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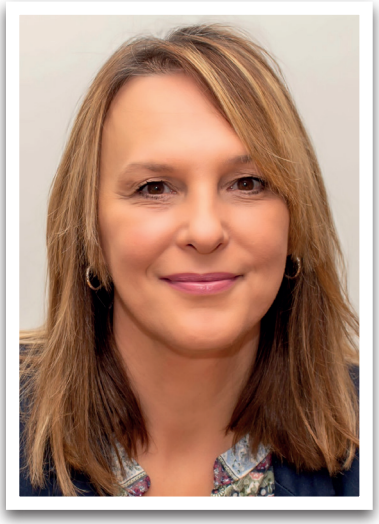

Dear **watt**now reader,

This issue features mining, a rich resource that assists us in reducing our carbon footprint if done correctly.

Our first feature article brings you a tracking trend report from Deloitte on redefining mining. What will successful mining and metals companies look like in a low-carbon, low-waste, purpose-driven future? The beauty of this question is that there is no definitive answer. While the core objective of the mining industry remains unchanged as we advance: to extract and provide metals and minerals to downstream sectors, many of the factors that have influenced how mining companies should look, feel, and act in the past have shifted in recent years. Read it on page 14.

Amid our global energy transition, corporations and governments are conscientiously building pathways to decarbonise our energy sources. These efforts hinge on how readily we embrace renewable energy sources, yet even renewable-based technologies require a massive input of materials, including metals and minerals. Page 36 discusses why innovation in the mining sector is critical for the energy transition.

The March issue features Smart Buildings, and the deadline is 20 February. Please send your paper/article to: minx@saiee.org.za.

Herewith the February issue; enjoy the read!

PS: Book now for the SAIEE Annual Awards taking place on the 10th of March 2023. See advert on the next page.

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INDUSTRYAFFAIRS

Discussion with SAIEE Council on the current load shedding issues in South Africa

By: Prince Moyo, SAIEE President

Mr Jan Oberholzer
GCOO Eskom

SAIEE Council Members

SAIEE Council Members

Mr Pascal Motsoasele
SAIEE Senior Vice President

The electricity grid has been struggling for over a decade to consistently match demand and supply. This situation has become worse in the last few years and is projected to worsen. Our members might wonder, what has SAIEE done to understand the reasons and thereby assist?

SAIEE has been actively engaging the Eskom leadership on these challenges. This started with the SAIEE Council meeting of 01 July 2022, where a resolution was taken to nominate a delegation to meet with the Eskom Group Chief Executive, Mr Andre de Ruyter. The SAIEE CEO was accompanied by two past presidents and the Deputy President. A letter outlining the Council's concerns about Eskom was despatched by the CEO, outlining specific questions to be addressed, which were:

- In Eskom's view, what are the causes of the recent increase in loadshedding (stages 2-6)?
- What plans does Eskom have to reverse loadshedding in the immediate term?
- What is the outlook of supply adequacy in the short-term (0-3

years), medium-term (3-10 years) and long-term (beyond 2032)?

A meeting date of 17 August 2022 was agreed upon which took place in Megawatt Park, wherein the SAIEE delegation met the Eskom GCEO and his delegation consisting of the GCOO, Generation, Transmission, Distribution and Stakeholder Management Group Executives.

The meeting proceeded with the purpose being emphasized that the SAIEE's focus was on building relationships towards making a professional contribution in addressing challenges of the day.

The Eskom GCEO shared the context of the present-day challenges. He further expanded that Eskom is busy with a skills audit at each of the power stations and will shortly communicate with SAIEE on its findings from the audit and will call for an SAIEE-facilitated response from its membership to provide the required input to address the identified skills gaps. His aspiration being towards formal, remunerated contracting with each of the skills providers with defined terms and conditions, performance and sustainability linked. The participants' task would also include skills transfer.

Discussions were held around Eskom's reliability-based maintenance program. It was agreed that Eskom would arrange a workshop wherein the challenges would be discussed between the parties, so that whatever information is shared on the program would be understood in the correct context.

Individual unit and power station performance was provided in detail to paint the picture of the current problems experienced.

Subsequent to the meeting, Eskom indeed issued a crowdsourcing call in September 2022 and the SAIEE responded by repeating the call to its members through all its social media platforms. Once again the SAIEE would like to encourage all that have the relevant skills and experience to make themselves available directly via that portal (Candidate - CrowdSource (eskom.co.za)).

In November 2022, a letter was dispatched from the SAIEE to the Eskom GCOO, requesting him to present and elaborate, to the SAIEE Council, issues that currently plague the Eskom generation fleet, to Eskom's plans for new generation (nuclear and gas) and energy storage (hydro, thermal and batteries). The GCOO responded positively, and a date of 13 January 2023 was agreed on. The GCOO met a group of Council members attending physically (17) and remotely (6) and made an in-depth, honest presentation on the current crisis plaguing Eskom, these being:

- Old infrastructure,
- Human capital,
- Debt and
- Fraud & corruption

The Eskom GCOO likened the generating units to vehicles which have been in service for a while and were ageing, which therefore cannot be driven at full capacity. Eskom was not allowed to utilise OEMs to service these machines but had to issue open tenders. These OEMs have since scaled down and face skills ramp-up issues themselves. He iterated repeatedly that Eskom was a policy implementer, not policy maker – and highlighted the importance of SAIEE's contributing meaningfully to policy making.

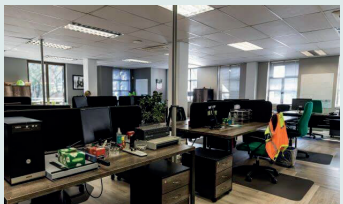
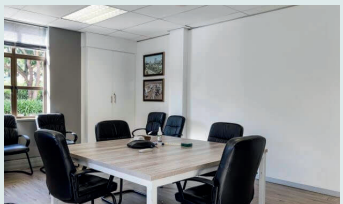
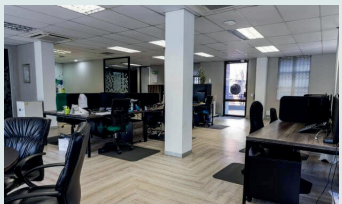
From the discussions with Council members, the GCOO promised to look into several points, amongst which were improving Eskom's communication strategy in order to improve the public's awareness of the situation and managing expectations.

SAIEE looks forward to further engagements with Eskom in an open and transparent manner that we have witnessed so far. We will continue to address the questions that we have posed in our letters to Eskom, while involving the general SAIEE membership as far as is possible.

I would like to personally thank Past Presidents Andries Mthethwa and Pat Naidoo, Deputy President Jan de Kock and the CEO, Mr Leanetse Matutoane. This is an engagement that promises to be long and hard but eventually fruitful. wn

Shared Office Space Available

SDE has several fully serviced plug-and-play workstations available in a beautifully landscaped park in the easily accessible Woodlands Office Park Woodmead, with ample parking available and is 100% generator supported, so no-load shedding. The office space will suit a small but growing Engineering consultancy in HV electrical or mechanical engineering. The space is fully furnished with reception, boardroom, Teams meeting cubicles, pause/coffee area, and kitchen. The lease will be a sub-lease to SDE with flexible lease options. For further information and an appointment for viewing, please get in touch with Kim Drewnicki at +27 78 550 3209, Email KimD@sde.co.za, or Wayne Fisher +27 82 318 8446 | Email waynef@sde.co.za


INDUSTRY AFFAIRS

Longer travel time on mines requires a more flexible approach to working hours

As South African mines get older, employers may have to adjust shift systems to ensure maximum productivity while avoiding contravening the Basic Conditions of Employment Act (BCEA) and other regulations.

