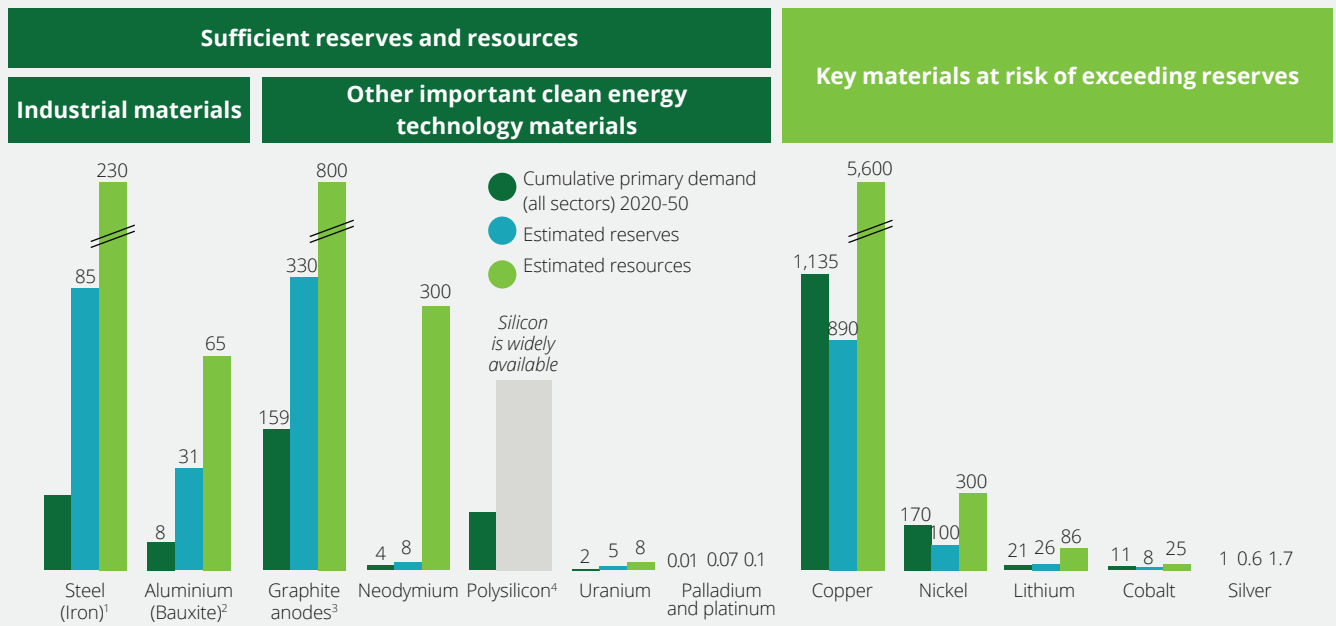
In many parts of the world, permitting processes for mines span years, even decades.

While it's important that projects receive proper scrutiny and approval from relevant parties, there's consensus that a new approach is needed to enable the creation of local supply chains for critical minerals within a timeframe that reflects 2050 net-zero goals.

Going forward, regulatory reform undertaken in consultation with key industries and rightsholders could influence the flow of capital and talent to and from jurisdictions, enhancing their competitiveness. This provides the chance to turbocharge economies, drive investment into communities, and help countries around the world meet their decarbonization goals.[2] In this trend, we'll look at some steps that are ripe for improvement and how governments, industry, and communities can work together to improve permitting and approvals.

THE RISK OF INACTION

According to S&P Global, the average mine takes 15.7 years to reach commercial production.[3] Although this



[1]Reserves and resources of content iron.
[2]Reserves and resources of bauxite. Demand for aluminium converted to bauxite assuming 4 tons of bauxite are required to produce one ton of aluminium.
[3]Graphite reserves/resources refer to natural graphite and do not include synthetic graphite.
[4]No estimated reserves for silicon, but quartz (the key input) is widely available in most geographies.

Note: "Resources" are an estimate of material stocks available in sufficient concentration to make exploitation and economic interest at some time. "Reserves" are the current economically and technically extract table subset of resources. It is important to note that even these estimates tend to increase overtime.
Source: SYSTEMIQ analysis for the ETC; US Geographical survey.

Note: Billion metric tons = industrial materials; million metric tons = all other materials.
Source: Energy Transitions Commission

Figure 1: Cumulative primary demand 2022–2050 from energy transition and other sectors, compared to estimated reserves and resources

number varies greatly by commodity and mine type, even in highly developed jurisdictions, such as the United States, Australia and Canada, permitting can be an expensive and lengthy process. For example, Northern Dynasty Minerals' Pebble project in Alaska— one of the world's largest undeveloped copper resources—has been making its way through permitting for several years, with no imminent resolution.[4]

Northern Ontario's Ring of Fire district is another example. There are concerns that projects like Eagle's Nest, which, together with its associated battery metals plant, could become an important source of nickel for electric vehicle production in North America, and could be at risk due to overly complex environmental assessments and extensive consultation requirements.[5]

In today's high-interest and high-inflation environment, the cost of financing for capital projects can be expensive and access to capital can be limited. While some governments are working to remove red tape and duplication—more could be done globally. Additionally, there may be more cautious decision making by regulatory bodies resulting in longer lead times. These problems are magnified for projects harnessing emerging technologies like small modular reactors, which have a long regulatory road ahead of them.

These challenges may intensify over the coming years as climate targets draw nearer and access to specialized skills becomes tougher. Rather than introducing new measures to resolve existing regulatory challenges created by complex systems, governments could consider a collaborative approach by consulting with the mining and metals industry and other stakeholders to revise regulations or policies for greater suitability and sustainability.

SEQUENCING: THE RIGHT PROJECTS AT THE RIGHT TIME

Areas that might benefit from attention include sequencing (identifying which projects to build, where, and in which order, with a view to balancing risk and opportunity); the integration and amalgamation of review processes into a single, streamlined application; establishing clear leadership; and working collaboratively with local and Indigenous communities rather than in parallel to them.

Choosing an optimized pipeline of projects with the right technologies requires intentional prioritization. Mining and beneficiating material efficiently, effectively, and consistently is dependent on numerous external factors such as power supply, water availability, labor, rail and road networks as well as capital investment. Without systematic planning and prioritization, the development of a beneficiation sector would be inhibited.

If industry can align with governments, there is a chance to better understand which projects need to be built, where, and when to deliver on critical metals and decarbonization targets.

PROCESS INTEGRATION SPEEDS REVIEWS

Unlocking the investment needed to supply critical minerals involves continued efforts to streamline regulatory approvals, including shortening permitting timelines.

Most major projects require authorizations from multiple regulators and jurisdictions, including federal, provincial/territorial, and/or Indigenous governments. When proposals are reviewed in an uncoordinated way, the result can be duplicated efforts, confusing and erratic processes, and delays. On the contrary, using a single, integrated process for collecting information allows regulators to hear from proponents, experts, and rightsholders, and to assess the impacts and mitigation strategies in a timely and coordinated fashion.[6]

In 2020, Australia's National Cabinet introduced a single-touch environmental approvals approach for mining projects to cut "excessive" wait times from the average 3.5 years to 21 months by eliminating duplicative processes and documentations.

It estimated that such projects were worth more than AU$72 billion (approximately US$46.2 billion) in public and private investment and supported more than 66,000 direct and indirect jobs.[7]

More recently, in November 2021, the Canadian provincial government of Alberta introduced a strategy to reenergize its minerals sector. As part of this, changes were made to the Mineral Resource Development Act to give the Alberta Energy Regulator (AER) sole regulatory authority over mineral exploration and production in the province.

This approach creates a more certain regulatory environment for investors and reduces compliance burden for industry, as they no longer need to submit multiple, duplicative applications to different regulatory authorities.[8]

Process integration may be needed across jurisdictions as well as among various organizations within a single jurisdiction, to the extent that each has its own discrete review powers.

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THE POWER OF ECONOMIC RELATIONSHIPS WITH RIGHTSHOLDERS

In many mining jurisdictions, a big challenge and opportunity in permitting lies in not just collaborating with Indigenous rightsholders through mandated consultation and accommodation procedures, but in establishing effective collaborations that provide communities with direct participation in the project and the fruits of its success.

Such relationships can take different forms and one strategy is having relevant Indigenous parties or local communities take equity stakes and integrate Indigenous traditional knowledge systems into project design, environmental monitoring, and decision-making. This approach means that concerns from both parties are heard and can be addressed or designed-out as soon as possible, lowering barriers to approvals.

Canadian miner Cameco has several such agreements with Indigenous communities to solidify the socioeconomic benefits they receive from its projects, as well as the miner's responsibilities. In 2012, Cameco and the northern village of Pinehouse Lake, Saskatchewan signed an agreement that provides the community with jobs, investment payments, and business through the village's economic development arm Pinehouse Business North (PBN).

In 2015, Cameco and PBN established a business development contract to develop and implement management procedures to increase PBN's capacity and to complete projects at various Cameco sites. The project provided support to PBN as it executed three contracts at the McArthur River site. Cameco also provided funding for PBN to hire trainees, as well as develop and implement internal procedures. This included equipment maintenance and project controls to ensure greater efficiency and safety, and Cameco made internal subject-matter specialists available to PBN to help them in the process. This part of PBN's business is seen as an area of future growth and one that can be a sustainable piece of business for them in the volatile resource sector.[9]

> "Governments can also facilitate this approach through capacity-building and the initial capitalization of Indigenous investment funds. For example, the Alberta Indigenous Opportunities Corporation (AIOC) facilitates up to CA$3 billion (approximately US$2.2 billion) in investment by Indigenous groups and communities in natural resource, agriculture, transportation, and telecommunications projects.[10] Additionally, the Candian Government recently announced a national Indigenous loan guarantee program to support Indigenous equity ownership. Just how this program is administered will be vital for its ability to realize reconciliation."[11]
>
> *Michelle Leslie, senior manager, Financial Advisory, Deloitte Canada*

HARNESSING INDIGENOUS LEADERSHIP AND KNOWLEDGE

While many mining and metals projects take place on lands that are under Indigenous ownership or custodianship—around 54% of projects extracting clean energy minerals overlap with Indigenous lands[12]—involvement of Indigenous peoples as potential investment leaders and ecological knowledge-holders is often limited.

It's important that projects respect both the rights and responsibilities of Indigenous peoples in their landscapes. For example, following the framework of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP),[13] including key components of the right to self- determination and free, prior and informed consent (FPIC), is fundamental, as is respect for Indigenous responsibilities.[14]

Integrating contemporary, non-Indigenous tools and technologies with traditional Indigenous knowledge systems can create opportunities for Indigenous peoples to play direct roles in the design, delivery and management of mining and metals projects, creating alignment between culture and employment, and generating jobs in

regions where employment is limited.15 Indigenous leadership in mining and metals projects will also help ensure that operations are designed and implemented in ways that drive long-term, systemwide benefits and positive outcomes. This, in turn, can bring value to corporate action on nature which could help to smooth permitting processes and lead to a just transition.

NO TIME FOR PROJECT DELAYS

These are just a few ways that governments, industry, and rightsholders can come together to improve project permitting for mutual benefit. Ensuring projects receive appropriate reviews, while delivering the required volume of metals supply, is a challenge that miners and regulators should tackle collaboratively.

FROM IDEAS TO ACTIONS

- **Engage early and often:** Proper engagement with communities and rightsholders is not only the right thing to do but is also key to ensuring that capital projects are built. Nationally coordinated engagement, integration, collaboration, and coordination efforts are vital given the capital lift that lies ahead and the environmental, social, and governance (ESG) standards that are coming into effect. Mining and metals companies can play a pivotal role in creating and coordinating these efforts through industry associations, and in making them a non-negotiable part of industry status quo.
- **Ensure clear leadership:** Major projects are complex, and unexpected considerations in the assessment process are usually inevitable. Nominating a leader who's comfortable dealing with sporadic demands and concerns, adapting to shifting circumstances, and finding ways to keep multifaceted processes on track without sacrificing fairness and rigor is important. This leader should be capable of balancing project needs and building strong relationships with communities and rightsholders.
- **Build a road map and timeline:** Creating a road map and timeline for each project is beneficial for the review process. Such action could help focus everyone involved and provide greater clarity, certainty, and confidence about how a review will unfold and when it's expected to conclude.
- **Build in Indigenous knowledge:** Working with Indigenous communities who are affected by capital projects to develop environmental monitoring and project objectives with traditional knowledge woven into science-based targets will ensure that their views are properly integrated. This should also help with government approvals and processes.
- **Get ready for reporting:** As mining companies and governments are planning projects it's imperative that baselines across the entire value chain are established and climate and sustainability planning are factored in. In June 2023, the International Sustainability Standards Board (ISSB) issued its inaugural set of standards with reporting beginning January 2024 for most filers. These standards create a common language for understanding and disclosing the effect of climate-related risks and opportunities on a company's prospects.16 Gap and materiality assessments are the first steps.

END NOTES

TREND 6
GOING BACK TO GRASSROOTS: NOURISHING GROWTH THROUGH INVESTMENTS IN EXPLORATION

Attitudes toward exploration, both from the mining and metals industry and investors, are currently a tale of two halves.

In copper, a key metal to help drive the energy transition, companies are focusing capital expenditures on extending or expanding high-grade, profitable assets, rather than exploring for and developing new projects to meet increasing demand. This has resulted in a dwindling pipeline, which, if left unchecked, could manifest as a supply deficit in just a few years.

In contrast, battery metals have seen an explosion in spend on both exploration and development—lithium, for example, saw a 90% increase in exploration spend during 2022.[1] With this explosion, there's catching up to do around evaluating, permitting, and downstream processing if supply is to keep pace with demand as well as environmental, social, and governance (ESG) expectations.

Several factors have contributed to this dichotomy, but at the core, there is a historical fluctuation in investment into exploration (based on commodity prices) as a mechanism for organizational and industrial growth. In this trend, we'll consider how becoming more intentional with investments as well as strategy, leadership, and technology could contribute to more plentiful metals supplies and preserve market capital.

PUT SPENDING INTO PERSPECTIVE

According to the International Energy Agency, global exploration spending rose by 20% in 2022, driven mainly by

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record growth in lithium exploration. Canada and Australia led the way in this, with more than 40% year-over-year growth. Uranium also experienced a 60% surge in spending due to renewed interest in nuclear power amid concerns over Russian supplies; and nickel at 45%, led by Canada, where high-grade sulfide resources, proximity to existing infrastructure, and access to low-emissions electricity offered attractive investment opportunities.[2]

In copper, budgets remain largely focused on Latin America, which hosts the world's largest reserves.[3] 2022 saw a 21% increase in spend on copper exploration to US$2.79 billion (the highest level since 2014) driven by strong prices through 2021 and into the start of 2022. However, persistently high inflation rates as well as a predicted slowdown in economic growth from 3.5% in 2022 to 2.9% in 2024[4] have affected commodity prices and, thus, dampened projected spend somewhat.[5] Despite these recent increases, it's important to take a step back and look at the bigger picture. The mining and metals industry is highly cyclical and exploration budgets are intrinsically linked to commodity prices (figure 1). This means that, when prices dip, exploration budgets tend to get cut (and vice versa), and the impact this volatility can have on exploration teams, the success of their programs, and, subsequently, project pipelines can be significant.

Additionally, the past decade has seen a shift away from grassroots exploration toward "safer" brownfield sites in established jurisdictions. This stems, in part, from the increasing difficulty and cost of finding quality deposits, which, in turn, has made it tougher for investors to fund riskier early- stage exploration.[7] Consequently, elevated spending over the past few years has not necessarily led to an increase in the number of major discoveries. S&P Global states that, while volume of supply in copper has increased by 50 million metric tons compared to 2021, most of that increase came from assets that were discovered in the 1990s.[8]

S&P Global reports, "All the new copper came from older, well-developed discoveries … In fact, we have only been able to identify three additional discoveries over the past five years, which added only 5.6Mt. This is a direct result of companies shifting more of their exploration budgets toward known deposits and existing mines."[9] It adds that this decade-long tendency could take time to reverse, as most producers have enjoyed record earnings from high copper prices.[10]

BALANCING INVESTMENTS IN GROWTH

Exploration is just one facet of the larger growth conversation, alongside mergers and acquisitions (M&A) and innovation, but it's an important one. M&A is generally more expensive, but less risky compared to exploration. However, with so few significant discoveries coming to light in commodities, such as copper, and an industry-wide shift away from grassroots exploration, sooner or later options for M&A could deteriorate.

To counteract this, major miners may decide to start spending more on exploration instead of relying heavily on the acquisition of smaller exploration companies. Ultimately, both pathways have a role to play in the growth of the mining and metals industry, but finding a balance between the two will likely be key to companies' longevity.

Source: S&P Global[6]

Figure 1: Indexed metals prices and exploration spend for nonferrous metals, 1996–2022

To change this cycle, organizations could look to better align their exploration efforts with their strategic direction, invest in the attraction and development of talent, and harness technologies, such as artificial intelligence (AI), to reduce the cost of campaigns and speed the identification and evaluation of targets.

USING TECH TO SPEED DISCOVERIES AND LOWER COSTS

It's tempting to think of technology as an easy solution to mineral exploration. However, the real value lies in augmenting human knowledge and capabilities, particularly where large datasets are involved.

For example, Curtin University researchers have developed an advanced machine learning tool to help identify undiscovered mineral deposits in Western Australia. As part of the project in collaboration with the Geological Survey of Western Australia, geochemical data collected across the state is being analyzed to reveal patterns that are difficult to see with standard methods. The database contains more than 50 million samples, which would present time, cost, and quality control challenges if examined manually.[11]

BHP has attributed its Oak Dam discovery in South Australia to applying a combination of "know-how and technology to sift through information that was previously available, but which people had interpreted in a different way."[12]

Satellite-based technologies are also proving valuable in speeding the identification and enhancing the accuracy of exploration programs. For example, Atlantic Lithium used Fleet Space's ExoSphere satellite-based mineral exploration system during 2023 to conduct geophysical surveys and identify concealed lithium pegmatites within the existing resource footprint at the Ewoyaa lithium project in Ghana.13

In time, generative AI (gen AI) could also help to find and summarize information that's important to exploration campaigns, for example, from technical and government reports, and even core logs going back decades as company records are digitalized.[14]

"It takes approximately 15 years for a mine to go from discovery to production. It's important that companies think about their decline curves today and determine the role exploration can play in their strategy to replenish and/or grow reserves."

Charles Hooper, director, Consulting, Deloitte Canada

Funding higher-risk forms of exploration

Finding ways to fund higher-risk forms of exploration without affecting market capitalization is a topic that's of increasing interest, and one that many major miners have started to investigate in recent years.

BHP's Xplor program is one high-profile example. It is a six- month accelerator program for early-stage explorers looking to fast-track and de-risk their geological concepts and become investment ready. BHP provides funding, coaching, and advice to juniors to ensure technical, business, and operational readiness. Members of each cohort also have the chance to pitch for follow-up funding or BHP relationships.[15]

California-based KoBold Metals has another interesting proposition. The company has built what it describes as a "full-stack digital prospecting engine, using computer vision, machine learning and data analysis" that it's applying to find critical minerals. Rather than selling the software as a product, KoBold generates revenue by taking ownership stakes in the mineral resources it discovers. The company already has relationships in place with BHP, which is using KoBold in its search for copper and nickel deposits in Australia, and Rio Tinto, which is working with KoBold on its Winu lithium project, also in Australia.[16]

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EXPLORING FOR A RICHER FUTURE

There are lots of ways that companies can expand their focus on grassroots exploration over the short and long terms, for both their own benefit and that of society. The key to success lies in starting now or doubling down on current efforts to minimize potential critical metal supply deficits, help enable the manufacturing of clean energy technologies, and support the global population.

FROM IDEAS TO ACTIONS

- **Invest in ESG competence:** Access to land is a key factor in grassroots exploration. Investing in appropriate ESG training for teams, both in the field and the office, and implementing leading practices could help manage potential risks (social, financial, and reputational) in the right way.
- **Build relationships in new jurisdictions:** Building relationships with local communities, rightsholders, and governments in emerging jurisdictions that could prove critical to future growth is a solid investment. Understanding priorities, pain points, and where they intersect with company interests could help in securing public support to operate locally if opportunities develop. It could also uncover possibilities to add value, for example, through shared value initiatives.
- **Augment teams with technology:** Consider where strategic investments in technology can be made to complement human talent. For example, AI-based core scanning and logging technologies could free up geologists for higher-level tasks, such as interpretation, and improve orebody knowledge and accuracy.
- **Sustain exploration through cycles:** Leadership and governance are key to sustained exploration efforts. Having a strong voice at the executive table—one who can represent the exploration function, communicate its needs effectively, and explain its importance to the wider organization—could prove critical in maintaining spend through market cycles and leadership changes.
- **Expose talent to exploration:** To understand the importance of grassroots exploration and how it feeds other business activities, graduates, managers, and leadership candidates need exposure to a range of organizational teams and functions. Consider creating a rotational program that provides talent with these experiences.

END NOTES

TREND 7
ADDRESSING WORKFORCE CHALLENGES THROUGH A SKILLS-BASED APPROACH:

EQUIPPING MINING AND METALS COMPANIES FOR THE FUTURE

Skills shortages have dominated the headlines over the past 12 months, causing one research group to declare the issue "persistent", rather than "transitory".[1] At the same time, organizations face the reality of an aging workforce. The United States is just one example—more than half of the country's mining and metals workforce is set to retire by 2029 (some 221,000 workers),[2] and with it could go knowledge that's critical to future ways of operating.

Diversity, equity, and inclusion (DEI) also remains a priority. While there's a clear business case for a more diverse workforce,[3] many organizations continue to grapple with creating workplaces that are physically, psychologically, and culturally safe.

These matters are indicative of the need for broader change in the way the industry values and treats talent to become a more desirable industry to work in. By coming together to tackle workforce challenges, mining and metals companies, educational institutions, and governments might have a better chance of success.

SPEAKING TO YOUNGER GENERATIONS

Recent research from Mining Journal[4] cited general labor scarcity as a significant factor globally; in July 2023, Australia and the United States had respective unemployment rates of 3.6% and 3.7%, and Canada 5.2%.

Mining and metals faces the difficulty in appealing to talent, particularly younger generations.[5] A December 2020 survey of 3,000 young Canadians by the Mining Industry Human Resources Council (MiHR) and Abacus Data found that 11% would definitely, or probably, consider working in mining and metals.[6]

In a 2023 article for Euractiv, Rohitesh Dhawan, president and CEO of the International Council of Mining and Metals (ICMM), wrote, "Just when we need the best and brightest talent to build the responsible mining industry of the future, graduates and potential future employees appear to be turning away from mining or being encouraged by their universities to do so."[7]

Dhawan attributed this partly to a lack of trust in the sector. He acknowledged that, despite considerable progress in environmental and social commitments, the industry still has a ways to go to appeal to the next generation of workers. Gen Zs and millennials for example, are values-driven and concerned about the environment8 so sustained positive performance over time could be critical

in changing the industry's image and in linking the mining and metals to clean energy, global food security, and development.[9]

REALIGNING EDUCATION WITH INDUSTRY

A shift of this magnitude also demands a step-change in the way that that mining and metals industry is taught and talked about. This requires government investment aligned with critical minerals strategies, as well as collaboration between industry players and universities to produce courses, curricula, and credentials as well as vocational education and training that better match current and future objectives.

A good example comes from the Bradshaw Research Institute for Minerals and Mining (BRIMM) at the University of British Columbia (UBC), which works closely with mining companies and Original Equipment Manufacturers (OEMs) to determine its offerings. The team established an executive microcertificate in Economic Leadership for Mining program in 2020. This 13-course program allows candidates to mix and match seven or more courses to achieve a UBC microcertificate.[10]

While people naturally learn in different ways and it's important to tailor training accordingly, there's also a shift in the way that different generations learn. Research from Deloitte US has shown that members of Gen Z proactively seek out personalized learning opportunities to enhance skills and prefer to learn independently via online platforms.[11]

Experiential learning tools, such as online games, could be used more widely to educate students about the role that the mining and metals industry plays in their lives, and to introduce organizations in this industry as a potential employer. For example, the Briefcase game, developed by the European Union and EIT Raw Materials, familiarizes students and teachers in three age groups with the minerals used to build everyday objects and where they come from.

"Micro-credentialing can accelerate the entry of talent into mining and metals and can prove valuable in creating pathways for underrepresented groups—for instance, Indigenous communities—where access to tertiary education may be limited."

Joanne Doyle, senior manager, Consulting, Deloitte Canada

BROADENING THE DEI LENS

A 2018 survey from the Pew Research Center found that Gen Z is the most ethnically and racially diverse generation in history.[12] While the mining and metals workforce is slowly becoming more diverse, it's vital that companies move beyond numbers and targets and address the systems that sit around diverse talent.

At BHP's fly-in, fly-out South Flank iron ore mine in Western Australia, women comprise 40% of the more than 850-person strong frontline workforce, making it the first gender-balanced mining operation in Australia. Research has found that this is attributable to multiple factors, including strong engagement from senior leaders, strict gender equity targets, major technological investments to support inclusivity, and new onboarding procedures for new employees.[13]

Wiring organizations and their systems to support intersectional diversity is central to workforce well-being. For example, individuals can be racially, culturally, and gender diverse. This is essential, not only in attracting and retaining skilled talent, but also in creating organizations that can adapt to change.

SHIFTING FROM JOBS TO SKILLS-BASED WORK

Prospecting for a future pipeline of talent is important, but so, too, is filling the vacancies that exist in the mining and metals workforce today. One way to

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broaden the talent pool and help ensure that individuals have the knowledge needed for the future, is to switch the focus throughout the industry from roles to skills.

Mining and metals organizations, like most others, are structured around jobs and hierarchies. However, with workplace agility and flexibility growing in importance, and with innovation and creativity increasing in value, separating some work from job descriptions, and workers from being seen as job holders, could allow organizations to tap into a wider range of workers' capabilities and to find new ways of working. That said, there are certain mining and metals jobs that are legislated, so there is a balance to be struck with a skills-based approach in this industry.

Deloitte US has developed an operating model called the "the skills-based organization," In this, skills can be technical abilities (hard skills), human capabilities (such as emotional intelligence), or potential skills (including latent qualities, abilities, or adjacent) that may be developed and lead to future success. Research has found that organizations that embed a skills-based approach are 107% more likely to place talent more effectively and 98% more likely to retain high performers.[14]

For example, Schneider Electric was able to improve employee retention by creating an internal gig economy, which allowed more than 2,300 people to move to areas within the business where their skills were of more value.[15]

The skills-based approach also applies at a macro-level. In Saskatchewan, Canada—a key region for future critical metals production—Deloitte Canada recently convened companies at a skills accelerator summit to address workforce challenges in the mining and minerals industry, so that Saskatchewan and its people can achieve their collective employment, empowerment, and economic ambitions for 2030.

Following an economic assessment, the summit identified the occupations needed by various industries, including mining and metals, and then deconstructed the roles, examining the skills needed to complete the work. It then looked at how rearchitecting work could help to increase each role's capacity as well as adjacent industries where talent with the requisite skills might be found. Research showed that this approach could cut the talent gap in half, by almost 2,400 workers.[16]

UPSKILLING FOR FUTURE CHALLENGES

As the work involved in mining and metals operations evolves, so too will the type and range of skills required to execute on it. Access to critical skills and knowledge—for instance, surrounding climate adaptability and decarbonization—and, in sufficient volumes, could become a point of increasing differentiation for companies in the future.

Upskilling and reskilling of the current workforce, both at the individual level and in mass (ICMM states that 48% of mining employees will require upskilling or reskilling in the next four years)[17] pose a challenge and an opportunity. However, the industry already has some experience and capability in this area. For example, some organizations have established digital academies to help transition their workforces to new ways of working.

In March 2020, Antofagasta Minerals opened a digital academy in Chile to speed up and deepen the implementation of its digital road map.18 The academy provides courses that increase the company's productivity and competitiveness, and improve the skill sets and employability of its workers. In its first year, more than 1,500 employees completed nine courses on the basics of design thinking, agile project management, big data, Internet of Things, cybersecurity, and digital technologies such as collaborative tools and robotic process automation.

Replicating operations and programs such as these for systems thinking, climate-based skilling, and more could prove critical in organizational change and help companies respond quickly to future opportunities and anticipate which skills might be required in time.

Artificial intelligence (AI) can also play an important role in reskilling or upskilling the workforce; for example, AI algorithms can help to personalize training programs that build on workers' existing skill sets to prepare them for future opportunities that leverage technology. For example, the EdCast platform by Cornerstone combines an assessment of workers' skills with analysis of future labor market needs, allowing users to identify potential future jobs and gain the skills and qualifications they need to secure them.[19]

Laying the foundations for modern work
In summary, by investing time and resources now to create systems that increase and accelerate the entry of young talent into mining and metals, widen the search for skilled candidates at organizational and regional levels, and improve the well- being of current workers, companies could not only improve their productivity but help ensure they have the capacity and

know-how required to deliver on their future ambitions.

FROM IDEAS TO ACTIONS

- **Think long term:** By using strategic workforce planning to assess the business's long-term strategy, organizations could become better equipped to identify potential future skills shortfalls, that is, in areas such as climate resilience and digital disruptions. This will inform workforce strategy choices, and prioritize and accelerate investments in training, such as the development of a skills academy or the creation of a regional labor force ecosystem. This will also allow organizations to implement strategies to attract talent locally and regionally.
- **Map out the organization's needs:** By defining a skills taxonomy or framework and a common way of validating skills, organizations can lay the groundwork for making decisions about work and workers based on skills rather than jobs. They can expand from there, transforming one talent practice at a time, or experiment with new ways of organizing work so that workers can flexibly flow to the work based on their skills.
- **Put a DEI lens over every implementation:** A standard part of the evaluation process for new projects, processes, or technology implementations throughout organizations should be consideration through an intersectional DEI lens. Making this a standard metric or procedure, regardless of the nature of the project, will help embed DEI thinking into company culture.
- **Prioritize skills-based changes:** When transforming companies to a skills-based model, start with practices that have clear connections to skills—for example, learning and development, internal mobility, and talent acquisition. Prioritizing these areas makes sense, as organizations may be able to use mature, off-the-shelf technologies as readily available upgrades to existing HR information systems, such as talent marketplaces.
- **Explore skills ecosystems:** Companies could start by exploring the regional and local skills ecosystems surrounding each operation and identifying groups or sources of talent, such as adjacent industries or communities, who are underrepresented in their current workforces. From there, barriers to entry can be determined and programs developed to support talent transfer, and educational and upskilling opportunities can be created.

END NOTES

TREND 8
UNLOCKING NEW VALUE IN EXISTING ASSETS:

BALANCING COMPLEX PRIORITIES AND MEETING SUPPLY DEMAND THROUGH OPERATIONAL OPTIMIZATION

As demand for metals and minerals soars, fueled by a burgeoning global population,[1] record levels of urban development[2] and impending decarbonization targets in key economies, mining and metals companies are under increasing pressure to bring new supplies online. In addition to speeding up new developments to counteract potential supply shortages, organizations are focusing their efforts on extracting greater value from existing assets.

Operational efficiency and productivity improvement initiatives are two ways to do this. These were already front-of-mind for mining and metals companies, which have, for years now, faced declining ore grades and rising operating costs; in 2022, the 40 leading mining companies had operating expenses of US$670 billion—an increase of 5.5% over the previous year.[3]

Today, data-led insights and digital technologies are enabling companies to balance complex and, sometimes, conflicting interests while meeting supply imperatives. The combination of operational technologies (OT), advanced visualization, and analytical tools are revolutionizing decision-making and changing the approach in long-standing functions, such as mine planning and maintenance, while also improving operational metrics. In this trend, we'll explore how organizations can use these techniques and technologies to enhance their operational productivity and efficiency.

ESTABLISHING A SOLID DATA FOUNDATION

As mining companies automate, electrify and connect ever more devices, applications and machines, there is a proliferation of data across the value chain. For example, in 2018, Rio Tinto's Iron-Ore operations, which, at the time, included 16 mines, 1,500km of rail and three ports, created 2.4 terabytes of data every minute from mobile equipment and sensors.[4] This number would likely be much higher today. However, despite mining and metals companies having a wealth of data, most of it is not properly collected, contextualized, normalized, stored or analyzed, and therefore cannot always be reliably used in decision-making.

To address data value leakage requires a back-to-basics approach, establishing a solid foundation with a comprehensive data model that's well-defined and understood by parties across each

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organization's value chain. Architectural approaches such as creating a unified namespace (the practice of integrating consistent naming conventions across systems and applications in an organization)5 are gaining in popularity. These serve as methods for organizing data to reflect both the structure and current state of an entire enterprise.

One foundational area where mining and metals companies are focusing time and effort in the pursuit of predictive and prescriptive maintenance ambitions is in the asset master data and metadata domain of their enterprise resource planning (ERP) or enterprise asset management (EAM) solutions. Technical object structures (or equipment hierarchies) and damage and cause codes describing failures are critical in helping ensure that equipment failures are not only documented against the right equipment, but also captured accurately. This helps to establish a trusted data set that enables both reliability engineers and more sophisticated analytics to improve asset performance.

HARNESSING TECH-ASSISTED DECISION-MAKING

Most operational optimization programs in mining and metals to date have centered on achieving incremental productivity and safety gains and/or cost reductions in certain processes and functions. However, with a solid data foundation in place, companies can use a more sophisticated and integrated approach to address the wide-ranging requirements and constraints that they face today.

For example, by leveraging OT to gather information relating to physical assets—such as a mill, truck or smelter—and contextualizing that data, companies can re-create those assets as well as their inputs and outputs in the digital world (i.e., a "Digital Twin"). This allows the asset, processes, and systems surrounding them to be visualized and simulated, enabling better predictability of performance and possible future failures.

> "If we take the example of a concentrator, asset performance has traditionally been measured by recovery, which is primarily constrained by throughput, and that has guided strategy and decision-making for these operations. However, in the future, the need to report each asset's carbon footprint and balance that against traditional productivity and profitability measures could lead to conflicting priorities on how best to operate the asset."
>
> *Shak Parran, Ecosystems & Alliances leader, Energy, Resources & Industrials, Deloitte Canada*

Simulation has been used for some time in mining and metals, although its applications are expanding. Its primary use is in validating the feasibility of new designs and concepts and to model changes to processes and operations over time. Companies can use simulations in advance of starting new projects or making changes, both big and small, to see whether the long-term gains could outweigh any short-term costs or production losses before finalizing their choices.[6]

Increasingly, simulation is being used with mathematical optimization tools to find the best possible solution to a problem given a business' objectives and operational constraints. For example, Australian data science specialist PETRA recently helped an iron-ore operation in Western Australia to achieve a 5.5% improvement in plant throughput by optimizing the drill-and-blast phase of its operation. Data fusion ore tracking was used to create digital twins that correlated crusher downtime with geology and drill-and-blast designs. The program resulted in an estimated annual financial benefit of more than AU$450 million (approximately US$285 million).[7]

AGILITY THROUGH AUTOMATED DECISION-MAKING

Both simulation and optimization can be deployed strategically, tactically, and operationally to determine which investment, scenario, or process is most likely to deliver the greatest

value across different time horizons.[8] Advances in software packages and computer processing capacity mean that simulations that used to take days or weeks to run can now be completed within minutes, leading to new opportunities and applications.

Another of these is automated decision-making, for example, in functions such as mine planning. This concept is still relatively nascent in mining and metals, but it can ultimately make for more agile and adaptive operations.

Another area where automated decision-making could prove useful is in predictive maintenance of equipment. This is high on the priority list of many mining and metals companies; a 2023 survey by GlobalData revealed that, 68% of mines had made moderate investments into predictive maintenance for mobile equipment, 40% expected to either invest in the technology for the first time or invest further over the next two years.[9]

Maintenance costs typically represent 1-3% of total annual revenues for mining and metals companies,10 so even small savings in this area can deliver significant bottom-line savings, in addition to minimizing hazardous hands-on work for their technicians.

Many companies struggle to optimize maintenance practices because they want to both increase uptime and reduce operating costs.

Using automated decision-making is a departure from the traditional engineering mindset given its statistical nature and requires a cultural shift; however, over time, it has the potential to deliver positive outcomes for businesses, given their objectives. Demonstrating this could help teams to work more harmoniously and help companies grow their trust in data.

MOVING FROM REACTIVE TO PROACTIVE MAINTENANCE

Tata Steel, which began its digital transformation journey in 2016, is taking its maintenance approach a step further. Through its Shikhar 25 transformation initiative, the company is creating digital twins for all its critical and complex processes, including mines, factories, and blast furnaces. Once in place, these will help the company to move from a predictive maintenance approach to a prescriptive one, which is expected to lead to greater efficiencies, fewer breakdowns[11] and lower costs.

Prescriptive maintenance is an asset maintenance strategy that uses machine learning to adjust operating conditions for desired outcomes, as well as intelligently scheduling[12] and planning asset maintenance. This is a step-up from predictive maintenance and represents a shift from reactive to proactive asset performance management. If organizations can contextualize and standardize their data, then there could be more opportunities to tackle rising operational expenditures through reduced maintenance and parts costs, and they could expect to deliver greater safety performance.

For example, a multinational mining company recently implemented the Aspen Mtell machine learning solution from AspenTech and was able to improve its production uptime. AspenTech said the customer now uses its autonomous agents for early warnings of degradation in metals refining processes and equipment. These regularly advise a time-to-failure of around 40 days on pumps.[13]

TURNING INFORMATION INTO COMPETITIVE INSIGHTS

Due to technological advances and digitization, mining and metals companies have access to more valuable data than ever before.[14] Making greater use of widely available tools, such as simulation and mathematical optimization, could turn information into a significant business advantage by driving more predictable operational outcomes, saving money and improving operational safety and sustainability.

In turn, these practices can be expected to help satisfy wide-ranging stakeholder expectations and bring new supply online for future-critical metals and minerals.

FROM IDEAS TO ACTIONS

- **Establish a solid data foundation:** Invest in the development of a data model and data dictionary for your organization to help ensure that data is understood and can be collected, contextualized, normalized and used in reporting, simulation, analytics and, finally, decision-making.
- **Look for easy-to-implement advances:** Find a small, high return-on-investment (ROI) use case to implement as a minimal viable product. Starting in this way can help build experience and confidence within teams and deliver tangible benefits that can be used to develop larger business cases.
- **Buy rather than build:** Many software-based simulation and optimization programs are available for different mining and metals applications. Today, use of the cloud means that these programs can often be deployed relatively quickly and inexpensively to address operational bottlenecks.

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- **Scale current applications:** Explore whether data and digital technologies for assisted decision-making could be expanded across other business operations and functions for maximum ROI.
- **Consider outsourcing data preparation:** High-quality data is essential for accurate simulation and optimization. Assess the state of the data and, if preparation work is necessary, consider whether there are resources to handle it internally. Outsourcing to a team of specialist data scientists could prove to be a faster and more cost-effective option in the short term until internal teams develop the requisite knowledge, skills, and abilities.
- **Appoint a chief data officer (CDO):** The data held by mining companies can be of tremendous value. Appointing a CDO to manage data with appropriate risk, governance and control mechanisms could improve OT usage.

END NOTES

TREND 9
BRINGING GENERATIVE AI INTO MINING AND METALS:

CAPITALIZING ON CURRENT AND FUTURE OPPORTUNITIES

2022 was a landmark year for artificial intelligence (AI) with the release of ChatGPT, Midjourney, and Bard, which brought generative capabilities and foundational models into homes and businesses around the world. While early traction with these technologies was mainly in consumer-facing industries, generative AI (gen AI) also holds huge potential in industrial and enterprise applications.

In the mining and metals industry, adopting gen AI presents a range of attractive opportunities, including addressing energy security and improving profitability, improving operational efficiencies and resilience, and reducing emissions. Although companies are beginning to realize the potential that gen AI could offer, adding contextual awareness and humanlike decision-making to workflows could significantly change how companies do business in time.

This trend will explore some potential uses that could help to drive productivity and streamline tasks in the short term; look at how early adopters in other sectors are using gen AI to navigate complex and uncertain environments; and discover how mining and metals organizations can prepare for more radical, long-term opportunities enabled by gen AI (figure 1).