Travel time to and from change houses (on mines) to the workplace has increased significantly, especially down ever-deepening mineshafts, with some employees travelling approximately three hours per day before starting to work.

The regulation of working time is one of the oldest concerns in labour legislation. Working hours are regulated by the BCEA, which does not cater for practical circumstances and arrangements faced by the mining industry. For example, the BCEA does not provide for and/or regulate travelling time to and from one's place of work. Ordinarily, travelling to and from work is not considered in measuring working hours for purposes of the BCEA. However, industry-specific directives inform how the provisions in the BCEA apply to the mining sector. Mine Health and Safety regulations provide that no employee may work in or at a mine for more than 48 hours in any consecutive seven days, excluding the time taken in getting to and from the place where the work is performed. The exclusion of travel time is qualified by these regulations in that any travel in excess of 60 minutes to reach the employee's place of work is included in the employee's working hours.

Employees work greater hours of overtime (overtime too, still being subject to BCEA limitations) to meet production and mine viability metrics to counteract the loss of production occasioned by inter alia increased travel time to the workplace. Employers facing this sector-specific challenge should carefully analyse the time it takes their employees to get to the workplace, especially when once at work it still takes employees a long time to reach their places of work. Employers should monitor whether travel or preparation is intimately linked with the job an employee is required to do, for the purposes of calculating and complying with the ordinary hours of work to be performed by employees. In this regard, employers may elect to reconfigure shift systems to lessen the number of days employees are required to work in order to increase their daily hours of work with the effect of extending face time and still remaining within the confines of the law.

The most effective legal mechanism to make provision for extended working hours is, in our view, for employers to: (1) conclude collective agreements with labour in respect of clearly delineating the calculation of working time and/or (2) to apply to the Minister for an exemption from various sections of the BCEA in respect of working hours. These options, however, are still confined to the limitations placed on the parties by the BCEA. wn

Automatic Purge System for Power Stations

INSTROTECH designed the successful Acoustic Steam Leak Detection Systems (Inspecta ASLD) and has now developed a fully automatic purging system that's easily retrofitted to existing Inspecta installations. The installation of this system eliminates routine manual purging of the pipe-sets and maintains the leak detection system at peak performance, without manual intervention.

Installed in most ESKOM power stations, Inspecta ASLD systems use acoustic detection technology that detects tube leaks less than 2mm in diameter in the large boiler structure. The coal used by ESKOM is very high in ash content, so there is a considerable amount of fly ash remaining after combustion. This fly ash swirls inside the boiler and quickly blocks the 'listening' pipe-sets that contain the sensitive leak-detection microphones. Unless the systems are frequently manually or automatically cleaned their ability to detect the leaks early, is significantly degraded. For more info, contact sales@instrotech.co.za or visit www.instrotech.co.za wn

Just Energy Transition demands risk mitigation approach for mining communities

Mining companies can put various risk mitigation measures in place to smooth the Just Energy Transition in South Africa, which will be especially felt by communities

In June 2022, South Africa adopted the Just Energy Transition Framework (JETF). In November, it adopted the Just Energy Transition Investment Plan (JETIP). Both of these followed the Just Energy Transition Partnership forged at COP26 between South Africa, France, Germany, the UK, the US and the European Union (forming the International Partners Group [IPG]).

Like many other countries, South Africa is clearly looking to transition from a primarily fossil-fuelled economy to one that is driven by renewable forms of energy, and it is publicly committing itself to this goal. It is inevitable that local communities at best demand and at worst protest to ensure they enjoy a piece of the pie, regardless of how sweet it may or may not be.

It is therefore regrettable that the Minister was silent in his speech opening Mining Indaba 2023 on such an important aspect, having regard to the statistics mentioned below.

According to the Department of Mineral Resources and Energy (DMRE), South Africa relies on coal to generate 92% of its electricity and to produce roughly 20% of its liquid fuels. As a result, Eskom and another large chemical firm together account for more than 50% of South Africa's greenhouse gas emissions and 85% of the coal used in the local market by volume.

The DMRE states that many of the country's coal deposits can be exploited at extremely favourable costs and South Africa is the fourth largest exporter of coal in the world. It goes without saying that a transition from fossil-fuel to renewable energy will be uncomfortable, and this may be felt more acutely at local community level.

Clearly, the demand for energy is steadily increasing. The JETF inter alia requests business and more specifically mining companies to embed ESG in all levels and operations, ensure board oversight of ESG, implement their SLPs and make adequate provisions for end of life mine rehabilitation. The JETIP inter alia on the other hand note the concept of special ownership of renewable energy production assets with community trusts at the forefront.

Thinking ahead means solving the problems which the solution may pose over and above the now imperative ESG compliance. The solutions below to mitigate litigation risk can be applied across the board by those thinking not just about tomorrow but the day after:

- ensure strict and progressive compliance with all ESG standards, including the JETF and JETIP (most importantly implementation and reporting);
- ensure the highest possible levels of both community engagement and participation in all just transition efforts;
- ensure that the structures through which community engagement and participation take place adhere to the objects for which they were created as well as the broad principles of good governance; and
- ensure that legal counsel is accessible when needed. wn

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Capacity building of EPC Practitioners for KwaZulu-Natal

During the launch of the EPC Practitioner Skills Programme in KwaZulu-Natal at the Durban University of Technology Steve Biko Campus, CEO of the Energy-Water SETA (EWSETA), Ms Mpho Mookapele, had a powerful message during her welcoming address relating to Environmental, Social, and Governance (ESG) in Africa, and emphasised finding solutions to some of the common challenges faced in embedding ESG practices in all aspects of Energy Efficiency.

Expressing her excitement for what the EPC Practitioner Skills Programme can bring for the youth in their development journey, but also in their new roles as interns in the workplace, she added, "Look beyond auditing and identify opportunities for you to become a solution creator", Ms Mookapele said.
The welcoming address was followed by Prof. Prathaban Moodley, General Manager for Applied Energy R&D and Innovation at the South African National Energy Development Institute (SANEDI), explaining the importance of all interventions to save us from the current energy crisis. He highlighted various opportunities in the Energy space. He said, "It's an incredible opportunity for KZN students as this program fits into the demand side to start helping solve the energy crisis."

The Energy Performance Certificate (EPC) Practitioner is an individual who assesses a building facility to compile and collect data and information required for verification towards an Energy Performance Certificate (EPC) for buildings. This is in terms of the EPC Regulation signed into effect in December 2020, and effective for compliance in December 2025 after the initial 2022 deadline was extended by the Minister of Minerals Resources and Energy (DMRE) in terms of Act number 34 of 1998.

South African building owners are required by law to submit their building data for the National Building Energy Performance Register (NBEPR) and display an EPC in the foyer of the building. This must be done through a South African National Accreditation System (SANAS) EPC Inspection Body following the EPC Regulation requirements and the relevant standards.