GETTING A HEAD START WITH GEN AI

While gen AI may be nascent in mining and metals, it's far from new in other industries. For example, research from Deloitte Digital has found that one in four business to business (B2B) and business to customer (B2C) organizations are already harnessing gen AI in content marketing,[2] and industry-specific solutions are helping to accelerate pharmaceutical drug discovery and reduce associated costs.[3]

Historically, the sector has taken a conservative approach to deploying novel technologies and, consequently, companies may be hesitant to become early adopters of gen AI.[4]

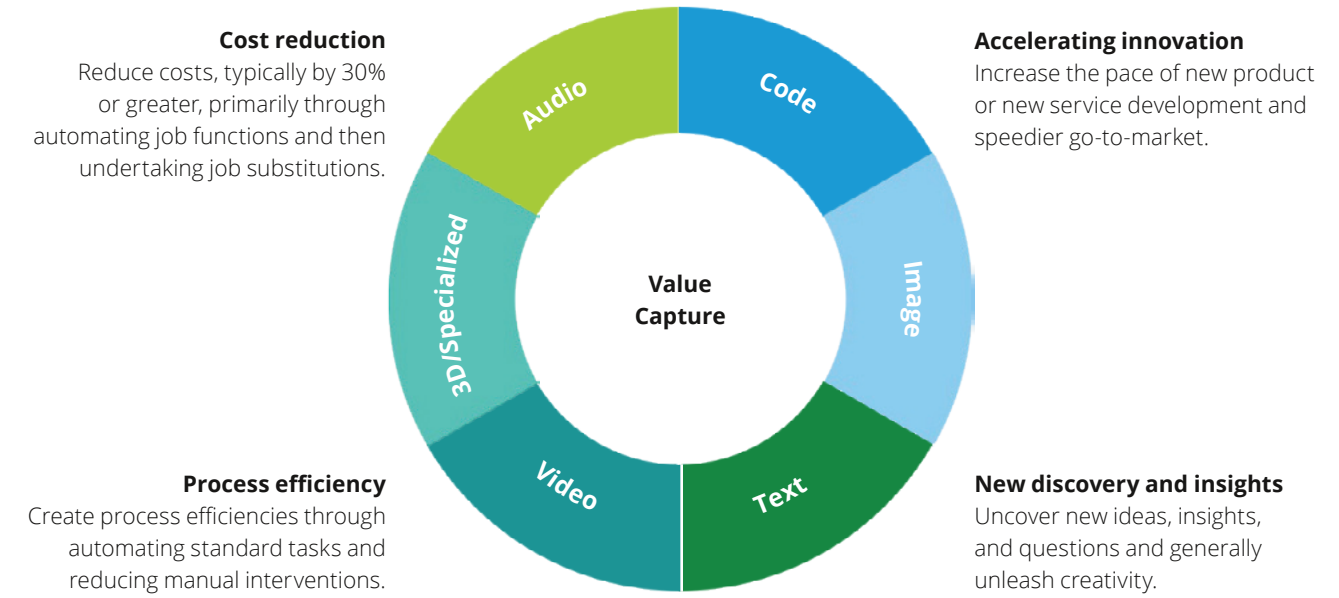
According to the Deloitte AI Institute, initiating the adoption of gen AI at this juncture goes beyond gaining a competitive edge in the present, it also creates a foundation for future growth by investing in the workforce. The Institute's 2023 Generative AI Dossier states, "Contemplating the energy, resources and industrial sector's future, gen AI will assume a central role in many functions. For example, in optimizing and mitigating health and safety risks by generating worksite- specific safety training that replicates real-world settings and critical scenarios."[6]

As companies transition to more environmentally sustainable business models—for instance, those built on circularity and climate action—gen AI could also help develop real-time, bespoke training materials that support workforce transitions and the adoption of sustainable practices.

UNDERSTANDING POTENTIAL USE CASES

There are various uses for gen AI that could transform the way mining and metals organizations operate over time, from changing the way that individuals work, to the way that enterprises and their value chains operate. Opportunities and applications will also span different business teams and functions, from exploration to mine design through to shipping and metals trading.

Foundation models are what differentiate gen AI from traditional AI. These are complex learning models that have been pretrained on a broad dataset and can be adapted to solve various problems. Many foundation models today are in the text domain and are driven by vast quantities of available training data. However, gen AI can create artifacts across various modes, including code, images, video, audio, and 3D models. Text, image, and voice are the modes frequently used by consumer-facing gen AI applications today. However, increasingly, the possibility for different modes and even multimodal models could both disrupt and drive step



Source: Deloitte AI Institute, *The Generative AI Dossier*, 2023[1]

Figure 1: The value that Gen AI use cases can enable can be conceived across four dimensions: cost reduction, process efficiency, accelerating innovation, and new discovery and insights.

changes in productivity across a range of functions (figure 1).

Transforming work in mining and metals In the near term, gen AI will likely have an impact on mining and metals organizations mostly through workforce productivity and efficiency. For instance, in the back office, employees are beginning to use tools such as Microsoft Copilot to handle emails, schedule meetings, and write documents. Developers could also use gen AI to enhance their efficiency when writing code, ensure its compliance with various standards, and reduce cybersecurity risk.

For example, if a technician is changing a part on a haul truck, gen AI could scour the organization's data for manuals and information that could help them to complete the job more effectively. It could tell the technician which tools and skills they need, and where accidents or mistakes have occurred in the past and how to avoid them

Virtual "field assistants" like these could help to not only improve safety, but also bridge skills and knowledge gaps by capturing valuable information and experience that could otherwise be lost from institutions as experts retire. Additionally, they could guide new recruits and contractors through processes and workflows where human mentors are not available.

In the future, organizations could use gen AI's ability to simulate, model, and generate data-driven insights to support supply chain resilience and optimization. For instance, gen AI could help identify and simulate potential disruptions in metals supply chains through assessments of port congestion, shipment routes, and supplier mapping. Supply chain managers could also use these tools to run what-if scenarios in a digital twin environment that reflect the real-world supply chain.[7]

Gen AI can also explore many possible designs to find the most suitable match for a company's objectives. It not only augments and accelerates design in many fields but has the potential to "invent" designs or objects that humans may have otherwise missed.[9] This means that, in the long term, it could transform the way in which operations are designed and run.

Capital project delivery and mine design are two functions that could potentially benefit from this capability, which is already proving its worth in other sectors. For example, drug discovery company Insilico Medicine uses an NVIDIA solution to develop new therapies for diseases, such as pulmonary fibrosis. In June 2023, the company announced it had used gen AI for each step of a new preclinical drug discovery process.

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Doing this using traditional methods would have cost US$400 million and taken up to six years. But with gen AI, Insilico Medicine accomplished it for one-tenth of the cost and in just two-and-a-half years.[10]

UNLOCKING THE VALUE OF DATA

One of the most important capabilities that gen AI provides mining and metals businesses is that it helps people to interact more deeply with data. Despite significant investment in digital transformation over the past decade, some companies continue to work to implement the right infrastructures that allow their workers easy access to the data they need to do their jobs more effectively.

Although gen AI platforms are still relatively nascent, they're already well-developed, and their capabilities are advancing quickly. Goldman Sachs predicts that as tools using advances in natural language processing work their way into businesses and society, they could drive a 7% (almost US$7 trillion) increase in global gross domestic product (GDP) and lift productivity growth by 1.5% over a 10-year period.11 By embarking on the exploration and implementation of gen AI now, mining and metals companies could acquire valuable insights, adapt to its nuances, and evolve alongside the advancing technology. This strategic approach may position organizations to leverage the full capabilities of gen AI as it reaches maturity.[12]

FROM IDEAS TO ACTIONS

- **Educate the workforce:** Educating and upskilling the workforce could help remove the fear of the unknown, create buy-in as new gen AI tools are introduced, and help workers perform their tasks better and more efficiently. Education will also help leaders pose the correct questions of gen AI. Investing in this knowledge now will help ensure a strong foundation for when gen AI becomes more widely used in the workplace.
- **Identify and prioritize use cases:** Determine use cases that might be relevant to the organization in both the short and long terms and that can be scaled for the greatest return on investment. Mapping and prioritizing implementations in this way can also help establish whether a build or buy approach is best suited for each solution.
- **Centralize and prepare data:** To produce useful results in knowledge retrieval applications, gen AI models require access to a company's data. Creating a data lake, or similar repository, could help. For more advanced applications that require the tuning of a large language model (LLM), it's important to assess the current state of the organization's datasets ahead of time, as this could affect deployment timelines.

> "In the field, gen AI could be used for knowledge retrieval, to help individuals access information held within the organization that might be relevant to the task they're completing."
>
> *Shak Parran, partner, Ecosystems & Alliances leader, Energy, Resources & Industrials, Deloitte Canada*

END NOTES

TREND 10
THIRD-PARTY DELIVERY MODELS:
GAINING AGILITY AND COMPETITIVE ADVANTAGE THROUGH NEXT-GEN APPROACHES TO OUTSOURCING

The continued evolution in the global risk landscape, with a prioritized focus on sustainability and increasing regulatory requirements, has resulted in organizations seeking new ways to reduce costs and evolve their capabilities in an agile and non-labor-intensive manner.

Furthermore, supply chain disruptions due to geopolitical events saw organizations seeking new ways to

source regionally and locally during 2023, all while the global economy faced a possible recession.[1] In response, many companies are turning toward third-party delivery models (TPDMs) for certain business functions, such as cybersecurity, data and analytics, and environmental, social, and governance (ESG) reporting, to fill capability gaps, drive value and agility, and provide end-to- end solutions as they build blueprints for the future.[2]

WHY CONSIDER THIRD-PARTY DELIVERY MODELS?

The early 2000s saw a wave of outsourcing arrangements across different industries. Typically, these would target low value-add transactional services and take advantage of labor arbitrage in relatively cost-effective jurisdictions, like India or the Philippines.

The cyclical nature of mining and metals means that these organizations need flexibility and agility to maximize their profitability. TPDMs provide an attractive way to dial certain activities and their output up and down quickly as required by demand or commodity and metals prices, without compromising the quality of work.

Likewise, the fast pace at which technology is moving, particularly in areas like artificial intelligence (AI) and data science, means that building and sustaining capabilities internally in these areas in a way that keeps pace can be difficult and costly.

Companies may also be reluctant to invest heavily in creating internal capabilities based on emerging technologies, such as generative AI, before seeing the value they can deliver for their businesses. TPDMs also provide a cost-effective way to test these technologies before investing and embedding them into permanent in-house capabilities.

The challenges of attracting and retaining skilled talent to resource core business functions are well known and something we have explored in detail in trend seven. Hiring and retaining highly skilled employees is one of the greatest challenges facing enterprise leaders today. The 2022 Global Outsourcing Survey from Deloitte US found that 50% of executives see talent acquisition as a leading challenge in meeting their organizations' strategic priorities, and 56% do not feel their organizations have the right mechanisms to retain employees.[3] By rethinking operating models and outsourcing certain functions or tasks to third parties who have the latest knowledge and capabilities, as well as an organization whose business centers on delivering value in specific areas, mining and metals companies can dedicate more time, people, and resources to their core operations.

TPDM: A NEW PARADIGM FOR OUTSOURCING

Traditional outsourcing efforts focused on cost reduction for simple, discrete tasks that could be automated—for instance, payroll or network administration. With this type of arrangement, the relationship between clients and vendors tended to be transactional in nature.

TPDM services move beyond this, combining cost reduction and discrete value-addition, where vendors support more complex processes, applications, or full business functional areas requiring specialized expertise. These might include hosting/cloud operations, analytics-as-a-service, cyber detect and respond services, or infrastructure support.

These relationships are usually longer term and tied to performance service level agreements (SLAs) based on outcomes and volume consumption. Clients are typically given on-demand access to hard-to-source talent, experiences, skills, and leading technology.

Deloitte US recently helped a multinational pharmaceutical company to optimize its supply chain and improve operational efficiency using data-led insights. To do this, the team developed a data modernization strategy and a use case collection and prioritization framework designed to target key business priorities effectively. The result was enhanced supply chain visibility across teams, locations, and systems. More than 20 manufacturing sites and over 400 users were enabled with modernized data. There was also an overall 75% reduction in time required to transform the data into insights at manufacturing sites and an 85% reduction in the manual effort required to extract and consolidate raw data before it could be consumed by the analytics applications.[4]

TPDMs like these are usually dynamic in scope and the relationship tends to be highly collaborative or viewed as an extension of the organization.[5] In fact, these third-party resources are becoming so important that 87% of respondents from Deloitte's 2022 Global Outsourcing Survey said they consider external workers as part of their own workforce.[6]

The 2023 Global Chief Procurement Officer Survey from Deloitte US also identified the increased use of hybrid delivery models that leverage TPDMs as a key value driver for top- performing procurement teams across businesses globally.[7]

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A tool to stay on top of technology trends
In the mining and metals industry, migration to cloud-based services has been another factor in the uptake of TPDMs.

The shift to next-generation enterprise resource planning (ERP) systems, many of which utilize a subscription-based model rather than licensing, is another function that companies are looking to outsource.

The move to the cloud offers a way to better leverage company IP and capability. Most recently, this is turning into "industry cloud," an approach that embeds industry-specific intellectual property (IP) (particularly data) directly into the cloud. For this to work well, the expertise must be shared, even if the data is private, which requires a TPDM.

Web3 was about sharing trust without waiting for platforms. The expense and complexity of these solutions has challenged their blockchain-based foundations, but the principles of decentralized trust and embedded value remain important, particularly in supply chain and operations. In this way, shared TPDMs provide platforms that can accelerate opportunities to share and empower supply chains.

USING TPDMS TO GET AHEAD

Amid an increasingly complex business environment, now is an opportune time for mining and metals companies to revisit their sourcing strategies. Traction has mainly been among major miners.

However, as competition in the market increases, mid-tier mining companies could leverage these services to gain an edge, and unlock and expedite value realization in an agile way.

FROM IDEAS TO ACTIONS

- **Identify where TPDMs could add value:** Look for business processes that are routinely affected by regulatory change or other new requirements; areas where technology is evolving rapidly, required to keep pace, and outside the core competency of the enterprise; and areas where talent is limited and in high demand, thus making it hard for the enterprise to compete for resources. The key is to identify functions where a combination of capabilities and teaming with key stakeholders and solutions could allow a third-party provider to deliver distinctive value.
- **Find the right TPDM providers:** Consider providers who offer access to and experience working with an ecosystem of vendors at the leading edge of technology disruption and who can bring purpose-built solutions. Those who are familiar with the latest industry regulations and have a track record of supporting organizations in your specific geography or industry could also prove beneficial. For organizations with international operations, seek TPDM providers that have the critical mass to support the areas in which the organization does business, whether the ambitions include an onshore, nearshore, offshore, or hybrid operational model.
- **Move beyond vendor management:** Aligning multiple vendors to a single objective can be challenging and time-consuming. This is underscored by the need for end-to-end talent and service integration, cyber control over the extended enterprise ecosystem, and a single source of reliable data. In this new environment, vendor management capability must evolve from traditional procurement-oriented vendor management to a strategic ecosystem management approach. Consider engaging one or more TPDM providers to focus on a critical goal and provide incentives that align with achievement of the goal. Given the longer- term nature of managed services, the relationship should have the ability to adjust to increasing or changing goals.
- **Interlock business ecosystems with TPDMs:** Building standard capabilities to manage a holistic network of vendors that is fully aligned to information technology (IT) or business strategy is vital. Ensure that each vendor fits the business's culture and vision, understands the organization, and provides innovative thought leadership to realize maximum potential through collaboration.
- **Service level agreements are necessary, but not sufficient:** When the goal is highly integrated teams working as one, service level agreements (SLA) set the baseline, but cannot reliably ensure peak outcomes. To unlock the most value from these teams, organizations must go beyond SLAs and create true relationships with vendors based on mutual trust and transparency that yields innovative thinking and mutually beneficial outcomes. Traditional penalties for SLA violations can be combined with incentives for continuous innovation to achieve this. Establishing a collaboration culture should be a priority at the beginning of a relationship and reinforced throughout. wn

END NOTES

73rd Bernard Price Memorial Lecture

Charting a Path for African Low-Resource Languages

- A Multifaceted Approach to Research and Development

The talk delves into the challenges and opportunities of advancing Artificial Intelligence in Africa, specifically in language development. It emphasizes the need for multidisciplinary approaches beyond technical solutions to address the cultural and human aspects essential to language innovation. It also highlights the difficulties of developing AI systems for Africa's diverse languages and the impact of linguistic diversity on technological progress.

Additionally, it showcases the work of the Data Science for Social Impact research group at the University of Pretoria and the efforts of Lelapa AI. These initiatives demonstrate collaborative and innovative strategies to overcome AI challenges in Africa, fostering a future where technology and culture intersect.

Our Guest Speaker: Prof Vukosi Marivate

Prof Vukosi Marivate holds the ABSA UP Chair of Data Science and is an Associate Professor of Computer Science at the University of Pretoria. He focuses on AI and Natural Language Processing (NLP), local or low-resource languages, and Data Science for Society, leading the Data Science for Social Impact (DSFSI) research group. He co-founded Lelapa AI, a socially grounded Africa-centric AI research and product lab. Vukosi also co-founded the Masakhane NLP research foundation and the Deep Learning Indaba.

DATE & TIME
26 September 2024
18h00 - 20h00

VENUE
Senate Room, Senate House
Wits University

RSVP
Gerda Geyer
geyerg@saiee.org.za
By 20 September 2024

The embedded costs of Lithium Batteries

- IT'S WAY MORE THAN THE PRODUCT – IT'S THE GLOBAL VALUE CHAIN

One of the most significant challenges facing the Energy, Renewables and Mining sector in the 21st century is the unmistakable need to move to renewables and a more environmentally friendly and economically sustainable future.

By: Minx Avrabos (PM, IAPW&E)
Managing Editor
wattnow magazine

There can be no doubt that the world is amid a genuinely global energy crisis. This crisis affects all countries but vastly impacts the people who can least afford it.

Global electricity demand is expected to rise faster over the next three years, growing by an average of 3.4% annually through 2026. The gains will be driven by an improving economic outlook, contributing to faster electricity demand growth in advanced and emerging economies. Particularly in advanced economies and China, electricity demand will be supported by the ongoing electrification of the residential and transport sectors and a notable expansion of the data centre sector. The share of electricity in final energy consumption is estimated to have reached 20% in 2023, up from 18% in 2015. While this is progress, electrification must rapidly accelerate to meet the world's decarbonisation targets. According to the International Energy Agency's (IEA) Net Zero Emissions by 2050 Scenario, a pathway that limits global warming to 1.5 °C, electricity's share in final energy consumption will be near 30% in 2030.

According to the World Meteorological Organization's provisional State of the Global Climate in 2024 report, extreme heatwaves, drought, and devastating flooding have affected millions and cost billions in the last year. There is a 47% likelihood that the global temperature averaged over the entire five-year 2024-2028 period will exceed 1.5 °C above the pre-industrial era, up from 32% from last year's report for the 2023-2027 period.

THE TELL-TALE SIGNS AND IMPACTS OF CLIMATE CHANGE ARE BECOMING MORE DRAMATIC

Economic, geopolitical, environmental, and social considerations have all contributed to an intensified and more robust debate regarding the future of our planet. The good news, however, is a growing consensus that economic factors can no longer be the sole measure of success or failure in the years to come.

As the world faces unprecedented energy shortages, increasing energy price inflation and the adverse effects of global warming, it has become abundantly clear that we must, all, governments, corporations, and individuals alike, be posing three simple questions:

- How did we get here?
- Where is it, we need to go? and
- What can everyone contribute to getting there?

Energy, mining and renewables sector leader David Tomasi, in a recent article entitled "It is not easy going green", stated - "One of the most important actions we can take is simply to acknowledge the harsh fact that it is not easy going green, without risking the very fabric of modern society and the vast, interconnected

global economy that has improved the lives of billions of families".

With the bar set so high on emissions targets, expecting us to reach these with one giant leap is unrealistic. Instead, we should think of it as climbing a step ladder, each rung on the way up representing an incremental improvement contributing to cutting emissions.

Tomasi stated, "Targets should be viewed as aspirations, but the real aim is to get to the top step without the base of the ladder toppling over. That is the way to achieve real and lasting change".

Lithium batteries and the embedded economic, social, and environmental costs associated with their production are one step in the ladder, requiring intense introspection and robust debate.

The verdict is out, and it appears, at least on the surface, that there is a general global consensus that energy generation through renewable sources such as wind, solar, and hydro is integral to reducing CO_2 emissions and a greener future. The jury is, however, still out on how to store energy sustainably once produced.

However, the solution to the world's energy storage needs is far more complex than it appears on the surface. Lithium-ion batteries are currently the industry standard and attract most research and development funding. While smaller lithium-ion batteries have been tried and tested in smartphones and smaller devices, the economic viability, durability, and longevity of larger storage lithium batteries remain burning questions that need to be answered.

In addition, one must factor in the environmental, social, and governance impact of production, which can be controversial and polarising. These factors can also be viewed from an ethical and economic perspective, as ESG investing is growing momentum. So much so that many security exchanges, such as NASDAQ, are purchasing or developing analytics and reporting systems to track the ESG factors of listed companies effectively.

The question remains: what is the actual cost of Lithium-ion batteries? The answer lies not in the product but in the global supply chain.

The intention behind this paper is not to provide a definitive answer but rather to provoke thought and debate around a subject that must surely dominate the boardrooms of all participants in the energy, mining, and renewable sectors.

LITHIUM BATTERIES AND POTENTIAL CONTRIBUTION TO A SUSTAINABLE FUTURE WITHIN THE EMR SECTOR

With the global shift to reduce our carbon footprints by 2030, which is currently about 4 tons, countries are working feverishly to meet the Paris Agreement's requirement that emissions be reduced by 45% and reach net zero by 2050. But lowering carbon footprints does not happen overnight!

Lithium is a key ingredient in our everyday life, from mobile phones, laptops and energy storage batteries to heart pacemakers, drones and clocks. We do not take cognisance of it as we plug our charger in to charge our lithium-ion battery. Lithium dubbed the 'white gold' of the new millennium, has seen exponential growth in recent years due to electronics, electric vehicles, and backup of renewable energy in homes, businesses, and national grids. They are vital to global efforts to curb climate change, reflecting market developments. Thanks to their high performance, rechargeable capabilities, and relatively low cost, it is widely agreed that lithium batteries will be crucial to our sustainable energy transition.

According to the World Economic Forum, the global battery market is surging. By 2040, the global energy storage market is projected to attract $620 billion in investment. Over the past decade, the rechargeable lithium-ion battery market doubled on average every three years.

Batteries are a core technology underpinning the shift to energy decarbonisation and transport systems and could be a game changer in efforts to curb climate change. Historically, portable electronics have been the

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primary driver of growth in the battery market; however, today, the increase in demand comes from electric vehicles.

The International Energy Agency projects that by 2030, 130 million electric vehicles could be on the world's roads. While scenarios vary, significant electric vehicle and battery production investments are well underway. These investments are also fuelled by national and international targets to support climate action, while several cities and governments have announced their intentions to ban internal combustion engines.

Looking beyond transport, the entire energy system is undergoing a systemic transformation. By 2050, wind and solar energy are expected to account for 50% of global power generation, while global carbon dioxide emissions from fossil fuels and cement will increase by 1.0% in 2022, new estimates suggest, hitting a new record high of 36.6 billion tonnes of CO_2 ($GtCO_2$). Besides the fact that batteries are the basis for future mobility, they are key as they ensure energy availability when the wind is not blowing and the sun is not shining.

Minerals like cobalt, lithium, and nickel are common in the composition of a range of tech products. Lithium, nickel, cobalt, manganese, and graphite help increase battery performance and longevity. The magnets inside wind turbines and electric vehicle motors require rare earth minerals.

The energy transition will put new and greater pressures on the global mining industry, triggering demands for enhanced mineral supply chain security. This is because many new-energy items – from turbines to vehicles – need greater volumes of minerals than their existing, old-energy equivalents.

The critical minerals mentioned above are essential for the functioning of our modern technologies and economies and run the risk that their supply chains can be disrupted.

BUT WHAT IS LITHIUM?

Lithium (Li) is a soft, lightweight metal with such a low density that it floats on water. However, it's an alkali metal, which means it's highly reactive. So, if you do drop it in water, it will usually burst into a red flame. It's also soft enough that you can cut it with a knife.

Lithium salts can be found in underground deposits of clay, mineral ore and brine, as well as in geothermal water and seawater. Most of the world's lithium comes from mines, where it's extracted. Briny lakes, also known as salars, have the highest lithium concentration, ranging from 1,000 to 3,000 parts per million.

Brine mining in salars is normally a very long process that can take from eight months to three years. Mining starts by drilling a hole and pumping brine to the surface. Then they leave it to evaporate for months, first creating a mix of manganese, potassium, borax, and salts, which is filtered and placed into another evaporation pool.

It takes approximately 12 and 18 months for that mix to be filtered enough to extract the lithium carbonate. While cheap and effective, the process needs a lot of water, estimated at 2 million litres per ton of lithium extracted.

Chile has the world's largest known lithium reserves, offering 8 million tons, with Australia on 2.7 million tons, Argentina (2 million tons) and China (1 million tons). Zimbabwe, the Democratic Republic of Congo, Ghana, Namibia and Mali have a combined 4.38 million tonnes of lithium resources, according to U.S. Geological Survey data.

The production of minerals such as lithium, graphite, and cobalt could increase by nearly 500% by 2050 to meet the growing demand for clean energy technologies due to the use of electric vehicles, wind turbines and other clean tech.

ENVIRONMENTAL IMPACT

As mentioned, the lithium mining process is highly water-dependent. Mining activities in Chile's Salar de Atacama consume 65% of the area's water. In a region with less than 15 millimetres of annual rainfall, the activity depletes already scarce water resources that local communities and species depend on.

Furthermore, toxic chemicals used in the separation process, such as hydrochloric acid, can leak from the evaporation pools into local water supplies and affect water and air quality. Communities, which are often indigenous to the area and hold traditional or communal rights to land and resources, are often displaced due to water shortages for themselves and their livestock.

Lithium is usually extracted from rock using more traditional methods in the United States, Canada, and Australia. Nevertheless, it still requires chemicals to be extracted in a useful form. The research found impacts on fish 150 miles downstream from a lithium processing operation in Nevada.

Open-pit and brine extraction, the standard methods of lithium mining, can cause erosion and pollution. Vegetation needs to be cleared for an open-pit mine, and a deep-pit mine creates erosion.

Brine extraction drains water from a natural underground drinking water resource, which cannot be replaced quickly enough by the natural water cycle.

The result is toxic soil and dust with high levels of heavy metals, which can threaten the well-being of people and animals.

Securing adequate supplies will pressure the mining sector to redirect operations into new areas, secure supply chains, and limit the environmental impact.

IMPROVED TECHNOLOGIES FOR LITHIUM MINING

Researchers argue that mining technologies need to be redeveloped to reduce the carbon footprint in the manufacturing process of lithium-ion batteries. There is a global shift in exploring new alternatives, such as battery chemistries that might replace cobalt and lithium with more common and less toxic materials.

Direct lithium extraction (DLE) and direct lithium to product (DLP) promise to increase lithium supply, reduce the industry's environmental, social, and governance footprint, and lower costs. However, these technologies are still in their infancy and subject to volatility. It offers the significant promise of increasing supply, reducing the industry's environmental, social, and governance (ESG) footprint, and lowering costs, with already announced capacity contributing to around 10 per cent of the 2030 lithium supply, as well as to other less advanced projects in the pipeline.

With new battery technologies, we have to ensure that the final product is less energy-intensive, as this could negatively impact the environment. A less durable yet more sustainable device could have a larger footprint once you factor in all variables to deliver it to the user.

The UN has declared that electronic waste (e-waste) has become one of the world's most pressing environmental and human health issues. Most electronic waste is not disposed of or appropriately dismantled and ends up in landfills, contaminating the soil and being a fire risk.

With the expected Lithium battery lifespan of around ten to 15 years for passenger vehicles and the possibility of extending EV battery life through use in the energy-storage sector, battery recycling is expected to increase during the current decade, but not to game-changing levels. Depending on the recycling process employed, it can recover between zero and 80 per cent of the lithium in end-of-life batteries. By 2030, such secondary supply is expected to account for slightly more than 6 per cent of total lithium production.

CLIMATE IMPACT OF LITHIUM-ION BATTERIES

Over the last ten years, the lithium-ion battery has gone from enabling mobile electronics technology to playing an essential role in the world's decarbonisation and reduction of greenhouse gases.

The lithium-ion battery has also rapidly become the technology of choice for different energy storage solutions, which are becoming more and more important when fossil fuel-based energy sources are replaced with cleaner but less predictable renewable energy solutions such as wind and solar, which themselves are prerequisites for the reduction of GHG.
However, accurately calculating the CO_2 emissions and the climate impact on the production of lithium-ion batteries is, at the very least, challenging.

The lithium-ion battery value chain is complex and requires as many as 20 raw materials to be mined and sourced worldwide. These materials then pass through several energy-intensive refining stages before entering an advanced manufacturing process. Each has a very different climate impact and a variable dependency on the energy source used.

A further complication in calculating the true impact of Lithium-ion batteries on climate change is the need for primary

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data. Of all research done on lithium-ion batteries' life cycle, only a few studies use primary data, and even in these cases, the primary data is rarely derived from real plants or production sites but is usually estimates and results from modelling.

Although the research available today shows significant differences in how to measure and evaluate the embedded climate impact of lithium-ion batteries, there is, however, a unanimous view of which main variables to use, which primarily are two:

1. CUMULATIVE ENERGY DEMAND (CED)

With this metric, we understand how much energy has been used to produce the battery, regardless of the energy source. Depending on the boundaries, it may include all energy used to produce the battery, from raw material extraction to the final assembly of the battery or any range within. When measured per unit, this is the metric a company in the value chain can use to alternate by changing its process or operation, regardless of its energy source.

The metric is limited if not combined with information regarding the energy source to analyse the actual climate impact, but it can be used in comparison even as an independent number.

2. AMOUNT OF GHG OR CO_2 EMISSIONS (CO_2E)

This is what really matters when analysing the climate effect of Lithium-ion batteries. However, the metric is only of marginal interest when not combined with CED data.

For example, a company that achieved a nearly zero amount of CO_2 emissions by buying green energy from the grid will only have moved fossil fuel consumption to somebody else on the grid. It is, therefore, important that energy is used efficiently, even when the energy source is clean.

To extract valuable data and ensure comparability, the above variables require to be considered and combined with so-called functional units, the most common being:

- (MJ/kWh) Mega Joules per Kilowatt-Hour
- (kg CO_2e/kWh) Amount of CO_2 or other GHG emissions turned into CO_2 equivalents, required to produce the battery's capacity
- (kg CO_2e/kg) Kilogram CO_2 equivalents per kilogram of battery
- (g CO_2e/km) the amount of CO_2 emission from the battery per driven kilometre

The biggest challenge of measuring a battery's CO_2 footprint is that it can't be physically measured in the usage phase. While the emissions from fuel combustion can be measured by analysing the emissions of an electric motor by examining how much energy it consumes, the only way to track the embedded emissions from a battery is to measure the direct and indirect energy consumption for the different steps in the production chain.

The complexities of attempting to accurately calculate and compare various analyses on the effects of Lithium-ion batteries on the global climate are further brought into perspective by significantly debatable and currently unclear "System Boundaries" to what extent are the extensive variables utilised in any calculation or analysis. I.e., do we assume a cradle-to-the-grave approach which would incorporate CO_2 emissions from mining of raw materials through the production of the batteries and second life and recycling considerations, or do we adopt a narrower, far more focused approach?

However, the above conundrum would be far easier to solve if legislation were put in place, dictating the parameters and governance measures within which companies are required to make these measurements.

The IEA's energy outlook highlighted that the world is currently facing an unprecedented energy crisis. At the same time, it is worrying that today's major global energy and climate challenges may increase the risk of geopolitical fractures and new international dividing lines—especially between advanced economies and many emerging and developing economies.

Unity and solidarity need to be the hallmarks of our response to today's crisis, and a successful energy transition must be fair and inclusive, offering a helping hand to those in need and ensuring the benefits of the new energy economy are shared widely.

With the production of Lithium-ion batteries gaining momentum and the extensive interwoven web of the production value chain reaching far and wide, it is clear that concise regulations and governance requirements are put in place to ensure that Lithium batteries have a sustainable future that is not only equitable and fair across the entire value chain but also defines and regulates methodologies and emissions levels within the energy, mining and renewables sector. wn

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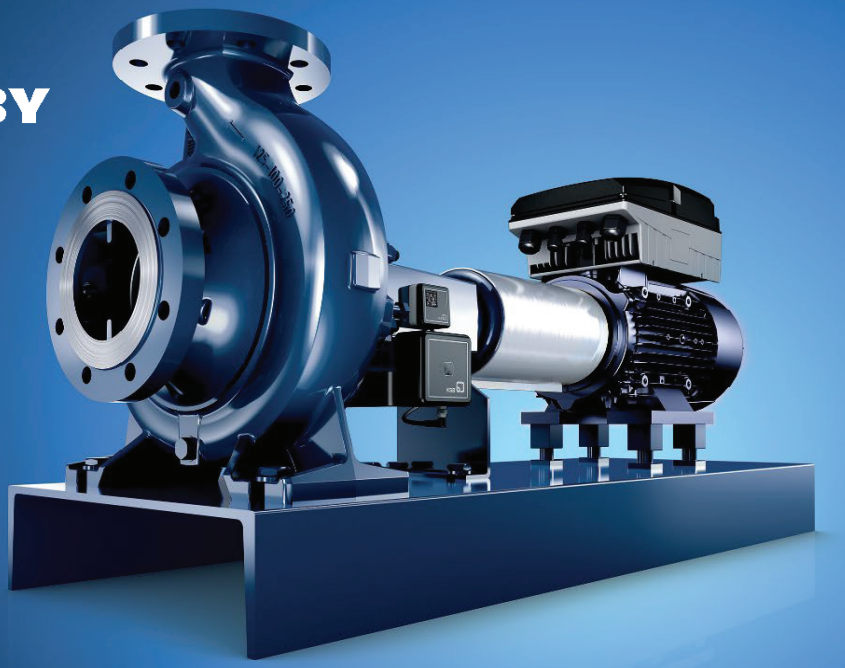

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Breaking barriers in Tanzania's mining industry
- THE WOMEN IN MINING PROGRAMME

Women's Month in South Africa provides an opportunity to spotlight the groundbreaking work being done to empower women in male-dominated industries. The mining sector, traditionally a mainstay for men, is undergoing a transformative shift thanks to initiatives like the Women in Mining programme, a collaboration between Prisma Training Solutions and Barrick Gold.

FROM UNDER-REPRESENTATION TO EMPOWERMENT

This six-month programme equips 20 local women with the skills to operate underground dump trucks, a stark departure from the industry norm. This initiative is promising in a sector where women constitute a mere 10% of the workforce, demonstrating that equal opportunity is not merely a distant aspiration but an achievable reality.

FOSTERING A HOLISTIC APPROACH TO WOMEN'S DEVELOPMENT

The training programme extends beyond the technicalities of operating heavy machinery, encompassing a holistic approach to women's development.

In addition to acquiring the requisite skills for operating underground dump trucks, participants are equipped with essential soft skills such as communication, teamwork, problem-solving, and leadership.

To enable a deeper understanding of the mining industry and its challenges, the programme also includes modules on the mining environment, safety protocols, and environmental sustainability.

A critical training component focuses on addressing and dismantling implicit biases, which contributes to creating a more inclusive and equitable workplace culture. Such a comprehensive approach is essential for empowering women to excel in their roles and thrive in the demanding environment of the mining industry.

HOW WOMEN ENRICH THE MINING INDUSTRY

The success of the Women in Mining programme highlights the undeniable value of diversity and inclusion in the mining sector. Women bring a unique perspective characterised by empathy, strong communication skills, and a focus on collaboration. These qualities can significantly enrich problem-solving, decision-making processes, and workplace culture.

The mining industry can foster a more innovative and adaptable environment by incorporating diverse viewpoints. Studies have shown that companies with greater gender diversity often exhibit improved financial performance and increased sustainability, which means that tapping into the potential of women in mining is not merely a social responsibility but a strategic business imperative.

TRAINING AS A CATALYST FOR CHANGE TO BRIDGE THE GENDER GAP

Training is a powerful catalyst for the empowerment of women in mining. It serves as a bridge to overcome gender disparities, bolster safety standards, and reduce staff turnover. Additionally, it elevates the industry's reputation and strengthens its ties with local communities.

To truly empower women in mining, shifting the narrative from competition to collaboration is imperative. Both men and women must recognise and appreciate their unique strengths and

perspectives. By fostering a culture of mutual respect and understanding, the industry can harness the full potential of its workforce.

EMPOWERING THE NEXT GENERATION

Prisma Training Solutions and Barrick Gold have set a commendable precedent for the mining industry. Their investment in women is a corporate social responsibility endeavour and a strategic move to build a more inclusive and prosperous future.

As their success story reverberates, it is hoped that other mining companies will follow suit, recognising the immense potential of a gender-balanced workforce.

Aspiring women in mining should embark on their journey, clearly understanding the industry's challenges and opportunities. The Women in Mining programme serves as a valuable preparation ground, equipping participants with the necessary skills and mindset to navigate the demanding environment.

BUILDING RESILIENCE AND CONFIDENCE

Prisma Training Solutions' emphasis on holistic development is commendable. The programme goes beyond technical training, addressing the emotional and psychological aspects of working in a male-dominated industry. Such an approach is vital in building resilience and confidence among participants.

Ultimately, the success of initiatives like these will benefit individual women and have a ripple effect that contributes to the overall growth and sustainability of the mining industry while having a positive, meaningful impact on the community at large. By creating a more inclusive workplace, the industry can attract and retain top talent, enhance innovation, and strengthen its social licence to operate.

A CELEBRATION OF PROGRESS

As we honour the women around us this month, it is essential to remember that the journey towards gender equality in mining is ongoing.

Celebrating achievements like the Women in Mining programme can inspire future generations of women to pursue careers in this challenging yet promising sector. wn

Power to the People:

WHY WHEELING IS THE COMMERCIAL & INDUSTRIAL SECTORS' SECRET WEAPON

While the lights have stayed on after the national elections, businesses are paying close to 34% more for their power than they did two years ago. Brandon Horn, Head of Commercial at SolarAfrica, cautions that these increases will likely stay the same for a while, highlighting the benefits of wheeling for a brighter bottom line.

It has been estimated that SMEs collectively account for roughly 30% of South Africa's GDP and employ more than half of the country's labour force, making up more than 90% of the registered businesses in South Africa. With the International Monetary Fund recently downgrading its economic-growth forecasts for South Africa to a meagre 1%, it's never been more crucial for these businesses to stretch every cent as far as possible.

However, businesses are battling to beat rising electricity tariff costs that have increased by 450% since 2008. Let that number sink in. That is almost four times as much as inflation over the same period, leaving many with no choice but to pass these costs down to their consumers.

To avoid the financial repercussions of ripple effects, many businesses are trying to mitigate tariff hikes by trying alternative energy options, particularly when it comes to solar. While solar does provide a cheaper power alternative, buying a complete system in cash comes at a hefty cost and requires long-term maintenance and insurance that falls on the business owner's shoulders.

Renewable energy companies have taken the solar game a step further and made it more accessible by offering it on financed terms. This is known as a Power Purchase Agreement (PPA) that typically requires no upfront investment from the business side and offers substantial savings over the long term.

But what happens when on-site solar isn't enough? What if a business needs more renewable energy to boost its sustainability or reduce its electricity bills, but it simply doesn't have the space or capabilities for more solar at its premises?

Enter the option of wheeling. Wheeling allows businesses to buy electricity directly from Independent Power Producers (IPPs). The IPPs generate this power through utility-scale solar, wind, or hydro projects, making it available through the national grid. A business's wheeled energy is credited against their utility bill – essentially lowering the owed amount.

The cost-benefit? Wheeling tariffs are up to 50% cheaper than utility power. SolarAfrica's wheeling solution shows that a daytime business that operates over 8 hours can replace 70% to 90% of its utility power consumption with wheeled electricity. These numbers can have a significant impact on operational costs. A 24-hour electricity user with a bill of roughly R190 million a year could typically see savings between R40 - R55 million in the first year, depending on their contract length which affects the wheeling tariff.

The benefits of wheeling extend beyond cost savings. When businesses take a layered approach to their power use, they really start to see a new dawn of energy independence unfold. Couple wheeling with a battery storage system, and they gain additional security and cost control.

How? The ability of a business to seamlessly switch to the clean energy stored in batteries, ensuring uninterrupted operations during power outages, is priceless. It would mean less downtime, fewer lost sales, and a happier workforce. Plus, with time-of-use tariffs, there is room to strategically charge batteries during off-peak hours when electricity is cheaper, optimising energy costs even more. It's all about getting the cheapest electricity for specific times and applications, whether from wheeling, solar, batteries or the grid.