With the necessary skills available, the DMRE can strive to meet the goals set by implementing EPCs. The South African National Energy Development Institute (SANEDI) – the body responsible for the NBEPR, in partnership with the Institute of Energy Professionals Africa NPC (IEPA), undertook a Skills Programme in the Quality Council for Trades and Occupations (QCTO) registered EPC Practitioner qualification code SP220323 at the beginning of 2022 to develop skills to meet the requirements of the EPC Regulation. IEPA is a QCTO Skills Development Provider (SDP) and was the Development Quality Partner (DQP) for the EPC Skills Programme together with a Steering Committee.

There are currently 8 SANAS accredited EPC Inspection Bodies, with a total of 17 Technical Signatories and over 40 EPC Practitioners who are ready to serve the building owners and assist with getting buildings ready for inspection or inspecting and issuing EPCs for you. In addition, a lot of training is available, including registered qualifications. Many building owners are already

EPC Launch event with the partners: Energy Water SETA, South African National Energy Development Institute (SANEDI), Durban University of Technology (DUT), Thekwini TVET College, Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ), the Institute of Energy Professionals Africa NPC (IEPA) and the KZN EPC Practitioner Skills Programme Interns

using these platforms to upskill their building managers, facilities managers, electricians, and other staff members to get their buildings ready for EPC Inspection Bodies to issue their EPCs.

There are many ways to approach this as a building owner or use the skills already available to you part-time through the programs developed.

The students form part of Cohort 2 of the scheme's pilot and will commence their practical modules at the Durban University of Technology (DUT) Steve Biko campus Library.

The Institute of Energy Professionals Africa will assist the Thekwini TVET College Central Office, Melbourne and Springfield Campuses' to establish the EPC Practitioner Skills Programme as part of their QCTO Accredited Qualifications.

It is amazing to see these partnerships come into effect to not only focus on job creation but also to secure future skills and expertise for the growth of the Energy Industry. wn

Free-To-Use Electricity Smart Meter Software Pilots in SA

Streamlining processes across the board between municipalities and end-users, Access Energy is a freely licensed software solution that reads smart meters, stores the meter data in a meter data sharing system, and delivers that data to municipalities. The software then allows the municipality to create and load their electricity tariffs and then apply them to a bill. It's been hailed as a game-changer for municipalities wanting to integrate renewable energy resources into their grid.

George Municipality is the first electricity provider in the country to pilot this freely licensed software that automates the reading, processing, and billing of electricity smart meter data.

"The need for this freely licensed software pilot became evident when we considered the scaling of wheeling and renewable energy on the George Municipality's electricity grid." says Mr Bongani Mandla, the director of electrotechnical services at George Municipality. "The manual billing process was one the main challenges, and resolving this meant reducing reliance and pressure on key human resources, reducing potential errors that could occur in the billing process. Engagement with Open Access Energy on showcasing their software that they license for free, has assisted in addressing the challenge for us and we are now piloting the automation of our metering and billing services." continued Mandla.

Wheeling is the delivery of electricity generated by a private operator in one location to a buyer or off-taker in another location via a third-party network (Utility or Municipality).

Mr Bongani Mandla highlighted that the current George Municipality wheeling pilot consists of trade between one generator and four off-takers through Enpower Trading (a NERSA licensed Energy Trader) and this entire process has now been automated using Open Access Energy's software. The Municipality is working on further improvements to its wheeling projects and to incentivise the private sector (both generators and off-takers) to participate in this program. These include creating a platform for customers to view their accounts and access their consumption and billing data in real-time, forming various committees to expedite the process of standardising the use-of-system contracts as well as moving from the 30-minute reconciliation to a Time-of-Use reconciliation.

James Beatty, Chief-Executive-Officer of Enpower Trading (NERSA licensed energy trader), said they obtained a use-of-system agreement at George Municipality and looked at ways to automate the wheeling pilot.

According to Gerjo Hoffman, Chief-Executive-Officer and co-founder of Open Access Energy, the developers of Access Energy, the software company aims to boost the use of renewable energy by simplifying wheeling.

"Our products aim to automate wheeling and serve the needs of anyone that wants to wheel energy. Our initial focus is South Africa, but our future aspiration is to offer solutions in all emerging markets globally," says Hoffman.

Open Access Energy currently has two products in the market. Access Energy

From left are Gerjo Hoffman, CEO and co-founder of Open Access Energy; Bongani Mandla, Director of Electrotechnical Services; Nicholas Rixon, COO of Open Access Energy; and Louise Botha, George Municipality Electrotechnical Services.

is a freely licensed software solution that reads smart meters, stores the meter data in a meter data sharing system, and exposes that data to municipalities. The software allows the Municipality to create and load their electricity tariffs and then apply them to a bill. The final bill is sent to the municipalities Enterprise Resource Planning (ERP) system, which then sends the bill to the end customer. Customers, however, do not have to wait until the end of the month to view their accounts and can access and view their consumption and billing data in real time. The sharing of this meter data to the customer by Access Energy is made possible through its implementation of the Eskom sanctioned NRS049 5-2 protocol.

"When we started looking at how we can enable the wheeling market, we realised that many municipalities and metros don't have access to sufficient software to allow these transactions. Municipalities have to go through tedious tender and procurement processes, so we decided to license our software for free to local municipalities and state-owned entities." continues Hoffman.

Open Access Energy's second product is called EnergyPro. This Software as a Service (SaaS) solution focuses on IPPs and Energy traders and assists wheelers to wheel to multiple customers.

"Our clients are renewable energy producers and energy traders who want to sell their energy to customers all over South Africa", concludes Hoffman.

Hoffman says they will be approaching more municipalities and hope to assist local municipalities by enabling them to offer renewable energy to their customers and alleviate the challenge of load shedding in South Africa.

To find out more about how Open Access Energy is helping enable wheeling in South Africa, visit us at www.openaccess.energy. wn

TRACKING THE TRENDS 2022:

Redefining mining

What will successful mining and metals companies look like in a low-carbon, low-waste, purpose-driven future?

The beauty of this question is that there is no definitive answer. While the core objective of the mining industry remains unchanged going forward: to extract and provide metals and minerals to downstream sectors, many of the factors that have influenced how mining companies should look, feel, and act in the past have shifted in recent years.

How companies fulfil this mission is now open to interpretation. And today, there is a rare opportunity for leaders to reorganise, generate new value, and forge partnerships to create a more responsible and attractive future for the industry.

While some early movers saw the need for change coming 10, 15, or even 20 years ago and have been redefining their organisations and operations accordingly, for many firms, the necessity for fundamental change only hit home in 2020-21. The convergence of factors, including the ongoing effects of the COVID-19 pandemic on the world of work, the continued drive towards digitisation, the growing need to integrate ESG commitments with central business functions, and the need to pivot in response to fast-moving business and operating environments, has opened many choices for companies.

Of course, the biggest underlying driver and opportunity for transformation lies in the green energy transition.

The 2021 United Nations Climate Change Conference (COP26), held in Glasgow in November, highlighted the mining industry's integral role in supplying the metals and materials critical for a low-carbon future. How mining companies position themselves today in preparation for this change will determine their sustainability and could make or break their competitive advantage over the next decade.

Change on this scale is undoubtedly daunting, which is why in this, its 14th year, Tracking the trends has focused on effecting transformation. The following ten trends provide a toolkit to help mining companies start thinking through, and moving towards, their vision of future success.

We explore how to evolve traditional mining and metals businesses through new business models, capital allocation, agile work practices, and data-driven technologies to create organisations fit for the 21st century, ones that can not only survive but profit from whatever the future might throw at them and leave a positive social impact in their wake.