With South Africa—and the world—facing a climate crisis, businesses have a responsibility to do their part.

SolarAfrica, for example, has recently broken ground on its first utility-scale solar farm based in the Northern Cape, known as SunCentral. This farm will provide power on a one-to-many basis, meaning more South African businesses can access cheaper, cleaner energy via wheeling.

By choosing wheeling, businesses are directly contributing to the development and growth of the renewable energy sector in South Africa. The more businesses sign up and use wheeling, the more support there is for IPPs to embark on utility-scale projects to ease the power generation burden off Eskom. When a business signs a Virtual Power Purchase Agreement (VPPA) for wheeling, it has a transparent view of the amount of green energy used, a significant selling point for eco-conscious consumers. This green energy can be quantified by the amount of carbon credits they receive from SARS and renewable energy certificates (RECs).

Wheeling holds massive cost-saving potential for South African businesses. As the technology matures and regulations become more streamlined, wheeling is poised to become a game-changer for the country's energy landscape, giving businesses the autonomy to choose the best energy source and schedule energy consumption.

Businesses are also empowered to negotiate the tariffs they pay – something that has never been an option with utility power. By accessing other forms of electricity through wheeling, a business has more bargaining power and can leverage aspects like contract length and agreement size to influence their tariff.

Securing South Africa's energy future is not only crucial for contributing to the growth of our country's economy.

Still, it should be at the top of the priority list for building a sustainable operation that is more than adequately geared to power through the darkness for the long term.

Localised recruitment is vital to unlocking opportunity in Namibia's burgeoning energy pipeline

The discovery of significant oil and gas reserves in Namibia's Orange Basin has the potential to transform the country into the world's newest petrostate. In addition, gigawatt-scale green hydrogen and abundant renewable energy resources represent significant opportunities. At the same time, there is a strong drive toward increasing local procurement to maximise economic advantage.

By Julien Karambua, Country Manager
Workforce Staffing Namibia

Leveraging opportunities in the energy sector while aligning with government initiatives, compliance requirements and cultural sensitivities can be challenging for international players. Localised skills in recruitment and turnkey employment services are essential to successfully driving energy projects and increasing Namibian economic participation.

BUILDING SKILLS PIPELINES FOR LONG-TERM BENEFIT

Namibia currently has a skills gap in the upstream oil and gas sector, often meaning that global companies will import their engineers to work on projects. However, with the government's renewed focus on local procurement to create sustainability and address unemployment rates, this has become more difficult. The government now requires recruiters to prove that they exhausted local possibilities before deploying international resources. In addition, Namibia is no longer a visa-free destination for many nationalities that could easily enter in the past, and it has become more complex to bring in international engineers.

It also does not offer a long-term solution. Many local Namibians have the necessary qualifications and accreditations to work on offshore rigs, but due to a lack of opportunity, many of them have taken up positions elsewhere. The focus needs to shift from simply importing resources to repatriating skills through the creation of opportunity and skills transfer to build a pipeline for future growth.

BUILDING THE SKILLS PIPELINE

Many burgeoning oil and gas positions do not require a high-level technical background, making them ideal for local employment. However, local resources may lack the specific experience requirement for the more specialised roles, necessitating import. For longevity and sustainability, a plan needs to be in place to develop skills transfer so that these positions can be taken up by locals in the future.

Having a local turnkey employment service provider can ensure that skills are found and matched from within the local area wherever possible. Where skills need to be imported, they will ensure that due process is followed and that all local statutory payments are made to ensure compliance. They will also handle contracts, placements, salaries, expenses, benefits administration, and other employment-related tasks, effectively taking on the entire employment function and providing a single invoice to the company monthly.

At the same time, they can provide local Namibians with appropriate accreditations and qualifications for the projects and facilitate the necessary skills transfer. They can also assist with training and upskilling the youth to take advantage of future opportunities, bringing them up through the ranks, helping them to gain experience and skills, and effectively creating a localised talent pipeline. This addresses the immediate need while ensuring long-term upliftment and sustainability. wn

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Human-centric employment solutions support greater sustainability in mining

The environmental impact of mining has come under scrutiny in recent years as the world strives to meet carbon emissions reduction targets. As a result, mines have increased their efforts towards improving sustainability. One element that needs focus is people, as the social factor is critical in the Just Transition. This means that compliance with health and safety regulations needs to become a priority, and skills development and community upliftment must form part of overall sustainability initiatives.

By Donné Nieman, Sales Director Workforce Staffing and Michael Montgomery Le Gassick, Regional Director at Workforce Staffing

A skilled, experienced Temporary Employment Services (TES) provider is an invaluable partner in this regard, supporting sustainability and social upliftment goals while ensuring that staffing is handled efficiently and, importantly, in a compliant manner.

BUILDING COMMUNITIES SUPPORTS SUSTAINABILITY

South Africa's mining landscape is centred on communities in smaller, outlying towns, with most economic activity in these communities centred on mining. In the past, when mines reached the end of life, they closed, which left the surrounding communities in a difficult position.

With a renewed focus on sustainability and Just Transition, this needs to shift toward ensuring that the towns and people can participate in the economy long after mining ceases to become the primary income stream.

Supporting local communities requires investment in both time and money because, ultimately, the success of the mine requires buy-in from the community as well. This starts at the ground level with support for schools and initiatives that make a meaningful difference.

In addition to fostering community relations, this also helps build a talent pipeline for the mines by ensuring people have the necessary skills for the future.

HEALTH AND SAFETY SHOULD ALWAYS BE A PRIORITY

By its nature, mining is a hazardous environment, which means health and safety and compliance with laws around this should always be at the forefront of people's minds. Proper health and safety measures help prevent accidents, and prioritising health and safety ensures the well-being of mine workers, reducing incidents of injuries, illnesses, and fatalities. In addition, mining companies that demonstrate a commitment to health and safety build trust with employees, local communities, and other stakeholders.

Effective health and safety protocols are part of comprehensive risk management strategies, and companies that prioritise health and safety are more attractive prospects for investors.

A strong culture of health and safety also means fewer accidents and disruptions, which means enhanced overall operational efficiency and reduced costs associated with accidents and lost productivity. There are also legal issues to consider, as non-compliance can result in penalties, fines, and operational shutdowns.

STAFFING EXPERTS SUPPORT SUSTAINABILITY GOALS

Working with a reputable TES partner ensures that all staff are appropriately skilled and certified and that all necessary compliance requirements are followed during the sourcing,

vetting, and onboarding processes. This includes police and medical clearance, which significantly reduces admin for mining companies, as the onboarding process alone can be onerous, complex, and time-consuming.

A reputable TES provider will also have community relationships and a strong focus on building and maintaining community relations to ensure vulnerable people are not exploited.

TES providers can also assist with skills development initiatives, identifying and nurturing talent, and providing opportunities, which not only assists in retaining employees but also ensures the longevity and sustainability of the talent pool.

A TES provider with a large geographic footprint can also give people with talent access to opportunities beyond the horizons of their immediate community, giving them scope to expand and grow.

The right TES partner can support mining's drive to become more sustainable, aligning with emissions targets and providing the resources needed to support these goals while ensuring that health, safety, and the value of human life are prioritised.

This goes beyond labour solutions to a human-centric solutions model, which is rapidly becoming a critical component in sustainability and the Just Transition. wn

Plastics manufacturer develops first recyclable plastic bicycle frame

E-bike manufacturer Advanced Bikes is relying on igus for future frame production. As agreed by Helge von Fugler, founder and managing director of Advanced with Jan Philipp Hollmann, head of bike components at igus.

Industrial polymer developer and manufacturer igus unveiled the first injection-moulded polymer bicycle frame designed for advanced bikes, marking a major milestone in sustainable mobility.

igus has collaborated with the German e-bike manufacturer Advanced Bikes to create a bicycle frame made entirely of recyclable plastic material using injection moulding technology.

e-bikes are becoming increasingly popular driven by increased environmental awareness. Traditional bicycle frames, predominantly made from steel, aluminium, or carbon fibre, are produced through energy-intensive processes and often end up in landfills.

Advanced Bikes has partnered with igus to develop a sustainable composite plastic bicycle frame for their new Reco Urban trekking e-bike. Leveraging decades of expertise in plastics manufacturing and experience from its previously developed 50% recycled RCYL bike, igus has designed a frame that is both eco-friendly and efficient.

The new frame boasts impressive strength, rigidity, and lightweight properties, thanks to a composite material made from high-performance plastics and carbon fibres. igus utilised a multi-part injection moulding tool to create the complex geometry of the bicycle frame, resulting in a 3.3 kg lightweight, single-piece frame that is corrosion-resistant, durable, and free from weld seams.

The company envisions extending this recyclable approach to other bicycle components like pannier racks, rims, handlebars, and seat posts, aiming to realise a fully recyclable e-bike.

igus's innovation extends beyond bicycle frames to various components made from lubrication-free high-performance plastics. The technology is being applied to develop new bicycle components such as wheels, cranks and handlebars. These components are lighter, corrosion-resistant, and can withstand high-pressure washing without the risk of lubricant loss or rust.

igus offers a comprehensive solution to the bicycle industry, providing everything from design to the finished product. By utilising high-performance plastic components, igus presents a new technology that allows for innovative design and geometry. wn

Addressing today's mining challenges by digging deep into cyber risks beyond IT

Despite the mining industry's Operational Technology (OT) systems being vulnerable to cyberattacks, many decision-makers still see these threats as purely an IT issue, even though a breach could potentially disrupt mining operations.

By Iniel Dreyer
Managing Director
Data Management Professionals South Africa

By compromising OT systems, cyberattacks can halt mineral extraction processes with severe consequences, including an impact on profitability and damaging reputations, leading to a loss of investor confidence. In the worst-case scenario, an OT hack can endanger the health and safety of mineworkers. Furthermore, OT systems generate huge amounts of historical mining data, which, if leaked, can reveal sensitive information to the market or, if lost, can negatively affect future decision-making.

Consequently, this can result in mining houses suffering reputational damage too, as disruptions to operations can affect their share price, cast doubt over their future production capabilities and damage their relationships within the industry.

While there is traditionally role segregation between IT and OT management in mining operations, both areas are technology-based, and mining houses must recognise that both areas should ideally be overseen by the company's Chief Information Officer (CIO).

From a cyber resilience perspective, IT and OT teams should ensure ongoing communication and collaboration. This would foster a better understanding of the impact of specific systems being unavailable and how this affects the entire business.

IT MUST BE INVOLVED

IT will always be involved in the process of effectively managing and protecting OT systems, especially when it comes to securing systems and understanding how they fit into a bigger system architecture.

Regular system maintenance and compliance checks are essential for mining companies to ensure that their OT systems are adequately protected against cyber threats. OT systems form part of the safety ecosystem. Thus, maintenance and compliance tests must be treated like the regularly conducted safety drills at a mine.

It is vitally essential that OT system operators understand the broader implications of what happens when the system is down. For example, they need to know what happens when the biometric access system goes down, and workers cannot be sent down the mineshaft or, for that matter, brought back up to ground level.

Additionally, it is key to understand how various IT systems interlink and whether there are dependencies on specific components that need to be available for a critical system to work.

Furthermore, C-level executives must recognise that some cyber risks extend beyond the IT department and that the proper budgets must be available to IT and OT to protect these environments effectively. Thus, all executives must understand that this must be part of their business objectives and that information security has to be at the top of the agenda at board meetings.

INCIDENT RESPONSE PLANNING

At the same time, mining companies should also not underestimate the importance of having an incident response plan in place to identify, contain, and restore systems after a cyberattack.

This would include planning for various scenarios when a breach happens and prioritising specific processes and systems based on the impact of the attack on the business.

Mines should also consider implementing cleanroom technology, which ensures a swift and uncontaminated recovery process for mining operations.

Cleanroom technology provides a space on the network where systems can be recovered in an isolated environment and tests whether the data is clean and can be safely brought back into the production environment.

Ultimately, mining companies can benefit significantly from engaging with a specialist in data management and protection to secure their OT environments from cyber threats.

While these companies may have general IT and OT skills, their core business remains mining. A Data management specialist can bring their expertise to the table and help companies draw up incident response plans and effectively protect their OT systems while allowing mines to focus on their core mineral extraction business. wn

Similarities between certain Olympic items and HV testing

By Dr. J.P. Holtzhausen, Pensioner/Electrical Engineer

While watching the Olympic games, I noticed, as a retired High Voltage Engineer, the similarities between some athletic items and high voltage testing. In both cases, one can discern analogue and digital principles.

ANALOGUE

In events such as the long jump, shot put, and javelin, the maximum distance achieved determines the winner. Similarly, in running events, time is measured to identify the fastest athlete.

Likewise, when determining the power frequency flashover or breakdown voltage of a gap or a piece of equipment, the voltage increases until breakdown occurs. This voltage is noted as the breakdown value.

DIGITAL

In field items such as high jump and pole vault, the bar is set at a specific height, and all the participants attempt to jump over the bar without disturbing it. Once all the participants succeed, the bar is raised for further attempts. For each jump, the outcome is either a "pass" (a binary "1") or a "fail" (a binary "0"). If a participant fails at a specific height, he or she gets two more chances. The winner is the participant who achieves the maximum height.

Similarly, during high voltage impulse testing of an air gap or equipment, a high voltage pulse of standardised shape and known magnitude is applied.

If the test object withstands the impulse, the magnitude is raised and reapplied to the object until a value is obtained, and the breakdown is inevitable. Due to the stochastic nature of the phenomena, it is often necessary to do several tests at each voltage level and to analyse the results statistically.

CONCLUSION

In certain Olympic events, distance or time is measured to evaluate the athletes' performance. This is similar to performing power frequency HV tests, where the breakdown voltage is measured.

In other field items, the bar is raised repeatedly to identify the athlete who achieves the highest height. Thus, there will be several attempts at each height. This method is akin to the one used in impulse testing. wn

The Digital Divide
– SYSTEMIC CHALLENGES

In this paper, we suggest that bridging the so-called 'Digital Divide' is not only a technology challenge but there are also some significant systemic, non-technology-related challenges that are overlooked in our often-parochial perception of delivering ubiquitous broadband internet connectivity to the unconnected population.

By Mr. Andre Hoffmann FSAIEE MIEEE, Mrs. Sharon Peetz and Mrs. Janine Meyer

Even with existing technologies such as optical fibre, microwave, mobile 2G to 5G, LTE[1], and satellite, which may cater to certain people, they are still unconnectable due to non-technology-related barriers.

As resellers and installers of multiple ISP[2] services over the past five years, we have observed four main systemic challenges, which we will discuss here.

1) Legislation such as the RICA Act
2) Ordering channel (Internet connectivity is required to order an Internet connection)
3) Proof of Address
4) Physical delivery of devices or SIM[3] cards

PREAMBLE

The digital divide refers to the gap between demographics and regions that have access to modern information and communications technology (ICT) and those that don't or have restricted access. This technology can include the telephone, television, personal computers, and internet connectivity[4].

Two-thirds of the world's population uses the Internet, but 2.7 billion people remain offline. This means that one in three people cannot benefit from the economic, educational, political, social and health potential of being connected. The Internet Society Foundation[5] article provides a more detailed review of digital equity and its significance in today's interconnected world. It delves into the definition of digital equity, its importance, the relationship between digital access and equity, the causes of digital inequities, the digital divide concept, the consequences of digital inequity, and strategies to bridge the gap and improve digital equity.

LEGISLATION

In South Africa, we have the Regulation of Interception of Communications and Provision of Communication-related Information Act 70 of 2002, known colloquially as the RICA Act, and the Electronic Communications Act 36 of 2005, which intends to promote convergence in broadcasting, broadcasting signal distribution, and telecommunications.

RICA regulates 'direct communications' and 'indirect communications', which are defined broadly to include, but are not limited to, e-mail and mobile phone transmissions and communications that deploy text, data, visual images, or a combination of the above.

Since its initial enactment in 2002, the provisions of RICA have been amended and supplemented several times to include, among others, a schedule relating to fixed line operators, mobile cellular operators and internet service providers. It further contains directives on the technical requirements and security requirements covering the interception, recording, storing and routing of various forms of communications. When analysing these supplements and amendments superficially, it is clear that additional guidelines and definitions are necessary to successfully regulate communications in an ever-changing

technological and digital world. Their effect is to impose duties on the providers of communication services to keep records of their customers and records relating to their customer's communications before they can provide such services to customers.

However, despite all its noble intentions, RICA is far from being effective in meeting its objectives. We will not cover this here, please refer to this 2023 article. - Rica is broken – and its consequences for South Africa. The proliferation of unregistered SIM cards, despite South Africa's RICA legislation, warrants serious investigation.

THE CUSTOMER ORDERING JOURNEY

Surprise, surprise! You need an actual internet connection to apply for an internet connection—who would have thought?

Not only that, but an email address and sometimes also a contact number that can receive an OTP[6] is a prerequisite for concluding an application for a broadband service in many instances.

These simple things, often taken for granted by us privileged few, are not so obvious to the Gogo[7] from the rural areas wanting to connect to family and receive weather updates and news of local and global events or the rural child wishing to get access to basic education or the citizen needing urgent medical or other assistance.

The same might apply to those living in the dense and unstructured informal settlements that are so prevalent around cities and metros globally.

The ISP product web portals are not necessarily 'friendly' to the unconnected, whose only access may be a 2G phone or, if fortunate, a small-screen basic smartphone.

The service application forms are generally optimised for applicants with access to a good broadband internet connection, a laptop/desktop appliance to display and complete the application forms, a scanner or photo-capable device to capture and upload the necessary documentation, and the computer savvy to do this.

In our experience, this has proved to be very challenging for many people who want to get connected but need more tools and sometimes the skills to navigate the onboarding journey.

PROOF OF ADDRESS

Due to legislation such as RICA, Service Providers must get Proof of Address for each of their subscribers who may need and order a SIM card for services.

WHAT DOES PROOF OF ADDRESS MEAN?

To a leading ISP that we work with, it means one of the following options where the date is not older than three months from the date of service application.

- An existing lease agreement. The full lease agreement, which includes proof of physical address, is completed and signed by both parties;
- Bank statement, which includes proof of physical address;
- Municipal rates and taxes invoice that includes proof of physical address;
- Telephone or cellular phone account, which provides proof of physical address;
- Any other utility bill, which includes proof of physical address;
- Retail account statement that provides proof of physical address;
- An insurance policy that provides proof of physical address;
- Current television license;
- A certified letter from a reputable real estate agency as proof of address;
- The ISP address form is proof of address.
- Some ISPs will allow for a certified copy of the original affidavit from a designated Commissioner of Oaths subject to the following being clearly visible on the stamp on the document:
    - The wording on the certified copy of the original
    - Name and surname of the commissioner of oaths
    - Designation of commissioner of oaths
    - Physical address of the commissioner of oaths

It must be noted that an affidavit from a local government councillor is generally not accepted as Proof of Address by an ISP.

This is not particularly challenging for those of us who live in formal towns or cities with roads with names, stands with numbers, and access to municipal and

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financial services. However, a significant number of people in Africa do not live in such a demarcated and regulated landscape. They live in a traditional thatched hut at the end of a footpath on a hill or in a valley somewhere, perhaps near a cluster of trees or a bend in a river. Many do not have retail accounts, bank accounts, insurance policies, utility accounts, or the like to produce as options.

As a practical example, we consider the territory of the Ingonyama Trust, which takes up 29.67% of the land in the province of KwaZulu-Natal. Home to over 5 million people and located on the eastern seaboard of South Africa, the Ingonyama Trust is a unique legal entity established by the Ingonyama Trust Act of 1994 in South Africa. Its primary purpose is to manage land on behalf of the Zulu Nation, specifically for the benefit of the Zulu clans.

The Trust holds title to approximately 2.8 million hectares (about 7 million acres) of land, and the majority of the over 5 million inhabitants of these 2.8 million hectares need access to formal addresses. The inability to access reliable internet connectivity puts these communities at a severe disadvantage economically. In a world where digital access is increasingly vital for business operations, rural areas need connectivity to engage in e-commerce, digital marketing, or other online business activities. This lack of connectivity prevents local entrepreneurs from reaching broader markets, stifling economic growth and innovation. It also means that rural businesses are cut off from crucial information and resources that could help them thrive, such as online tools for financial management, agricultural advice, and access to broader supply chains.