The next decade will be one of the most exciting and transformative in the mining industry's history. We look forward to discussing the trends with you and supporting your company on its journey. Thank you for your ongoing support.

TREND 1
ALIGNING CAPITAL ALLOCATION TO ESG

CREATING AN ADVANTAGED PORTFOLIO WITH AN ESG LENS

The race to cut Scope 1, 2 and 3 emissions in mining has well and truly begun. Over the past five years, several miners have set themselves ambitious decarbonisation targets. For them, the challenge now lies in determining the best way to move from intent to reality.

The approach organisations use to prioritise and operationalise different projects and allocate capital spend across their assets could make or break their competitive advantage over the next decade. Many are, understandably, proceeding with caution.

While the global majors weigh up their next move, the mid-market is playing catch-up. Many mid-market players are only now laying out their net-zero targets and planning the steps these will require both in the short and long term. Their journeys will need to be faster than those of their predecessors to keep pace with fast-moving expectations around environmental, social, and governance (ESG) from stakeholders and markets.

While much of the focus today is on climate change and decarbonisation, companies will increasingly need to think holistically and ensure their capital-allocation decisions reflect their ESG commitments. Building a portfolio of businesses, initiatives, and projects that are collectively strategically sound, value-creating, resilient, and sustainable will minimise risk in the face of significant future uncertainty and boost the aggregate value of a company's holdings over time.

USE AN ESG LENS FOR SMART CAPITAL ALLOCATION

Numerous frameworks are designed to help executive management teams build and sustain an optimal corporate portfolio. The Sustainably Advantaged Portfolio framework is simple yet effective. Creating an advantaged sustainable portfolio involves a range of initiatives spanning four broad

categories of investments detailed in figure 1:

1. Investments that help create a strategically sound portfolio that is competitively positioned, has the right balance of innovation and leverages synergies within the portfolio.
2. Investments that create value through maximising intrinsic value address any gap concerning the market value and establish whether the company is the right owner for an asset in the long term.
3. Investments that make the organisation more resilient by balancing feasibility and risk, building optionality and ensuring the organisation's survival through different scenarios.
4. Investments that make the organisation more sustainable through creating social, environmental, and economic value.

"The aim is to build a portfolio of assets which not only provide a financial return but consider a broader set of dimensions," says Andrew Swart—Global Mining & Metals Leader, Deloitte Touche Tohmatsu Limited. "The portfolio approach is important because not all investment opportunities will deliver all types of value. Each asset or project will play a different role to create a balance that informs effective capital allocation."

As companies move beyond pure metrics reporting to making ESG an integral part of their strategies, a key differentiator will be the narrative they build for investors around their portfolio and how they are positioning their assets for the long term. With time, we could see the emergence of different portfolio themes, some of which are explored below.

THEME 1: THE ECONOMIC DECARBONISATION PORTFOLIO

Today, many energy-management-related projects have clear economic returns thanks to the advancement of technology, scale effects of production, and investments made in research and development (R&D) by equipment manufacturers and the industry itself.

With energy accounting for approximately 25-30% of direct operating costs, two companies could prioritise this lever (primarily focused on Scope 1 and 2 emissions) to enhance their asset competitiveness and free up cash flow. Some firms may also invest small amounts in longer-term innovation initiatives to secure a lower long-term energy footprint.

Through the lens of mergers and acquisitions, companies may prioritise assets in geographies where renewable energy forms a significant portion of the baseload or alternatively invest in their own renewable power capacity. These will be key to creating a competitive advantage and driving value creation.

These portfolios and investments must also be resilient across various commodity and carbon price regimes and regulatory changes. For example, today, we see legislation being

Source: Monitor Deloitte Creating a Sustainably Advantaged Portfolio, 2021

Figure 1: Sustainable advantaged portfolio attributes

An ideal portfolio evaluation framework will consist of multiple tests that assess the four main qualities of a sustainably advantaged portfolio.

considered in Mexico that could potentially limit the self-generation of power. These types of scenarios would need to be contemplated.

Finally, on the ESG side, companies might prioritise initiatives that address compliance requirements set out by local authorities and metrics that traditional investors require.

THEME 2: THE VALUE BEYOND COMPLIANCE PORTFOLIO

Under this theme, some companies may push the boundaries beyond an immediate focus on energy, making investments to rethink greenfield projects and create fully electric mines with a step-change in emissions and performance. Others might look not just at projects which meet traditional return-on-investment (ROI) metrics but perhaps those with lower metrics which help the company toward its wider net-zero commitments.

This portfolio might also contemplate a different asset mix, reducing exposure to commodities that are overweight in carbon emissions on a per-ton basis. It would look at the portfolio through the lens of a potential ESG investor and consider what they might want to include in an index.

Andrew Lane—Energy, Resources & Industrials leader, Deloitte Africa, explains, "Beyond energy, it's likely that some companies will ramp up their community and stakeholder investments. Often, these struggle for equitable assessment through traditional capital allocation metrics. Still, some companies are developing methods to quantify these investments, particularly if they help de-risk assets and create deeper buy-in from communities."

These portfolios might also look beyond cost savings and contemplate investments that build greater climate-change resilience. These could include mechanisms to address the impact of drought or flooding in different regions or those that look at the disruption of supply chain and logistics routes due to climate change.

In essence, a portfolio like this would go beyond compliance requirements to create a deeper connection with stakeholders and position the organisation for the future.

THEME 3: THE DISRUPTIVE SUSTAINABLE PORTFOLIO

Under this theme, mining companies may take the opportunity to rethink how demand for green and critical minerals could generate a competitive advantage going forward. In this instance, companies could diversify parts of their portfolio to include these commodities, as Australian miner South recently did with copper.

In October 2021, the company announced it would spend US$2.05 billion to purchase a 45% stake in the Sierra Gorda mine in northern Chile from Sumitomo Metal Mining Co.

There is also the potential for scrutiny of Scope 3 emissions to disrupt the value chain, generating new alliances, vertical integration, and greater transparency both up and downstream. Examples include the US$10 million investment made by Rio Tinto with China Baowu Steel in December 2020 to establish a Low Carbon Raw Materials Preparation R&D Centre which will develop low-carbon ore preparation processes.

Companies could also increase their focus on the circular economy and opportunities around urban farming to retrieve minerals through recycling. For example, Swedish miner Boliden is one of Europe's largest recyclers of used lead-acid batteries and electronic waste. The company opened a new SEK750 million (approximately US$83 million) leaching plant at its Rönnskär facility in September 2021 to boost the recovery of lead, copper and zinc from residual material and cut the amount of waste it deposits underground by 80%. Investments such as these reflect a growing belief that traditional mining models might need to evolve in the long term.

Under this theme, companies would focus on the evolution of ESG expectations, the potential for non-traditional players to enter the value chain or the speed at which technologies such as hydrogen, carbon capture and storage (CCS) and robotics might achieve widespread adoption. All of these changes would also need to be examined from the point of view of sustainability while also evaluating collaborative models, new ways to create social value, and rebuilding trust.

None of these portfolio themes are mutually exclusive, and we have purposefully pulled them apart to create a contrast. In reality, a final portfolio will have a mix of these elements depending on the longer-term vision of organisations and their inherent risk appetite.

The message is that companies need to factor ESG more explicitly into their capital-allocation frameworks and use that to define the contours of their portfolios today and in the future.

CREATE YOUR OWN SUSTAINABLY ADVANTAGED PORTFOLIO

- Build a company focused on purpose: Most mining companies have visions and missions, but very few have looked beyond these to an underlying purpose that resonates with communities, employees and other stakeholders.

- Consider investor-base evolution: The recognition of mining as a key part of the energy transition will, in time, bring new investors into the market, particularly for those companies with strong, sustainable track records. Think about how that investor base could potentially evolve.
- Develop plausible scenarios: When setting a decarbonisation strategy, don't fall into the trap of focusing only on immediate returns. An investment that commands a small portion of an overall capital-allocation portfolio today could generate significant dividends ten years down the line and, therefore, is strategically important today.
- Think outside of the sustainability box: ESG or decarbonisation decisions can add value to any of the four categories from the Sustainably Advantaged Portfolio framework; they are not purely sustainability investments. Many miners are using them to create new business models while driving down their cost curves and mitigating energy risk. Think strategically, and don't limit thinking by only considering historically successful business models.

TREND 2
RESHAPING TRADITIONAL VALUE CHAINS

LAYING THE FOUNDATIONS FOR A LOW-CARBON FUTURE

As the green-energy transition gets underway, calls for greater responsibility and transparency in metals, supply are reshaping value chains, realigning portfolios, and spurring new business models.

While the changing needs of consumers, suppliers, and investors are partly responsible for this disruption, a projected shortfall in the supply of green and critical minerals is also at play.

The industry must demonstrate that it's responsible enough to produce the vast quantity of metals required for a low-carbon future. The challenge lies in using the climate-change commitments that organisations have made and the commodities or services they provide to tell the story of growing, profitable, and sustainable enterprises that positively contribute to societal and environmental needs.

For some companies, this might mean a portfolio restructure – perhaps selling off certain assets and reinvesting the returns into existing assets or critical minerals ventures – or refocusing the businesses they have to deliver better value or even balancing them with new businesses that offer different types of value.

As we advance, mining and metals companies should also consider the impact of their operations and products across the value chain and how that will change with the transition from linear to circular pathways. Successfully incorporating circular initiatives like metals reprocessing, recycling or urban mining into their portfolios may require mining companies to build new capabilities and skills that differ from their current business models. A key question will be how much value investors attribute to that change.

We see traditional value chains being reshaped in interesting ways, including how portfolios are restructured, the types of new alliances being struck, new entrants coming into the value chain, and new circular business models being created.

REALIGNING PORTFOLIOS

Under pressure from investors to exit high-carbon commodities, mining companies continue to review their portfolios, carving out commodities such as oil, thermal coal, and metallurgical coal assets. This will have the net effect of repositioning these corporate portfolios.

Andrew Lane—Energy, Resources & Industrials Leader, Deloitte Africa, explains, "Take BHP as an example; the company is divesting its oil and gas business and realigning as a mining major focused on the energy transition. I can see more mining companies heading in this direction in the future. We're also starting to see spill-over between the mining and energy sectors. For example, some of our oil and gas clients provide decarbonisation solutions for mining."

While public companies shed some of their assets, the underlying demand for these commodities will remain for some time. In the interim, private capital and family office money will continue flowing into higher-carbon assets, although this may not lead to the desired outcome of a greener economy. For example, while new hydrogen technology is being developed to displace metallurgical coal in steel production, it may be prohibitively expensive without large government incentives to convert the majority of blast furnaces to hydrogen.

Demand for critical minerals, particularly rare-earth elements, is also driving some miners to add commodities to their portfolios. For instance, Rio Tinto has recently added scandium and tellurium to its portfolio. We should expect further moves in this direction as public mining companies realign themselves with the transition to green energy.

NEW ALLIANCES

Scope 3 emissions reporting will also inform a key set of choices for mining companies in terms of who their customers and suppliers are. While companies may not forward-integrate in the value chain, they are likely to create more strategic alliances to lower the value chain's overall carbon footprint.

The agreement between BHP and South Korea's POSCO in October 2021 to jointly develop steel- decarbonisation technologies is a good example. The memorandum of understanding (MoU) follows BHP's earlier agreements with China Baowu Steel, JFE Steel and HBIS Group to explore emissions reduction from steelmaking. Combined, the output of these four steel companies equates to around 12% of reported
global production.

John O'Brien—Partner, Financial Advisory, Deloitte Australia, adds, "The alliances and partnerships that mining companies strike now with specialist re-processors will set them apart in the future. For tier one miners, the challenge will lie in redefining how they partner with customers and suppliers to achieve different outcomes to those of today."

Another parallel seen between mining and energy in recent years is a tilt toward the customer; as interest in metals provenance grows, there is an opportunity to move from a push to a pull supply mentality. Placing greater focus on the customer's needs could help mining companies achieve a premium for responsibly-produced metals which, if reinvested correctly, will help to decarbonise mining operations further and accelerate value-chain transformation.

More likely in the short term is a drive-by downstream company, such as automakers, to lock up the supply of minerals required for the energy transition—again, either buying into the base resource itself or creating strategic alliances across the value chain. An example is the recent agreement between Tesla and Prony Resources to secure a multi-year nickel-supply agreement for electric-vehicle battery production.

NEW ENTRANTS INTO THE MINING VALUE CHAIN

The drive for green and critical minerals also attracts companies outside the traditional mining environment. Lithium is key in powering electric batteries, and this appeals to companies like Albemarle, a speciality chemicals producer, which has focused on Lithium production for many years and more recently acquired a 60% stake in the Wodgina lithium mine in 2019, and American Battery Technology Company that is creating an extraction and recycling business based around lithium.

In other commodities, we have seen new players. For example, technology company Jetti Resources is extracting copper from low-grade primary sulfides. This has drawn the interest of miners such as BHP and Freeport McMoRan, who have invested in the company.

These plays represent new entrants into the traditional 'explore– extract–process' value chain of mining, and more companies will likely enter the market to support the energy transition.

MOVING BEYOND COMMODITIES

While new entrants look to explore opportunities in the traditional value chain, some existing miners are keen to invest in new businesses and sources of growth. For example, Fortescue Metals Group has created a new business called Fortescue Future Industries which will supply renewable energy, green hydrogen, and green ammonia for Fortescue operations—all central levers to its own decarbonisation journey.

The company has also announced a green hydrogen investment of up to US$8.4 billion into Argentina.

But mining companies also have their eye on the circular economy. According to the World Business Council for Sustainable Development, the circular economy represents a US$4.5 trillion opportunity for global economic growth by 2030. Many mining companies already undertake a certain level of mineral and/or metal processing within their operations. Extending that interest to reprocessing will allow organisations to become less dependent upon the primary extraction of finite resources and redefine their corporate purpose.

For example, Glencore has recycled more than one million tons of electronic scrap since the 1990s and announced in October 2021 that it is looking to build an electronics-recycling business in the UK. This form of 'urban farming' uses significantly less energy than mining and smelting primary metal—around 80-90% less for copper—and addresses a key shortfall in the supply of certain critical minerals.

In short, the focus on ESG and the opportunity around the circular economy is reshaping the traditional mining value chain and business models in new and interesting ways.