Having no formal address is a non-technical barrier to inclusion in an increasingly digital world and all the impacts that come with it.

Impact on Online Education - The lack of connectivity profoundly impacts education, especially as online learning becomes more prevalent. Students in rural areas without internet access cannot participate in online classes, access educational resources, or submit assignments electronically. This digital divide exacerbates existing inequalities, leaving rural students behind their urban counterparts. The long-term consequences are significant, as these students miss critical learning opportunities, which can affect their future employability and ability to contribute to their communities' development.

Access to employment opportunities - The absence of digital connectivity also hinders job seekers in rural areas. Many job applications today are conducted online, requiring applicants to submit CVs and cover letters through digital platforms. Without internet access, individuals in these communities cannot search for jobs, apply online, or even create digital resumes. This exclusion from the job market further entrenches poverty and limits opportunities for upward mobility.

The inability to connect to online job markets means that rural residents are often forced to rely on informal networks or migrate to urban areas in search of work, leading to a drain of talent from these communities.

In summary: Even if we assume that these Proof of Address documents presented are legitimate, how long are they valid? Given the migratory nature of many people with a SIM card, the address provided may well be invalid the very next month, week, or even day.

Assuming the prospective subscriber can successfully muster one of the above documents as Proof of Address, the next challenge...

DELIVERY OF DEVICES OR SIM CARDS

Assuming all the aforementioned barriers have been successfully overcome, the SIM card and/or device must be delivered to the subscribing customer. Most ISPs elect to use a courier service to deliver any device or SIM card to the new client, and no courier company is willing to accept delivery to such vaguely specified locations.

The addressing issue also relates to the effectiveness of local emergency services such as police, ambulance, or fire-brigade services in reaching citizens quickly.

IMPACT

MEDIUM-TERM IMPACT

Economic Growth and Development

In the medium term, the lack of adequate access to existing internet connectivity would stifle economic growth in rural areas. Small businesses, farmers, and entrepreneurs needed help accessing online markets, digital payment systems, or business management tools. This would limit their ability to expand, innovate, or compete with urban-based businesses with access to these resources.

The result would be a growing economic divide, where rural areas fall further behind in income levels, job creation, and overall economic development. It will only exacerbate migration into urban areas, putting pressure on urban housing and the associated support

infrastructure, resulting in increased informal settlements.

This also presents a meaningful opportunity for national service providers to see this rural community as not just a 'market' from which to draw revenue but also a local partner resource that can represent the service provider brand in their own community. Local tech resources are available to be developed as first-line field support.

They can provide faster time to restore faults and lower costs of S&T[8] in not having to dispatch metro-based teams into rural areas who will not have an appreciation of the local culture or the local relationships that make a big difference in gaining access to local facilities.

Education and Access to Online Learning

Without internet access, students in rural areas would face significant educational disadvantages. The inability to participate in online learning, especially during times of crisis like the COVID-19 pandemic, would mean that rural students miss out on critical educational content and resources.

This gap in access would lead to lower academic outcomes, reduced literacy rates, and a widening performance gap between rural and urban students. The submission of assignments, access to digital libraries, and participation in interactive learning platforms would remain out of reach for many, further entrenching educational disparities.

Potentially, there may well be hidden talent and intellectual capacity in these areas, and because they have no broadband access, their intellectual contribution to society will be missed.

Healthcare

Rural healthcare services would also suffer. Telemedicine, which relies on internet connectivity, offers a critical lifeline for remote areas with sparse medical facilities. Without it, rural populations would be deprived of timely medical consultations, follow-up care, and specialist advice. This would lead to worsening health outcomes, higher mortality rates, and a continued reliance on overburdened and often under-resourced local clinics.

Social Integration and Development

In the medium term, the lack of access to existing connectivity would also hinder social integration and development. The internet is crucial in connecting people, fostering community engagement, and supporting social services. Without it, rural communities would remain isolated, unable to benefit from social programs, online support groups, and civic participation initiatives. This isolation would exacerbate social inequalities and limit the ability of rural residents to participate in broader societal conversations and developments.

LONG-TERM IMPACT

Economic Growth and Development

In the long term, the economic impact of high barriers to access existing internet connectivity would become even more pronounced. Rural areas would increasingly be left behind in the digital economy, unable to attract investment, skilled labour, or tourism.

The lack of digital infrastructure would discourage new business ventures and innovations, leading to economic stagnation. This would widen the gap between rural and urban areas, with rural communities becoming economically marginalised and more reliant on government aid. This would

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further reinforce trends towards urban migration and the entrenchment of growing informal settlements.

Education and Access to Online Learning

Over the long term, the educational disadvantages would compound, leading to a generation of students who are significantly less prepared for the workforce. This would reduce the overall human capital in rural areas, limiting economic and social mobility opportunities. The gap between rural and urban education standards would become entrenched, leading to a cycle of poverty and limited opportunities for future generations.

Healthcare

The long-term impact on healthcare would be dire. Without access to telemedicine and digital health records, rural areas would face persistent challenges in managing chronic diseases, responding to health emergencies, and providing preventative care. The continued lack of access to specialist care would lead to a deterioration in public health, with rural populations experiencing higher rates of preventable diseases and lower life expectancy.

Social Integration and Development

In the long term, the persistent lack of connectivity would affect the social fabric of rural communities. The digital divide would contribute to isolation and exclusion from national and global developments. This would limit opportunities for cultural exchange, social cohesion, and community-driven development projects.

The lack of access to information and communication technologies would also make it harder for rural communities to advocate for their needs and interests, further marginalising them in the political and social landscape.

UNINTENDED CONSEQUENCES

Besides delaying broadband adoption in cases where the current technologies already provide a technical solution to a willing but unconventional market, there is the opportunity that all of these ineffective barriers create for deliberate circumvention.

There is fertile ground for circumvention by unscrupulous actors, which then puts the more vulnerable in our society at risk of identity theft and often the scamming of their pensions and life savings.

WHAT ARE THE POSSIBLE SOLUTIONS?

Some ideas are below for discussion regarding the pros, cons, and costs of each option.

LEGISLATION

- Leverage GSM[9] and SIM cards' location capability and link this to possibly mandatory personal identification parameters such as fingerprints or facial recognition applications on the device. This could be captured at the bureau or kiosk used for ordering, as per below.

ORDERING CHANNEL

- Consider the use of a distributed Internet kiosk or bureau based in partner facilities such as Banks or retail shops like PEP, Boxer, Spar, Checkers, and Pick 'n Pay (Post Office[10]), similar to the Department of Home Affairs's use for citizens to order Smart identity cards or passports.
- Reseller partners can often provide both distributed bureau facilities and the resources to operate and manage a local physical touchpoint for service providers to not only onboard new customers but will, in many cases, also provide remote first-line smart-hand field support for delivery, installation and maintenance services by local community-based Tech-entrepreneurs who live, work and are invested at the edge of the network. This would create a blended online and physical front-end channel for service providers that will go a long way to differentiating any supporting ISP from the call-centre-only customer interface. This *Ikasi*[11] ISP enabled by BIG ISP should be seen by service providers as a 'beachhead' opportunity for measured network and service expansion into the more informal and sometimes unstructured areas.

PROOF OF ADDRESS

- Use GPS coordinates or other coordinate-based location systems like the What3words platform to establish the precise location of one's domicile.

PHYSICAL DELIVERY OF DEVICES OR SIM CARDS

- Collection can be from the same bureau where the recipient made and signed the application.

These suggestions are by no means exhaustive and would require some discussion and debate, particularly around the protection of personal information, risk of identity theft and possible overreach in respect of civil liberty rights.

CONCLUSION

Overall, there is a lack of formal addresses and the inability to access data connectivity packages, mainly where broadband coverage may already exist. This severely disadvantages South

African rural communities. Besides the constraint on economic development which exacerbates educational inequalities, and limits employment opportunities and contributes to a cycle of poverty and underdevelopment, these non-technical barriers leave a lot of potential in unidentified talent and skill that cannot make their contribution to society. Addressing these challenges is essential for ensuring that all South Africans, regardless of where they live, can participate fully in the country's economic and social life.

Technology exists to cover almost any terrestrial location on planet Earth, and in addition to the need to meet this requirement at an acceptable service level to satisfy a reasonable broadband service at a cost and price viable to both service providers and most consumers, there are also non-technical associated barriers to adoption that the stakeholders need to consider systemically across the service delivery and life cycle of the solutions.

Legislation such as the RICA Act, albeit with good intentions, may be creating more problems than it is solving. The ordering channel for Internet connectivity generally requires the applicant to have access to an Internet connection – the same thing they are ordering. The necessity for proof of address where no formal address exists and the subsequent delivery of the physical device to that location.

These challenges are not insurmountable. Domain owners need to step back and look at the bigger picture. Each touchpoint in the matrix of broadband development, service delivery, and operations has upstream and downstream ramifications that need to be tested and evolved to optimise

adoption in the quickest, most cost-effective, and safest possible way.

A mindset change is called for with service providers. Rural or unstructured markets should not be viewed as just a potential source of revenue only.

Service provider margins are under pressure in a competitive environment and the positive impact of enabling beneficiation of local communities by allowing them to contribute and be part of the service delivery chain at the edge of the network.

This will not only give local tech entrepreneurs a piece of the revenue cake but will also improve the customer experience and lower the operational cost for the service provider. wn

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8. Subsistence and Travel.
9. Global System for Mobile Communications.
10. If the Post Office is viably operating.
11. Ikasi is a colloquial isiXhosa term meaning. township, similar to the hood, ghetto, el barrio, banlieue, slum or favela found

- Internet Society Foundation
- Southern African Legal Information Institute
- TECHCENTRAL
- Ingonyama Trust Board

NuMeRi

- RESEARCH AND INNNOVATION WITH A SOUTH AFRICAN FLAIR

Within the DSI's South African Research Infrastructure Roadmap programme, NuMeRI was conceived. This facility is a paradigm shift offering a one-stop-shop medical imaging and theranostics facility dedicated to drug development and clinical research. NuMeRI provides consolidated expertise in nuclear technologies, medicine and biosciences, creating significant RD&I capacity in South Africa.

Jan Rijn Zeevaart
General Research Manager: Applied Radiation
NECSA
For the SAIEE Biomedical Chapter

NuMeRI synergises preclinical and clinical imaging, radiopharmaceutical production, translational research, radiobiology and medical physics under one roof, which is the first of this kind in South Africa and unparalleled worldwide. The facility incorporates groundbreaking technological and construction design completed within two years and is below budget.

BACKGROUND

The original Research Infrastructure Proposal and Business Case for the Nuclear Medicine Research Infrastructure (NuMeRI) was compiled in November 2015/6 on behalf of the South African nuclear medicine community and was accepted by the DSI and the South African Nuclear Energy Corporation (Necsa).

Necsa successfully steered the project during the incubation phase, establishing the research infrastructure as an open-access national research facility as a distributed network comprising:

- The NuMeRI node for Infection Imaging (NII) at Tygerberg Hospital was completed in 2019 and has been operational since
- A Pre-Clinical Imaging Facility (PCIF), which was completed in 2019, housed and operated at Necsa, Pelindaba, until 2023
- The NuMeRI main centre at Steve Biko Academic Hospital

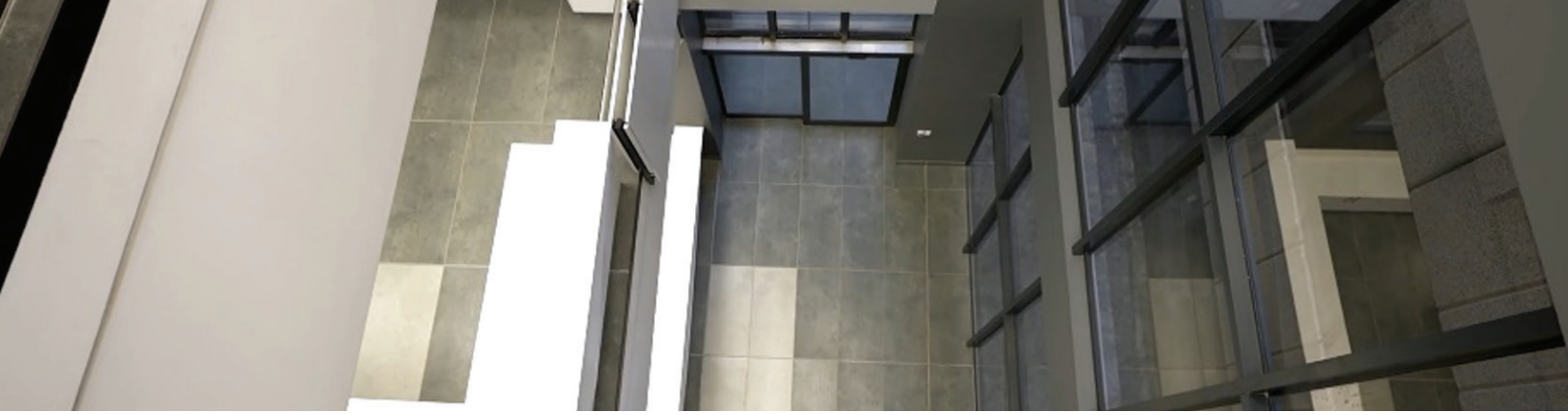
Necsa facilitated the Not-For-Profit Company "Nuclear Medicine Research Infrastructure (NPC 2019/104491/08)" registration with the CIPC in 2019, and a Board was constituted. Prof Mike Sathekge, who led the SBAH/University of Pretoria bid to host the main centre for NuMeRI and became the CEO. He led the project through the establishment phase with Yunus Munga as the COO tasked with executing the building project and Prof Zeevaart continuing as the CSO (Chief Scientific Officer) as a partial secondment from Necsa.

The NuMeRI NPC accepted the responsibility for establishing a main centre NuMeRI infrastructure and set out to design and build a state of the art and world class facility at the Steve Biko Academic hospital.

Due to the COVID pandemic no building work could take place in 2020 but this afforded the team to design and optimise for the three-storey facility which saved MR94 from the original budget. Building stared in February 2022 and was completed in an unprecedented 18 months and was handed over from the contractor to NuMeRI NPC on 12 December 2023

RESEARCH & INNOVATION

The innovation of the project is paramount. It is one of a few in the world that managed to create a one-stop for imaging and therapy, fully equipped with 2 cyclotrons (one for a commercial partner and one for research) seamlessly connected to two separate radiopharmacies. The research Radiopharmacy is equipped with 10 hot cells connected via dumbwaiter lift to the preclinical floor below the cyclotron and clinical suite above. All of which meet



the stringent requirements for GMP. The imaging techniques available in the PCIF include microPET, microSPECT, Autoradiography, Cherenkov imaging, etc..., all of which meet the stringent requirements for GLP. Equally so, the clinical unit is equipped with top-of-the-range human PET and SPECT cameras and therapy rooms complying with GCP.

The research infrastructure provides enabling support for healthcare research and development for academia and commercially driven healthcare companies (pharmaceutical and biotechnology).

The project's output is the three-storey high, unique NuMeRI facility located at Steve Biko Academic Hospital, which is estimated to cost MR450. To appreciate this monumental achievement, an appendix has been included with the layout and links to videos documenting the building phase and the final product.

The very nature of NuMeRI's research activities necessitates a coalescence of their objectives with the priorities of the National Department of Health, strengthening the Nuclear Medicine capacity in South Africa and beyond its borders in Africa and enhancing South African research in Medicinal Chemistry, expediting the development of drugs to address national priority diseases, e.g. Cancer and Tuberculosis, enabling new pharmaceuticals to reach market sooner, and giving South African pharmaceutical development a competitive edge with global equivalents.

NuMeRI demonstrated its impact in addressing the Grand Challenges related to the Bio-economy, particularly in "Pharmaceutical solutions to attack the disease burden that is further worsened by poverty", and aspires to cover bench to bedside for drugs, providing a platform for drug discoverers to test new drug entities locally to the clinical format. In this regard, South Africa's rich biodiversity can be used to attract multinational pharmaceutical companies. NuMeRI has, to date, created a variety of radiotracers that can be used in several applications, not only in radiopharmaceuticals. The tracing of nanoparticles helps elucidate their behaviour and where they go in living organisms, as demonstrated. In all fields of treatment, personalised medicine is becoming a reality. Radiopharmaceuticals are ideal for this as they provide a non-invasive technique to determine a patient's uptake or excretion of a drug. This is called companion diagnostics, where a radiopharmaceutical imaging agent is used to individualise the dose of a chemotherapeutic or internal radiotherapeutic agent.

This research is embedded within the healthcare domain and creates a mutually beneficial environment for medical research and general practice, with public health as the common goal. The research conducted at NuMeRI has contributed to developing therapies addressing national priority diseases.

Research is not limited to Oncology, where outputs have been recorded above. Infection imaging has been of particular interest to NuMeRI/UP/SBAH/Necsa, with the first PET infection imaging agent developed, which is used as a research tool. TB research has been pursued for many years, and advances are being made to specific TB imaging agents.

The NuMeRI facility has been instrumental in capacitating the public healthcare sector with critical/scarce skilled medical professionals (nuclear medicine, medical physics, radiopharmacy, radiochemistry and radiobiology) through the provision of key infrastructure that is unique to their field(s). The facility has a laboratory infrastructure includes three levels: preclinical, radiopharmacy, and clinical. All are equipped with state-of-the-art equipment and a unique layout, as highlighted by the following:

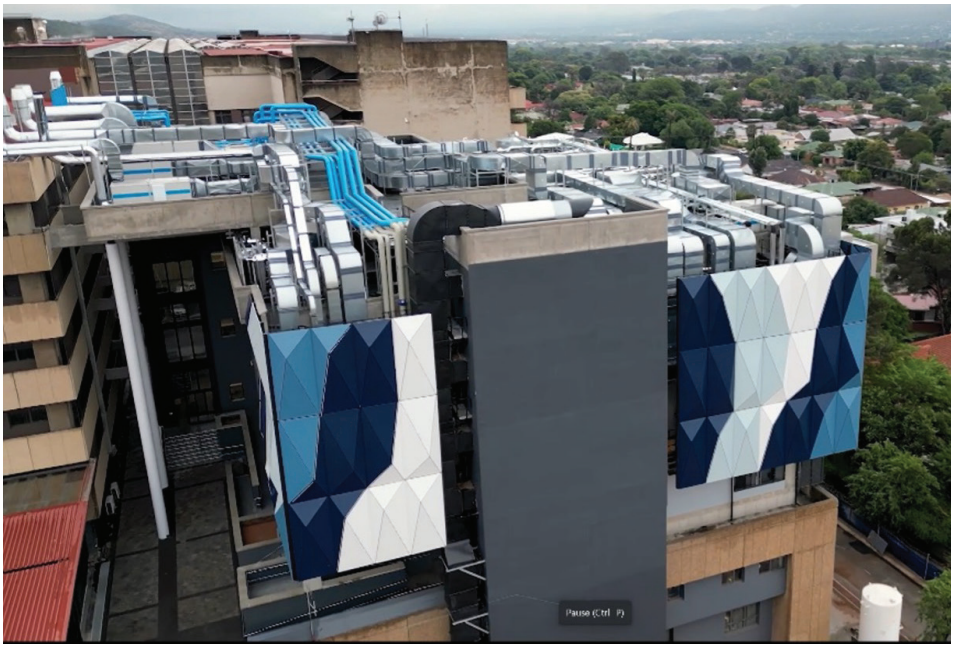
STRUCTURAL ELEMENTS

- The building was designed with a design limit of 20mm of sag. After the concrete was poured and equipment installed, we are currently at 2mm, 10x better than the design specification.
- The floor of the cyclotron bunkers has a special levelness requirement of not exceeding 0,5mm per 8m. Our final levelness is 0,2mm, 2.5x better than required.
- The concrete design is of a special high-density slurry mix of dolomite to provide higher density with lower weight loading; the density is above average at 2865kg/m3 vs standard density of 2300kg/m3, offering higher levels of radiation protection safety

continues from page 73

HVAC SYSTEM

- Each floor and level of the building is independent of the other to avoid cross-contamination between animals, humans and radioactive isotopes
- The HVAC system has full dual redundancy capability on every chiller and HVAC assembly
- There is an entirely separate and independent HVAC system for commercial cyclotron and radiopharmacy operation
- Specialised pressure control and low leakage dampers offer fine levels of control within each environment
- Each room or location has independent pressure, temperature and humidity controls directly attributed to the function in that specific location



This was achieved by complying with the latest SANS codes available and adhering to the OHS Act (85 of 1993) and Regulations. The building's finishes are designed to meet the lowest carbon and UV emissions but still leave an architectural design of note that catches the public's eye.