REIMAGINING MINING VALUE CHAINS

- Position your portfolio: The composition of a company's portfolio is one of the strongest indicators to the investment community around the firm's positioning. Miners could use the Sustainably Advantaged Portfolio framework detailed in Trend one to explore synergies and value-creating opportunities based on their current portfolio and future investments, particularly those surrounding environmental and social governance (ESG).
- Look for loops: Explore opportunities to build circular loops into current production processes and design out waste. Characterising fresh and historical mine wastes will enable potential new revenue streams to be

identified and reprocessed options evaluated. In certain instances, tailings can provide a source of residual metals and minerals ripe for secondary prospectivity. Approaches like this could provide a powerful narrative to the market.

- Collaborate for circular products: According to the Global e-waste Statistics Partnership, 53.6Mt of e-waste was generated globally in 2019, but only 17.4% was properly recycled. Part of the issue is that recycling processes are often developed retrospective of materials and, therefore, are either sub-optimal or large quantities of waste material have accumulated by the time they come into play. Mining companies should consider partnering with customers and others in their value chain to improve recycling processes for future materials. We should acknowledge that these businesses often require new capability sets relative to what miners have today. Collaborating to develop new products and materials that could replace metals in instances where supply might fall short could also reduce the risk of disruption.

TREND 3
OPERATING IN THE NEW SUPER-CYCLE

NAVIGATING THE POST-COVID REGULATORY AND TAX ENVIRONMENT

For the mining and metals industry, 2021 was defined by soaring commodity prices and the prospect of a new super-cycle.

Sustained demand for critical metals fueled by the transition to green energy caused several analysts to declare the start of a new super-cycle. In this period, commodity prices rise above their long-term trend for between 10 and 35 years. By June 2021, metal prices had risen 72% relative to their pre-pandemic levels, with many, such as aluminium, copper, iron ore and nickel, reaching multi-year highs in Q3.

This is good news for miners, although it is challenging. With cyclical highs come government demands a greater share of mineral wealth. As many countries began to recover from the recession following COVID-19, the mining industry saw a raft of regulatory measures proposed and imposed for the period from 2020 to 2021, as well as various forms of resource nationalism.

THE RISE OF RESOURCE NATIONALISM

Resource nationalism can take many forms—some obvious, others more subtle. Traditional measures range from the expropriation and nationalisation of strategic assets to states interjecting in operations by reviewing pre-agreed terms and implementing new forms of taxation.

The direct expropriation of the Kumtor gold mine in Kyrgyzstan from Canada-based Centerra Gold demonstrates how these measures can create significant operational risk and financial difficulties.

In September 2021, Centerra applied for urgent interim measures in its international arbitration against the government of the Kyrgyz Republic and shareholder Kyrgyzaltyn JSC, citing deviation from the approved mine plan in ways that could cause "irreversible damage".

According to Verisk Maplecroft's 2021 Political Risk Outlook, 34 countries, including key copper producers such as Zambia and the Democratic Republic of Congo, witnessed a significant increase in risk during 2020 due to resource nationalism.

The firm expects this threat to grow over the next 12 months, with the mining industry bearing the brunt of new measures as governments attempt to recuperate financial losses inflicted by the pandemic.

Roman Webber—Mining & Metals Leader, Deloitte North South Europe: UK, explains, "In the past, resource nationalism has mainly taken the form of direct or indirect expropriation of assets. This time, we see more sophisticated methods, and mineral taxation is one way that host governments want to exert more control or gain better resource returns."

He continues: "In many cases, the mining sector will be a key source of tax revenues for countries going forward. So, it's unsurprising that we've seen local governments, for example, Chile and Peru, looking to increase tax on these companies specifically."

In Chile, under a proposed bill, investors could face a tax burden of 82% in royalties and taxes on sales exceeding 12,000 tons annually of copper and 50,000 tons per year of lithium, up from 40.3%. Beyond changing tax regimes, we also see other forms of state intervention, such as that currently being debated in Mexico. There, the government is considering legislation limiting private participation in lithium production, but it could also be extended into other minerals key to the energy transition. Many of these issues are driven by concerns about the security of supply.

Decisions like these are often driven by politics rather than economics. The danger is that if the proposed tax rates are too high or legislation limits wider industry participation, they could potentially be counter-productive, lower long-term competitiveness, and limit mining activity in that region or country.
Valeria Vazquez—Mining & Metals, Deloitte Mexico, adds, "Fiscal measures enforced without proper industry

consultation could also impact mergers and acquisitions; one of the consequences of elevated risk ratings is that investors will lean toward safer jurisdictions which carry less risk of disruption."

FUTURE TAX REFORMS

An additional challenge is that the international tax system is currently under reform. The OECD estimates that domestic tax-base erosion and profit shifting (BEPS) practices cost countries US$100-240 billion in lost revenue each year (the equivalent to 4-10% of global corporate income-tax revenue). Developing countries that often rely more on corporate income tax are disproportionately affected by this.

In October 2021, using the OECD/G20 Inclusive Framework on BEPS, 136 countries and jurisdictions agreed to implement a two-pillar plan to tackle tax avoidance, improve the coherence of international tax rules, ensure a more transparent tax environment, and address the tax challenges arising from the digitalisation of the economy. The new minimum corporate tax rate of 15% applied to companies with revenue above EUR750 million (approximately US$873 million) is expected to generate around US$150 billion in additional global tax revenues annually.

Countries aim to sign a multilateral convention during 2022, with effective implementation in 2023, and mining companies must be ready for this.

As key players in the green-energy transition, mining and metals organisations must also have one eye on carbon taxes which could increase as countries look to incentivise decarbonisation. For example, the South African Carbon Tax, introduced in 2019, has proven weighty on mining companies. The first phase only applies to Scope 1 emitters, but the second phase, which is currently under review and will be implemented in 2023, will be more expansive and could include changes to rates and tax-free thresholds.

Vazquez adds: "I think we'll see more of these measures introduced as the energy transition accelerates. Over the next decade, there will be unpredictable and substantial changes in mineral taxation and/or regulation of assets. Mining and metals companies must prepare for and adapt to these as best they can."

BUILDING FLEXIBILITY AND RESILIENCE IN THE FACE OF REGULATORY UNCERTAINTY

- Seek partnerships and consultation with authorities: Many organisations' current relationship with governments and tax authorities is dictated by past experience, whether good or bad. Some companies actively seek to create an open and engaging dialogue with authorities, while, for others, a lack of trust is the defining factor in the relationship. Neither approach is right or wrong, but, as in so many matters, it is best to have a seat at the table, if not a voice, wherever possible. Being part of the consultation process for potential tax reforms brings predictability that will be useful in future strategy development. Greater transparency around tax planning and public disclosure will also help to build trust where it is lacking.
- Demonstrate value beyond tax: Companies should lean on their environmental, social, and governance (ESG) efforts to better explain their value to governments, not just through economic returns but also through environmental and social-impact initiatives.
- Increase organisational agility: Even when operating in jurisdictions that have relatively stable fiscal regimes, mining and metals companies need to factor a certain level of flexibility into their strategies so that they can adapt to and take advantage of changes in the political and economic environment.
- Embed the use of scenarios in strategic planning: Use long-range scenario planning tools to consider different regulatory regimes in the geographies in which you operate and plan for possible responses.
- Diversify portfolios and supply chains: Aim to spread investments across jurisdictions with a range of risk ratings to reduce overall exposure to risk.

TREND 4
EMBEDDING ESG INTO ORGANISATIONS

CREATING OPERATING MODELS TO SUPPORT ESG COMMITMENTS

Pressure on mining and metals companies is growing to reach beyond environmental compliance and make high-level commitments in the public domain around environmental, social, and governance (ESG) issues shaping the industry's future.

Although commitments to voluntary targets and standards around matters such as climate change or tailings management are usually set with the best intentions, companies will find it hard to make effective progress toward them without the proper internal structures. When asked by investors and rating agencies, they also risk failing to demonstrate how they honour those commitments from the boardroom to the mine site.

Research shows that this issue is fairly pervasive; the Responsible Mining Foundation's RMI Report 2020 assessed the policies and practices of 38 large-scale mining companies around the globe. While most companies mention the United Nations Sustainable

Development Goals (SDGs) in their sustainability reporting, a few have integrated them into their business strategies.

CREATE SENIOR-LEVEL ACCOUNTABILITY IN THE STRUCTURE

To move from pledge to action, mining and metals companies must be functionally set up to respond to and deal with ESG-related opportunities, challenges, and risks. At a practical level, this requires an operating model that facilitates visibility, accountability, a collaboration between departments, and a clear governance structure.

In many respects, ESG now represents a wider transformation of the business. A decade ago, the sustainability, or corporate social responsibility, agenda was overseen by a sustainability leader, either at the executive level or reporting to another senior decision-maker. However, with the rise of ESG, the implications are far more cross-cutting, expanding to cover areas such as investor relations, finance, human resources, operations, supply chain, communications, and corporate development.

Today, many organisations have large teams of people focused on environmental and safety issues, with a chief sustainability officer role (or similar) overseeing them.

This is a good start and will help ensure compliance with environmental-permit regulations. However, to move beyond this, operational teams should be properly connected to corporate strategic initiatives; they should understand that ESG commitments are steadfast, and there should be clarity on how they translate into business or operational processes within their specific function.

We are also seeing different models emerge. Where the sustainability function leads ESG initiatives, it's important that this function is elevated to have sufficient corporate representation at the executive level, i.e., a vice president or executive vice president of sustainability role might be required in the case of large or multinational companies.

In other cases, we have seen executive roles, such as the chief financial officer (CFO), taking responsibility for the ESG agenda, particularly as they need to face off with investors and market analysts. In many ways, it doesn't matter who leads the effort as long as integration takes place across the organisation and the individual in question has sufficient organisational authority.

Henry Stoch—Sustainability Leader, Deloitte Canada, says, "There's a more sophisticated expectation now from external stakeholders, particularly large institutional investors, around ESG. Many are asking complex questions and are keen to understand how companies integrate targets around issues such as climate change or diversity, equity and inclusion (DEI) throughout their organisations."

He goes on to explain: "If organisational structures are not yet designed for a high level of collaboration and interaction between certain departments and business units, then companies are going to struggle to demonstrate how these issues form part of their strategic planning, or budgeting and forecasting processes, for instance."

DESIGN PROCESSES FOR TRANSPARENT INFORMATION FLOW

For ESG commitments to be properly met at the operational level, information must be able to flow freely up and down the organisational structure rather than through neural pathways. Leaders must be able to look into the business and check that the commitments they have made public are being understood and reflected in practices below them.

Likewise, information must flow back up from operational teams through risk registers, internal audits, operational plans, and capital commitments that show whether teams are on track with the commitment. Digital transformation will go some way toward this, making timely, critical information transparent and available on demand.

The danger is that if companies don't implement and test these structures and processes, and they cannot answer stakeholders' questions or, worse still, if a failure in governance occurs, they could lose an important source of capital or be accused of greenwashing.

The latter isn't just damaging to an individual company's reputation but to the industry as a whole. Creating accessible engagement structures to discuss plans and progress with key stakeholders can foster a more cohesive and responsive approach.

This is why ESG needs to be incorporated into a broader corporate strategy, enterprise risk management (ERM), and performance-management systems. Using past examples of tailings dams or social failures, it's now possible to quantify the financial and non-financial impacts of not having the appropriate operating model in place.

Leading companies are starting to question traditional ERM approaches and are developing their language and thinking to reflect this.

EMBED ESG INTO ROLES AND INCENTIVES

As ESG starts to be reflected in corporate strategy, it should also be reflected in the functional strategies

and plans of the organisation and within each function's roles. Every function across the organisation has a part to play in delivering the overall ESG strategy, whether that is operations, finance, human resources, or any other key corporate role.

Harsha Desai, Associate Director, Consulting, Deloitte Africa, says: "This is an opportunity to make the day-to-day choices in the business very personal for people, so they are empowered to make many little or large shifts that directly affect their community.

Whether this is water consumption at the operations or working with local vocational training institutions to bring more females into the workforce." With time, these elements will become embedded in role profiles, development plans, and performance systems.

Like many organisational transformations, ESG will require people to change their behaviours, and how people are incentivised will be a significant driver. Individual and functional incentives should therefore reflect the wider ESG agenda so that companies can create the required level of accountability.

DESIGNING AND TESTING ESG-DRIVEN OPERATING MODELS

- Factoring ESG into organisational establishment: For companies that are either just establishing themselves or are reorganising following an acquisition, it's important to set up the organisation to create clear accountability for external commitments from the outset. In these cases, ESG can be designed into the heart of the business and become part of the company's operations and decommissioning, from exploration to mining.
- Test structures regularly: Established organisations that have made bold ESG commitments have begun to put structures and processes in place to support them. These connections or lines of reporting must be tested regularly. Audits are an effective way to do this. Internal or external auditors can assess whether a company meets its commitments at every level. A key success factor is ensuring that the assessment results go beyond the mine manager and that information is shared at senior executive levels. This enables change to be effected from the top if shortcomings are identified.
- Quantify the risk: Once companies quantify the level of risk associated with social or environmental failures—such as the impact of an ESG re-rating among key investors or the exclusion of a stock in an index—it becomes easier to make a case for capital allocation into ESG- driven organisational restructures, resource allocation and the creation of new roles. The latter will cost much less than the former.
- Create a transparent and agile ESG culture: If an audit or risk-management exercise reveals that the organisation structure is not working as it should—perhaps a key role or communications channel is lacking—leaders must facilitate positive action based upon it. This is a learning journey for many organisations, and adjustments and changes will need to be made. Being congruent in what is said and what is done will be the most important currency to build credibility.
- Revaluate incentives: Incentives are a powerful behavioural lever within organisations. Companies should re-evaluate current incentive structures and align these with the broader ESG agenda.
- Define ESG responsibilities across the value chain: ESG-related expectations and responsibilities need to be written into roles at every level of the organisation and every stage of the value chain. Aligning these responsibilities within applicable mandates to ensure that individuals are empowered to make decisions and take action should be considered. Miners must clearly communicate their expectations around key internal and external interfaces, both verbally and in writing, so there's strong alignment—particularly regarding supply-chain partners.

TREND 5
EVOLVING MINING'S WORLD OF WORK

POSITIONING ORGANISATIONS FOR AN INCREASINGLY COMPETITIVE LABOUR MARKET

Like many industries, the mining sector has felt the lasting effects of COVID-19 on the labour market. Over the past months, waves of employees have quit their jobs in 'The Great Resignation,' seeking opportunities that better meet their needs and expectations. This has put extra pressure on organisations to ramp up recruitment and retention efforts, re-evaluate their employee value proposition and transform ways of working.