Last but not least, the facility is fully powered by 2 x 1.2MW diesel generators, which go from start to full power delivery in 7 seconds and have a diesel reserve for 3-day operation.

In terms of relevance, NuMeRI offers key Socio-Economic impact and Translational outputs in the following areas: Education and training through research, Enhancing South African research in Medicinal Chemistry, Expediting development of drugs to address national priority diseases, e.g. Tuberculosis and Improving the quality of life of local pollution. wn

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IEC YP COMPETITION WINNERS ANNOUNCED

- CARRYING THE SOUTH AFRICAN FLAG HIGH

Two Young Professionals from South Africa who entered the IEC Young Professionals Workshop Essay Competition will attend the IEC General Meeting in Edinburgh, United Kingdom, from 21 - 25 October 2024. They are Mr Mongale Tebogo and Ms Ndoro Netshipale.

The IEC Young Professional (YP) Essay Competition aims to expose the next generation of experts and leaders to IEC standardisation and conformity assessment activities. These young professionals will gain valuable experience attending the IEC General meeting, which brings together the IEC technical and management community. They will learn how international standards are managed and developed by attending management and technical meetings.

Herewith, you will find the essays* from the two winning 2024 IEC YP Essay Competition winners from South Africa.

STANDARDIZATION AND CERTIFICATION: ACCELERATING ELECTROMOBILITY ADOPTION IN SOUTH AFRICA.

BY MONGALE TEBOGO

INTRODUCTION

Background: South Africa's Electromobility and Environmental Efforts Commitments

South Africa is working to reduce its greenhouse gas (GHG) emissions while increasing vehicle exports and employment in the automotive industry. This effort is challenging, given the country's commitment to the Kyoto Protocol and the Paris Agreement, which require substantial GHG reductions. Although electromobility is a key strategy to achieve these reductions, the high cost of electric vehicles (EVs) poses a barrier for local consumers.

The global shift towards EVs also threatens South Africa's automotive exports. In 2022, ICE vehicle exports made up 63% of total production. However, international bans on new ICE vehicle sales in key markets could diminish the demand for South African-produced ICE vehicles and components, jeopardizing the growth of the domestic industry.

A challenge for South Africa which has proven to be a solution for Electromobility adoption is seen in the ratification of the Kyto protocol and the Paris agreement commitments. In 1997, South Africa signed the Kyoto Protocol and ratified it in 2002. The Kyoto Protocol was a significant step for South Africa, marking

*These essays are unedited.

its commitment to reducing greenhouse gas emissions and transitioning towards more sustainable practices. Under the Kyoto Protocol, South Africa was classified as a developing country, which meant it did not have binding emission reduction targets. However, the country recognized the importance of addressing climate change and began taking steps to promote sustainability and reduce emissions.

In 2015, South Africa reaffirmed its commitment to combating climate change by signing the Paris Agreement, which aims to limit global warming to well below 2 degrees Celsius above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5 degrees Celsius. Under the Paris Agreement, South Africa submitted its Nationally Determined Contribution (NDC), outlining its plans to peak greenhouse gas emissions between 2020 and 2025, plateau for approximately a decade, and then decline in absolute terms. The country's NDC highlights the need for transitioning to a low-carbon economy, enhancing energy efficiency, and increasing the use of renewable energy sources.

Electromobility and Its Role in Reducing Greenhouse Gas Emissions

Electromobility, the use of electric vehicles (EVs) powered by electricity rather than fossil fuels, is increasingly recognized as a critical strategy in reducing greenhouse gas emissions. Unlike traditional internal combustion engine vehicles, EVs produce little to no tailpipe emissions, making them a significantly cleaner alternative for transportation.

The adoption of electromobility is essential for mitigating climate change, reducing air pollution, and fostering sustainable development. The shift towards EVs not only aligns with environmental goals but also supports the transition towards a more sustainable and resilient energy system.

The Importance of Standardization and Certification in Electromobility

Standardization and certification are fundamental to the widespread adoption of electromobility. They provide a foundation of consistency, safety, and market confidence, ensuring that the transition to electric vehicles is smooth and reliable. Standards ensure uniformity across charging infrastructure, vehicle components, and safety features, promoting interoperability and ease of use. They enhance safety for users, manufacturers, and service providers by defining protocols that prevent accidents and ensure reliable operation.

Moreover, standards foster market confidence, as adherence to recognized standards assures consumers of the technology's reliability and safety.

Certification plays an equally crucial role by providing quality assurance. Certification bodies assess compliance with established standards, validating the quality, reliability, and safety of electromobility products. Certified products gain better market access, meet regulatory requirements, and enjoy broader acceptance in global markets.

Certification also builds consumer trust by assuring that products meet established norms, thereby encouraging wider acceptance and adoption of electromobility. In summary, standardization and certification create a robust foundation for the sustainable and reliable adoption of electromobility.

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THE CURRENT STATE OF THE TRANSPORT INDUSTRY IN SOUTH AFRICA

The Transport Sector's Impact on Greenhouse Gas Emissions

The transport industry in South Africa significantly contributes to greenhouse gas emissions, accounting for approximately 11% of the country's total emissions, making it the third-largest source of emissions after energy production and industrial processes. The heavy reliance on fossil fuels such as petrol and diesel, coupled with the dominance of road transport, particularly private vehicles, leads to inefficiencies and higher emissions. These emissions, including significant amounts of carbon dioxide (CO_2), nitrogen oxides (NOx), and particulate matter (PM), contribute to global warming, climate change, and air pollution, adversely affecting public health and ecosystems.

Electromobility offers a promising solution to these challenges. Promoting the use of electric vehicles, e-bikes, and other electric modes of transport can significantly reduce emissions. Integrating renewable energy sources for EV charging can further enhance these benefits, making electromobility a critical component of South Africa's strategy to reduce its carbon footprint and promote sustainable development.

The Need for Sustainable Alternatives

The transport industry in South Africa faces a pressing challenge: reducing its carbon footprint and embracing sustainable alternatives. Electromobility, encompassing battery electric vehicles (EVs), fuel cell electric vehicles, e-bikes, and e-scooters, presents a viable solution. However, achieving widespread adoption requires a strategic approach that leverages standardization and certification.

Battery electric vehicles (BEVs) rely solely on electricity stored in rechargeable batteries, resulting in zero tailpipe emissions. Fuel cell electric vehicles (FCEVs) use hydrogen fuel cells to generate electricity, with water vapor as the only emission. Although less common, FCEVs contribute to a cleaner environment.

E-bikes combine pedal power with an electric motor, making cycling easier and more accessible, while e-scooters run on electric motors and rechargeable batteries, often used for short-distance travel within cities. These forms of electromobility contribute to reducing traffic congestion and emissions.

Standardization plays a pivotal role in driving the adoption of electromobility. Consistent practices ensure interoperability, safety, and ease of use. The International Electrotechnical Commission (IEC) has developed standards like IEC 61851, which defines EV charging protocols.

However, localized standards that consider South Africa's unique context are equally crucial. These standards guide manufacturers, policymakers, and consumers toward sustainable practices, ensuring that the benefits of electromobility are fully realized.

Certification and quality assurance further enhance the reliability and safety of electromobility components. Certification bodies assess compliance with standards, providing quality assurance and validating product reliability. Programs like ISO 9001 and ISO 14001 enhance consumer trust and ensure that electromobility solutions meet performance, safety, and environmental benchmarks.

III. ELECTROMOBILITY: A SOLUTION FOR REDUCING CARBON FOOTPRINT

The Definition and Forms of Electromobility

Electromobility encompasses various forms of electric transportation, each contributing to the reduction of carbon emissions. Battery electric vehicles (BEVs) rely solely on electricity stored in rechargeable batteries, producing zero tailpipe emissions and contributing to cleaner air. Fuel cell electric vehicles (FCEVs) use hydrogen fuel cells to generate electricity, with water vapor as the only emission, making them environmentally friendly.

E-bikes combine pedal power with an electric motor, making cycling easier and more accessible, while e-scooters run on electric motors and rechargeable batteries, often used for short-distance travel within cities, helping reduce traffic congestion and emissions.

Electromobility's Contribution to Emission Reduction

Electromobility significantly reduces emissions through various mechanisms. BEVs and FCEVs produce no tailpipe emissions, unlike internal combustion engine vehicles, which emit pollutants such as nitrogen oxides and particulate matter. Electromobility also encourages the use of renewable energy sources for charging. When EVs charge from solar panels or wind turbines, their overall carbon footprint decreases.

Although EVs have emissions associated with manufacturing and electricity production, their lifecycle emissions are still lower than traditional vehicles. As the energy grid transitions to cleaner sources, EVs become even more environmentally friendly.

Potential Benefits for South Africa

Promoting electromobility in South Africa offers several potential benefits. Reduced air pollution leads to cleaner air, positively impacting public health and ecosystems. By transitioning to electric vehicles, South Africa can reduce its dependence on imported fossil fuels, promoting energy security and resilience. Developing EV infrastructure, manufacturing, and maintenance creates employment opportunities. Skilled jobs in renewable energy and electric vehicle technology contribute to economic growth. Embracing electromobility encourages research and development in battery technology, charging infrastructure, and smart grid solutions, positioning South Africa as a hub for sustainable transportation innovation. Countries leading in electromobility gain a competitive edge, attracting investment, collaborating with international partners, and participating in the global EV market.

IV. ROLE OF STANDARDIZATION

Ensuring Consistency, Safety, and Interoperability

Standardization ensures consistency, safety, and interoperability across the electromobility ecosystem. Standards provide a common framework for designing, manufacturing, and operating electromobility components, ensuring uniformity across charging infrastructure, vehicle interfaces, and safety features. Consistent practices simplify maintenance, troubleshooting, and upgrades. Standards address safety risks related to electrical components, battery systems, and high-voltage charging, minimizing the likelihood of accidents, fires, or electric shocks. Compliance with safety standards enhances user confidence in adopting electromobility. Interoperability ensures that different components, such as EVs, charging stations, and grid infrastructure, work seamlessly together, enhancing user convenience and fostering market growth by allowing new entrants to develop compatible products.

Existing International Standards

Several international standards related to electromobility contribute to its safe and effective implementation. IEC 61851 defines the requirements for EV charging infrastructure, including communication protocols between the vehicle and the charging station. It specifies different charging modes, such as AC and DC charging, ensuring compatibility across various EV models and charging stations. IEC 62196 addresses the physical connectors used in EV charging, ensuring that connectors and inlets are interchangeable. ISO 15118 defines the communication interface between EVs and the power grid, facilitating smart charging and allowing EVs to interact with the grid for optimized energy use and load management.

The Importance of Localized Standards

While international standards provide a robust foundation, localized standards are crucial for addressing South Africa's unique context. South Africa's power grid may face stability issues due to the intermittent nature of renewable energy sources. Localized standards can address these challenges and ensure reliable EV charging. Standards should consider the geographical distribution of charging infrastructure, ensuring accessibility in both urban and rural areas. South Africa experiences diverse climate conditions, and localized standards can address the impact of extreme temperatures on battery performance and charging efficiency. Standards should align with national policies and regulations, promoting coherent and supportive frameworks for electromobility adoption. Localized standards can guide the implementation of incentives, subsidies, and grants for EV adoption, ensuring they are effective and well-targeted.

V. CERTIFICATION AND QUALITY ASSURANCE

The Role of Certification Bodies

Certification bodies play a crucial role in the electromobility ecosystem by assessing compliance with established standards. These bodies evaluate products, systems, or processes against the criteria defined by standards, ensuring that they meet quality, safety, and performance benchmarks. Certification bodies conduct thorough evaluations, including testing and inspections, to verify that products or systems meet the specified standards. Upon successful evaluation, certification bodies issue certificates indicating compliance, signifying that the product or system adheres to recognized norms. Certification bodies perform ongoing surveillance to ensure continued compliance, maintaining product quality and safety over time.

The Importance of Quality Assurance

Quality assurance is essential for ensuring the reliability, safety, and performance of electromobility components. Certified charging stations must consistently deliver power without interruptions or malfunctions. Certification ensures that charging stations are compatible with different EV models, enhancing user convenience and preventing electrical hazards, such as short circuits or overheating. Certification bodies test battery systems for performance, efficiency, and safety, including evaluating energy density, charging cycles, and thermal management. Electric motors are assessed for efficiency, reliability, and durability,

 continues from page 79

ensuring they meet performance standards and operate safely. Electronic control units (ECUs) manage various vehicle functions, including power distribution and battery management, and certification ensures they function correctly and safely. Certification bodies evaluate the crashworthiness of EVs, ensuring they meet safety standards for occupant protection, and certification ensures that active safety systems, such as anti-lock braking systems, and passive safety systems, such as airbags, function as intended.

Examples of Certification Programs

Several certification programs enhance the quality and reliability of electromobility components.

ISO 9001 is a globally recognized standard for quality management systems, ensuring consistent quality, customer satisfaction, and continuous improvement across organizations. ISO 14001 provides a framework for environmental management, helping organizations minimize their environmental impact, promote sustainability, and comply with regulations.

ISO/IEC 27001 focuses on information security management, ensuring robust data protection and secure practices crucial for the digital aspects of electromobility. ISO 45001 addresses occupational health and safety, helping organizations prioritize employee well-being, prevent workplace injuries, and manage risks.

VI. CHALLENGES AND OPPORTUNITIES

Key Challenges in Implementing Standards

Implementing standards in electromobility faces several challenges. Developing and adhering to standards can be expensive, especially for smaller companies. Research, testing, and compliance activities require significant investment. Implementing standardized practices may involve upgrading infrastructure, training personnel, and integrating new technologies. Many stakeholders, including manufacturers, policymakers, and consumers, may lack awareness of electromobility standards, hindering adoption and compliance. Providing education and training on standards is essential to ensure that all stakeholders understand and implement them effectively.

Establishing a robust charging infrastructure network requires significant investment and coordination, and inadequate charging infrastructure can deter EV adoption. Integrating EVs into the power grid poses challenges related to load management, grid stability, and renewable energy integration. Aligning national policies with international standards can be complex, and clear policy frameworks encourage industry players to adopt standards voluntarily.

Effective incentives and subsidies are needed to promote standardization and encourage stakeholders to invest in electromobility. Different countries may have varying standards for electromobility, hindering global interoperability. Harmonizing standards internationally ensures consistent practices and facilitates cross-border trade.

Opportunities for Collaboration and Innovation

Despite the challenges, there are numerous opportunities for collaboration and innovation in promoting electromobility standards. Collaborative research and development (R&D) efforts can drive innovation in battery technology, charging infrastructure, and smart grid solutions.

Partnerships between government bodies, industry stakeholders, and research institutions can accelerate infrastructure development and standardization. Governments can provide financial incentives, grants, and subsidies to support standardization efforts and promote electromobility adoption. Clear and supportive policies can guide industry players and encourage voluntary adoption of standards. Investing in skills development and training programs ensures that stakeholders have the necessary expertise to implement standards effectively. Awareness campaigns and workshops can educate stakeholders about the importance of standards and their role in promoting electromobility. Raising public awareness about the benefits of electromobility and the role of standards can drive consumer demand. Educating consumers about the importance of certified products and the benefits of electromobility can foster market acceptance. Investing in the expansion of charging infrastructure ensures accessibility and convenience for EV users. Upgrading the power grid to accommodate EV charging and renewable energy integration enhances grid stability and reliability.

The Importance of Incentives and Policy Frameworks

Incentives and policy frameworks play a pivotal role in promoting electromobility adoption. Offering tax credits, rebates, and subsidies for EV purchases can reduce the upfront cost for consumers and encourage adoption. Reducing or waiving registration fees for EVs can further incentivize consumers to choose electric vehicles. Providing grants or

subsidies for the installation of public and private charging stations can accelerate infrastructure development. Offering preferential parking for EVs, including free or discounted parking, can encourage EV ownership. Implementing stringent emission standards for vehicles can drive the transition to cleaner alternatives like EVs. Mandating the inclusion of EVs in public and private fleets promotes the adoption of electromobility. Allocating funding for research and development in electromobility technology, battery systems, and renewable energy integration fosters innovation.

VII. CONCLUSION

In conclusion, standardization and certification are fundamental to the widespread adoption of electromobility in South Africa. They provide a foundation of consistency, safety, and market confidence, ensuring that the transition to electric vehicles is smooth and reliable.

Standardization ensures uniformity across charging infrastructure, vehicle components, and safety features, promoting interoperability and ease of use. Certification provides quality assurance, validating the reliability and safety of electromobility products. Despite the challenges in implementing standards, opportunities for collaboration and innovation abound, supported by incentives and policy frameworks that promote electromobility adoption. Through a strategic approach that leverages standardization and certification, South Africa can reduce its carbon footprint, promote sustainable development, and position itself as a hub for sustainable transportation innovation.

HOW CAN STANDARDIZATION AND CERTIFICATION INCREASE ADOPTION OF ELECTROMOBILITY IN SOUTH AFRICA?

BY NDORO NETSHIPALE

1. INTRODUCTION

The transport sector is one of the major contributors to global greenhouse gas emissions, accounting for approximately 14% of the total human-caused emissions worldwide [1]. These greenhouse gases arise from fossil fuel combustion (gasoline, diesel, petrol, coal). Carbon dioxide is one of the primary greenhouse gases with the highest contribution to global warming and climate change. The latter has contributed to adopting electric vehicles (EVs) to ensure a healthy and safe environment.

The adoption of electric vehicles is not without challenges. Barriers such as charging infrastructure limitations, insufficient electricity in South Africa, and the high upfront cost of electric cars are slowing the adoption of EVs in South Africa. The purpose of this essay is to address the latter challenges by discussing the following: Sections 1, 2, and 3 outline the different types of electric vehicles, different types of batteries, and the EV charging infrastructure, respectively. Section 4 highlights the customer's concerns regarding electric vehicles. In section 5 and 6 advantages and disadvantages of EVs are discussed. Section 7 looks at ways to increase the adoption of EVs through standardization and certification. Section 8 concludes the paper.

Key words: Electric vehicles (EVs), charging infrastructure, vehicle-to-grid (V2G), renewable energy integration, standards, and certification.

2. TYPES OF EVS

2.1 Battery Electric Vehicles (BEVs)

These vehicles are operated solely using electric energy stored in a rechargeable battery. These types of vehicles do not have a combustion engine, hence, zero emissions. These types of vehicles can travel up to 480 km without being recharged, depending on the type of battery installed [2].

2.2 Plug-in Hybrid Electric Vehicles (PHEVs)

These vehicles consist of both electric motors and internal combustion engines. The electric motor is powered by energy stored in a rechargeable battery. Fuel is used to power the internal engine. These vehicles can operate in electric mode, engine-powered mode, or both modes. These vehicles can travel up to 80 km before changing into hybrid mode [2].

2.3 Hybrid Electric Vehicles (HEVs)

HEVs are powered by an internal combustion engine with an electric motor that runs from energy stored in a battery. The battery on HEVs is not researchable. Unlike BEVs, the PHEVs and HEVs produce tailpipe emissions [2].

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2.4 Fuel Cell Electric Vehicles (FCEVs)

These are hydrogen-powered vehicles. During operation, these vehicles release water vapor and warm air. On a full tank of hydrogen, these vehicles can travel up to 480 km [2].

3. THE MAIN TYPE OF BATTERIES USED IN EVS

The commonly used EV batteries and their advantages are summarized in Table 1 [3].

4. EVS INFRASTRUCTURE AND POWER CHARGING LEVELS

4.1 EV Components

The main EV components are summarized below [4].

- *Charging Stations:* These are charging infrastructure equipped with chargers where EVs can plug to recharge their batteries.
- *Charging Network:* These networks connect charging stations across different areas. These charged networks are owned by the power utility companies or the government.
- *Grid Integration:* EV charging infrastructure must integrate with the electrical grid to manage electricity demand efficiency.
- *Home and Workplace Charging:* Most EV owners charge their vehicles at home using level 1 and 2 chargers. Workplace charging stations are becoming common nowadays, providing convenient charging during work hours.
- *Public Charging:* These are in the urban and commercial areas to ensure means of recharge during long-distance travel.

4.2 EV Charging Power Levels

See Table 2.

5. CUSTOMERS' CONCERNS WITH REGARD TO THE ADOPTION OF ELECTRIC VEHICLES

5.1 Inefficient Electricity in South Africa

South Africa has been experiencing load-shedding problems since 2007. The adoption of EVs will put more pressure on the grid, and as it stands, the demand for electricity exceeds the supply of electricity. The latter is slowing down the adoption of electric vehicles in South Africa because customers are aware of the problem, and they become reluctant to adapt to new technologies as they believe that the adoption of EVs will worsen the state of the state of South African electricity infrastructure [5].

5.2 EV Charging Infrastructure

Insufficient battery charging infrastructure is one of the reasons delaying the adoption of EVs in South Africa. The latter affects the adoption of EVs in South Africa. Customers are unsure of the interest of the government regarding investing in the recharging infrastructure required for the operation of EVs [5].

5.3 Cost of Electric Vehicles

The current EVs offered in the South African market are expensive, with a high maintenance cost. The cost of EVs is one of the factors that is delaying the quick adoption of EVs in South Africa [5].

BATTERY TYPE	ADVANTAGES
Lithium-ion (Li-ion) batteries	These types of batteries are characterized by high energy density, fast charging capacity, and lightweight, with good life cycle.
Lithium polymer batteries	They can be shaped differently allowing for greater design flexibility in vehicle integration.
Nickel metal hydride batteries	Matured battery technology with lower energy density compared to Li-ion.
Solid state batteries	Higher energy density with improved safety and long lifespan when compared with Li-ion.
Sodium ion batteries	Low-cost batteries with improved safety characteristics.

Table 1: Types of batteries used in EVs.

CHARGING LEVEL	POWER OUTPUT	CHARGING TIME	USE CASE
Level 1 AC charging	120 volts, 1.4-1.9 kW	Slow	Standard household outlets
Level 2 AC charging	240 volts, 3.6-19.2 kW	Faster	Homes, workplace and public
DC fast charging	50-350 kW	Very fast	Long distance, installed in highways and major cities.

Table 2: Different EV charging power levels [4]

5.4 Lifespan of the EVs and EV battery

Most of the customers in South Africa travel a long-distance trip of approximately 14 hours, considering the insufficient recharging infrastructure in South Africa, it raises an uncertainty towards the adoption of EVs. Another concern is how long the EV battery lasts and its depth of discharge. The last concern is the durability, performance maintenance, and lifespan of EVs [5].

6. POSITIVE IMPACTS OF EVS

6.1 Economic Impacts

As the adoption of EVs increases, exponential growth is seen in the automotive sector through manufacturing, research, and development of different types of EVs. The manufacturing of EVs requires other key components such as batteries, electric motors, converters, controllers, cooling systems, etc. The latter implies growth in the other manufacturing companies that produce EV components. This growth results in direct and indirect job creation. The job creation promotes skills transfers and increases customer expenditure [6].

The charging of EVs demands a lot of electricity during peak hours the latter implies high revenue for the utility companies. The extra revenue earned during these peak hours can be invested in renewable energy sources to reduce carbon emissions [6]. As more and more EVs are being produced and sold, there will be an increase in government tax revenue. The revenue earned can be invested in the EV charging infrastructure, resulting in economic benefits through construction contracts and employment opportunities. Tax credits aim to promote the adoption of EVs without affecting government revenue [6].

6.2 Environmental Impacts

The operation of BEVs depends solely on electricity, resulting in zero emissions. The latter reduces the amount of greenhouse gases (carbon dioxide, nitrogen oxides) released into the atmosphere, reducing climate change and air pollution. Studies have shown that EVs have low life cycles in comparison to conventional vehicles [6].

6.3 Social Impact

The reduction of greenhouse gases through the adoption of EVs improves air quality, which reduces health risks and diseases such as respiratory diseases [6]. EVs are quieter than internal combustion vehicles, reducing noise pollution in urban areas and creating a quiet and pleasant living environment for the residents [6].

6.4 Electricity Demand Management

EVs increase the demand for electricity through smart charging strategies, time-use pricing, and demand responses demand, for electricity can be managed, balancing the grid and preventing the strain on the electricity infrastructure [6].

6.5 Grid Stability and Reliability

As EVs charging from the grid increases in number, voltage fluctuations are introduced, which affect the grid stability and reliability. To prevent the latter, the voltage and frequency monitoring system must be introduced. Network upgrades are also necessary to support the increased EV charging demand [6].

6.6 Smart Grid Technology and Grid Integration

The implementation of smart grid technology and communication systems manages the EV charging patterns, optimizes the energy consumed, and supports grid balancing. Implementation of smart meters and demand management systems to allow real-time monitoring and control of charging loads [6].

Vehicle-to-grid integration strategies can be explored where EVs can discharge the stored energy back to the grid during peak demand periods. The latter supports grid flexibility and renewable energy integration and allows EV owners to have an extra income stream [6].

6.7 Renewables Integration

EVs can be used as a flexible load to

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integrate renewable energy sources like wind and solar. The EVs can be timed to match the periods of high renewable generation, reducing reliance on fossil fuel and lowering carbon emissions [6].

7. NEGATIVE IMPACTS OF EVS

The negative impacts that come with the adoption of EVs are highlighted below [7].

- Limited driving range: EVs have limited driving range as compared to internal combustion engine vehicles. EV drivers must plan well and consider charging station availability.
- Charging speed: The time needed to charge an EV is higher as compared to refilling conventional vehicles with diesel/ petrol. To fully charge an EV battery can take several hours, depending on the size of the battery and charging power levels.
- Charging infrastructure availability: Although the is an expansion of EV charging infrastructure, recharging is not as fast as refilling an engine vehicle with petrol or diesel. Rural areas, especially in SA, have limited access to public charging stations.
- Upfront cost and depression rate of EVs: Electric vehicles have a high upfront cost in comparison to diesel and petrol vehicles, although the cost is forecasted to reduce as the battery cost decreases. This remains one of the biggest barriers for customers when it comes to the adoption of EVs. EVs can depreciate much quicker as compared to conventional vehicles, which can affect the resale value and total cost of ownership considerations.
- Battery lifespan and replacement cost: EV batteries nowadays are designed to last longer, however, after a long period, they need to be replaced, and the replacement cost is normally high, which is one of the factors that need to be considered. Battery warranties and maintenance practices can mitigate the high cost of replacement.
- Grid capacity versus electricity demand: EVs could strain the existing grid, especially during peak hour periods. Network upgrades and renewable energy integration must be looked into as the adoption of EVs increases.
- Cold weather performance: EV performance is affected by cold weather as low temperature affects the battery efficiency, affecting the overall power performance of an EV.
- EV battery recycling process: The production and recycling of EV batteries involves a complex process that can have environmental impacts, including recycling /disposal challenges.

8. WAYS TO INCREASE THE ADOPTION OF EVS IN SOUTH AFRICA

Standardization and certification play an important role in increasing the adoption of electromobility in South Africa (SA). This section discusses ways in which standards and certification can contribute to ensuring the growth of electromobility in SA.

8.1 Safety and Quality of EVs

The design, manufacturing, and performance of EVs, EV components, and the charging infrastructure need to meet certain technical requirements and specifications to ensure the safety and quality of EVs. Standardization must implement technical standards relating to the design, manufacturing, and performance of EVs, EV components, and the charging infrastructure [8] [9].

Standardized specifications for charging connectors and communication interfaces must be developed to ensure safe and reliable operation during the charging process. Additionally, the installation of the charging infrastructure must have a standard to ensure protection against electrical hazards during installation. Lastly, a standard addressing the functionality safety of EVs (risk assessment, hazard analysis), must be in place to mitigate the risk associated with vehicle operation [8] [9].

Certification bodies and testing laboratories must perform different tests to verify that the EVs meet all the standards and criteria. The latter implies testing for safety, durability, and reliability under different operating conditions of the EV. Test the performance of EVs (including battery and electronic components) at different temperatures, humidity, and vibration levels [8] [9].

Standardization bodies and certification agencies must work together and incorporate information from the automotive industry, researchers, and customers to update standards and any emerging safety concerns. Standardization to provide innovation support by providing a common framework for the new emerging technology and solutions to ensure safety and quality [8] [9].

The above paragraphs highlighted safety and quality measures that standardization and certification bodies can implement to allow quick adoption of EVs. These measures are to ensure that the EVs and the EV components comply with safety, environmental, and quality standards. One of the factors that customers consider in their decision to purchase a new product (EVs) is compliance and certification, as this proves the reliability of the product. Therefore, with the guaranteed safety and quality of EVs, customers will be willing to spend money on EVs [8] [9].

8.2 EV charging infrastructure

Standardization bodies to ensure the development of standards for the EV charging infrastructure. The standard must also cover the connector types, communication protocols, and safety requirements. Standardization to ensure compatibility between EVs and charging stations. The latter implies that the charging stations should be able to charge different EVs manufactured by different companies (Tesla, Ford, BMW, etc) [8] [9].

Certification process to be followed for all the charging stations to ensure the performance, reliability, and safety of the charging infrastructure. Government and regulatory bodies can introduce policies and incentives to encourage the development of EV charging infrastructure [8] [9].

Standardizations to facilitate regularity compliance by providing clear installation, operation, and maintenance requirements for the EV charging infrastructure. Certifications to assure the stakeholders of the quality and compliance of the infrastructure, inspiring investment in EV charging infrastructure. As the adoption of EVs increases, the standardized charging stations can be expanded and integrated into the existing grid [8] [9].

The development of standardized EV charging infrastructure motivates the development of new technologies such as smart grid integration, V2G, and fast charging solutions. Standardized infrastructure minimizes barriers related to compatibility and reliability, resulting in the fast adoption of EVs [8] [9].

8.3 Training and Skills Development

Standardization bodies with industry associations and educational institutions can collaborate with one another to develop standardized curricula for EV-related training programs. The curriculum must cover topics such as EV technology, charging infrastructure, maintenance, and safety procedures. To be included in the training programs is a standardized competency framework outlining the knowledge, skills, and abilities required for different roles in the EV industry [8] [9].

Certification bodies may certify training providers who will provide related EV training programs. The accreditation process must also form part of the training program, whereby individuals are examined before being accredited. The latter will give confidence to the employer and the learners when it comes to adherence to all the rules, regulations, and procedures in the EV sector [8] [9].

Standardization to promote continuous education and professional development. The latter can be done by introducing more modules relating to EV technology, such as battery management, environmental and safety impact assessment, servicing and repairing of EVs, etc. These modules will help individuals to have a broader understanding of EV, its benefits, and its impacts through learning and training [8] [9].

Standardization bodies, in collaboration with the government, automotive industry, certification bodies, and educational institutions, can promote workshops and workforce development initiatives to allow different stakeholders to come together for knowledge sharing and discussions around EV technology. The latter will also ensure that individuals are educated and trained to meet the upcoming future EV job demand [8] [9]. Standardization to develop standardized safety and quality training programs to emphasize the safety measures when it comes to handling EVs, battery storage, and high voltage systems. The training programs will ensure that trainees are well-informed of the risks associated with the operation of EVs [8] [9].

8.4 Cost Efficiency

Standardized EV components (batteries, charging connectors) enable economies of scale in the manufacturing industry. Suppliers can produce standardized parts in bulk, reducing the unit price

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cost. Standardization encourages manufacturing companies to adhere to the same design specifications and interfaces, which minimizes manufacturing errors and leads to cost savings. Therefore, standardization must encourage manufacturing of standardized EV components [8] [9].

The certification process ensures that the EVs adhere to all the safety, performance, and environmental standards. With clear compliance and certifications, manufacturers of EVs can save on redesigns and repeated testing. The efficiency of the certification process results in cost savings [8] [9].
The development of clear standards with regard to the durability, reliability, and performance of EVs over a long period of time can help the manufacturers of EVs to design EVs that are more reliable and require less maintenance over time, reducing ownership costs [8] [9].

8.5 Global integration

The International Organization for Standards (ISO) and the International Electrotechnical Commission (IEC) can develop and publish international standards for EVs, EV charging infrastructure, and related technologies to define common EV components, performance criteria, communication specifications, and safety requirements.

The latter will allow for cross-border compatibility, where EV components can be imported or exported from one country to another [8] [9].

The development of the international standard for EV charging connectors will ensure compatibility between EVs and charging stations worldwide. This allows EVs to access the charging stations without an additional charging adapter [8] [9].

Standardized V2G technology globally allows for EVs to participate in the grid and energy management at a global level. Manufacturers and grid operators can implement solutions whereby EV batteries are integrated into the grid, providing grid stabilization, peak shaving, and renewable energy integration [8] [9].
Promote market access through regulatory compliance. EV manufacturers can undergo a certification process to demonstrate compliance with global standards and regulatory requirements. The certification marks that the products meet the safety, performance, and quality requirements and are recognized across the international market [8] [9].

Government agencies, industrial associations, and standardization bodies come together to develop and update standards relating to trending technologies and regulatory priorities. The collaboration will promote knowledge sharing and alignment of industry practices globally [8] [9].

The global standardization and certification of EV technology assures customers of the safety and reliability of the product, which results in the acceptance of EVs as a viable transport solution worldwide. EV drivers are at ease when traveling internationally with the knowledge that their vehicles can access compatible charging networks and services [8] [9].

International standards bodies can facilitate global harmonization, allowing EV manufacturers to design and manufacture EVs that can be sold and operated in multiple markets without significant modifications. The latter encourages participation in the global market and reduces costs associated with adapting to different regional standards [8] [9].

8.6 Interoperability

International standard bodies such as IEC and ISO can establish common charging and communication technical standards to enhance interoperability between EVs and charging infrastructure. Certification must ensure that the EVs and charging stations comply with the relevant technical and safety requirements [8] [9].

By ensuring common technical standards for EVs and charging stations, drivers can confidently charge their EVs at any compatible charging station, with the knowledge that standardized protocols support seamless operation. Standardization promotes the development of charging stations, supporting the adoption of electric mobility [8] [9].

9. CONCLUSION

This essay proposed ways to increase the adoption of EVs to reduce carbon emissions and create a safe and healthy environment. The proposed ways were developed based on the EV technology analysis. The analysis looked at the different types of EVs, EV infrastructure, EV concerns raised by the customers, and the positive and negative impacts of EVs.

The analysis showed that there are existing barriers such as charging infrastructure limitations and the cost of EVs, that are delaying the uptake of EVs.

Private and public sector investment in EV infrastructure was one of the solutions to these barriers. Standardization and certification requirements to ensure the safety, quality, and reliability of EVs were discussed to assure the customers of the safety and performance of EVs. Hence, encouraging customers to invest in EVs.

REFERENCES

SOUTH AFRICA INTERNATIONAL INDUSTRIAL EXPO
& CHINA (SOUTH AFRICA) INTERNATIONAL TRADE EXPO

SOUTH AFRICA GOLDEN BRIDGE

3th South Africa International Industrial Expo & China (South Africa) International Trade Expo

Expo 1 , Sandton Convention Centre,Johannesburg, SA

19 - 21 Sept, 2024

Pre-Expo Match Meetings

Golden Bridge is holding industry specialized Pre-Expo Match Meetings before the physical expo which will assist clients and exhibitors to establish contact in advance and improve the efficiency of the business negotiation during the exhibition.

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Located in Midrand, Golden Bridge has set up a long-term display center and overseas warehouse in Inospace Business Park with highways and the Gautrain station within walking distance. Business people are able to check the samples of settled enterprises and negotiate with them at any time. It is conducive to shortening the delivery time of products and improving trade efficiency, and it does provide the visitors with convenience in trade links such as sample check and transportation.

Factory Visits in China

Golden Bridge Expo China team will connect business people on business trips in China with factories and assist with on-site factory visits and inspections according to the needs, so as to facilitate clients to choose trustworthy business partners.

TOGETHER, GROWING INDUSTRIES

MEMBERSHIP FEES EFFECTIVE 1 DECEMBER 2024

The Council meeting held on 6 September 2024 approved subscription & entrance fees as from 01 December 2024 as per schedule indicated below.

PLEASE NOTE: In terms of Bylaw 3.2 annual subscriptions are due on 1st December 2024

MEMBERSHIP FEES CAN BE PAID IN MONTHLY RECURRING PAYMENTS

Council agreed to a discount for fees paid before 31 March 2025. Members are therefore encouraged to pay promptly to minimize increase impact.

Grade of Membership	Annual Subscriptions paid before 31 March 2025		Annual Subscriptions paid after 31 March 2025		New Members FEES * see Notes 1 & 4 below.	
	RSA incl VAT (R)	Outside RSA excl VAT (R)	RSA incl VAT (R)	Outside RSA excl VAT (R)	RSA incl VAT (R)	Outside RSA excl VAT (R)
Student	nil	nil	nil	nil	nil	nil
After 6 yrs study	1 890	1 644	2 268	1 972	2 268	1 972
Associate	1 890	1 643	2 268	1 972	2 268	1 972
Member	2 089	1 816	2 507	2 180	2 507	2 180
after 6 years	2 441	2 122	2 929	2 547	2 929	2 547
after 10 years	2 555	2 221	3 065	2 666	3 065	2 666
Senior Member	2 555	2 221	3 065	2 666	3 065	2 666
after 6yrs/age 40	2 768	2 407	3 322	2 889	3 322	2 889
Fellow	2 768	2 407	3 322	2 889	3 322	2 889
Retired Member (By-law B3.7.1)	1 174	1 021	1 409	1 225	n/a	n/a
Retired Member (By-law B3.7.3)	nil	nil	nil	nil	n/a	n/a

1. The fee for all new applications is R3457.00 which includes an entrance fee of R950.00. On election to the applicable grade of membership the new member's account will be adjusted accordingly and refunds/additional payment made on request.

2. Transfer fee to a higher grade is free for all grades of membership.

3. Members are encouraged to transfer to a higher grade when they qualify. It will be noted that the fees of Member and Senior Member grades after 10 and 6 years respectively are equal to the fees at the next higher grade.

4. Members elected after May 2025 pay a reduced subscription fee.

5. By-law B3.7.1 reads “Where a member in the age group of 55 to 70 years has retired from substantive employment in the engineering profession, such member may make written application to Council for recognition as a retired person and a reduced membership fee".

6. By-law B3.7.3 reads “any member complying with the conditions of B3.7.1 but who has been a member of the Institute for not less than 25 consecutive years, shall be exempt from the payment of further subscriptions.” Members who comply with the requirements of By-Law B3.7.3 may make written application to Council for exemption from paying subscriptions".

7. By-law B3.9 reads “any member in good standing who has been a member for fifty (50) consecutive years shall be exempt from the payment of further subscriptions.”

8. Members not in good standing by failing to pay their subscriptions by end of June of each year will, subject to Council decree, be struck-off the SAIEE membership role.

9. Members in good standing and no longer in substantive employment and do not receive payment or salary for work done may apply to Council for a reduction in their annual subscriptions.

10. The members monthly magazine ("wattnow") is available on line and members who require a hard copy may acquire same on request and for a nominal fee subject to minimum uptake numbers.

11. Members who wish to pay their membership fees in recurring payments should activate the payments on their banking portal. Members will receive the early bird discount only if their fees are fully paid by 31 March 2025.

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CPD training discounts	CPD training discounts	CPD training discounts	Exclusive Networking Events	Exclusive Networking Events
Charge Reward Programme earnings	Charge Reward Programme earnings	Charge Reward Programme earnings	CPD training discounts	CPD training discounts
Bursary programme	Bursary programme	Long standing member gifts	Charge Reward Programme earnings	Charge Reward Programme earnings
Publication access (**watt**now & ARJ)	Publication access (**watt**now & ARJ)	Bursary programme	Long standing member gifts	Long standing member gifts
Site visits	Site visits	Publication access (**watt**now & ARJ)	Bursary programme	Bursary programme
SAIEE Centres	SAIEE Centres	Site visits	Publication access (**watt**now & ARJ)	Publication access (**watt**now & ARJ)
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11/09/2024	Fundamentals of Developing Renewable Energy Plants
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12/09/2024	Rotating Machine Section site visit | LH Marthinusen
17/09/2024	Earthing & Lightning Protection - East London
18/09/2024	Introduction to Artificial Intelligence for Professionals
19 - 21/09/2024	South Africa International Industrial Expo - Sandton
26/09/2024	SAIEE BP Lecture - Wits University

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16/10/2024	SANS 10142-1 Edition 3 2020
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