Digitisation and remote working have fueled a fundamental shift in how employees think about work. Facing an increasingly competitive labour market requires mining and metals companies to position themselves as an attractive sector and employer capable of meeting evolving priorities.

For several decades, miners have found themselves starved of talent, but COVID-19, among other issues, has intensified this challenge. Social purpose, reimagining work, and building an inclusive leadership culture allow miners to secure a strategic and sustainable advantage through human capital. But will companies take up the challenge?

MAKE WORK MATTER

Mining companies will not realise their full human capital potential unless they evolve to meet two social norms: adapting to the green energy transition and maturing diversity, equity, and inclusion (DEI) within the workforce.

The push for decarbonisation and renewable energy sources provides an opportunity for organisations to reinvigorate their purpose and, in doing so, speak to untapped sources of talent. Greater DEI is crucial to breaking down prejudice and discrimination and unleashing individual and team potential.

Aligning with a low-carbon future and mining's role in the energy transition will help miners retain employees with valuable and transferrable skill sets needed for these initiatives and attract new recruits who may not have previously considered a career in mining and metals.

The link between digital transformation in addressing climate change concerns and creating a more attractive industry for younger generations is clear. In a 2020 survey from Deloitte Insights, almost 70% of executives who reported that their company had a sustainability strategy in the place cited digital technologies as a key enabler.

REALIGNING WORK AND TECHNOLOGY

In the future of work, human potential is entwined with technology. Rearchitecting work creates sustainable value for organisations by intentionally designing new outcomes focused on optimising the interconnection of humans and work-related technologies.

Effective re-architecture requires companies to redefine current outcomes while looking ahead several years to understand and design how people could interact with technology and each other. As they do so, new skills and capabilities will emerge, both at a core technical level (e.g., data interpretation) and at a soft, human level (e.g., collaboration); developing both skill sets is essential for a sustainable future.

As organisations introduce new technologies, roles are evolving rapidly, and new jobs previously unassociated with mining are emerging. It's important to consider which skills and capabilities are needed and how companies could build these capabilities in-house or outsource them to external partners, including the community—a unique opportunity to change the DEI profile across the value chain.

Firms are also still adapting to remote working, and some are looking to place flexible work arrangements and workforce well-being at the core of their strategies going forward.

Janine Nel—Partner, Consulting, Deloitte Canada, says, "We're seeing this with several clients. For example, a major mining company in South America is going through an operating model review. The team is reconsidering the necessity for a physical presence in operations and, potentially, consolidating their regional head office operations."

BUILDING A NEW LEADERSHIP CULTURE

As the mining industry settles into a 'new normal,' leaders face mounting pressure to avoid falling back into conventional working methods. Achieving the transition requires them to craft new business models, challenge conventional definitions of productivity, embed a culture of trust, replace hierarchic management with empowered collaboration, and manage the cultural and engagement issues associated with long-term remote working.

Marcello Cordova Alvestegui, Director, Consulting, Deloitte Chile, explains: "Understandably, culture is currently a hot topic, with leadership being at the core of this shift as we move from a traditional command-and-control environment to a more inclusive and collaborative style of leadership."

Equity is the new key; companies should no longer focus only on hiring and achieving through KPIs. Today, the goal is to hire and integrate diverse talent and ideas, including people from underrepresented groups, races, those with disabilities, LGBTQIA+ community members, and new generations.

Boosting DEI within the mining sector will make it more attractive to new recruits and also improve retention.

Companies must build the confidence and environment for diverse individuals to develop to their fullest potential and create programs to instil the capabilities needed for tomorrow's mining operations. More inclusive environments will help to drive out institutionalised harassment and discrimination, which still plague even the most progressive of firms.

Working collaboratively, and even in partnership with competitors, to promote DEI within the industry will accelerate the uptake of best practices and consequently improve mining's appeal to diverse talent relative to other industries.

SOURCING TALENT FOR THE MINING ORGANISATIONS OF TOMORROW

- Define purpose: Putting social purpose at the heart of corporate messaging and recruitment efforts will help miners resonate with younger generations and diverse talent, many of whom have new skill sets vital to the future of mining.

- Reshape the social impact agenda: Beyond talent, mining and metals organisations must reconsider their social impact agenda to improve corporate brand and stakeholder buy-in. Studies show the impact this can have on consumer choices, where 87% of respondents said they would buy a product based on the company's stand for a societal issue. This trend is even higher among millennials and zoomers who look at the corporate social purpose when choosing a workplace, with 64% considering a company's social and environmental commitments before employment.
- Consider introducing hybrid or permanent virtual/remote work arrangements: Virtual/ remote work has become a hiring and retention appeal. It will allow miners to leverage skills in geographies they previously lacked. Remote job postings on LinkedIn increased more than five times between March and December 2021, and 46% of workers plan to move to a new location next year because they can now work remotely. According to LinkedIn data, since April 2020, internal-mobility hiring has also increased by almost 20% year-on-year, demonstrating the need to adapt virtual/remote work practices for employee value proposition.
- Rethink the skills required: Review the required skills for different roles and consider how recruits could potentially be sourced from other industries. Looking to adjacent industries for talent could provide access to a wider pool of applicants and support culture change and new performance standards within teams.
- Consider technologies, HR and training requirements that can widen the talent pool: Including reskilling and training programs that can deliver or support workforce needs and broaden new opportunities. Deloitte's Human Capital Trends 2020 survey found that, while 74% of organisations surveyed said that reskilling the workforce is important for their success, only 9% said they are ready to address this issue.
- Reduce labour barriers for underrepresented groups: To foster a more diverse workforce, mining companies must lower barriers for under-represented talent, including women, immigrants, and those with disabilities. Indigenous communities account for a valuable and, in many cases, untapped source of talent, not just for blue-collar positions but for management positions too. By creating partnerships with community organisations and schools, mining companies could access this valuable source of local knowledge.
- Speculate to accumulate: Mining and metals organisations should actively seek to improve the quality of life for marginalised groups in remote communities, for example, by reinvigorating the pursuit of reconciliation with Indigenous people or providing essential services to remote communities. Financial, physical, and social resources provided for citizens will eventually trickle back to the organisation in the form of human capital.

TREND 6
ESTABLISHING A NEW PARADIGM FOR INDIGENOUS RELATIONS

CREATING PARTNERSHIPS FOR PROGRESS

Public interest around Indigenous rights and the types of relationships that corporate organisations forge with traditional landowners continues to grow.

Mining companies are now under pressure from multiple angles to rethink their strategies and set the stage for future relationships that offer economic and social prosperity for all.

Today, it's clear that Indigenous communities worldwide no longer want to be positioned as stakeholders in transactional-style relationships. They are keen to establish a new type of connection and understanding with all entities participating in their environment, including mining companies, about responsibility for the landscape.

MORE THAN AN ESG ISSUE

In recent years, this connection with the land has seen Indigenous engagement lumped in with mining companies' environmental, social, and governance (ESG) agendas. While increased collaboration with Indigenous communities offers many opportunities, examining how a better underlying relationship could benefit all mining companies' functions and how ESG strategies could better serve traditional landowners is important.

Issues such as decarbonisation and natural-resource management, securing diverse talent, and even leadership are all subsets of how Indigenous peoples can help mining companies better relate to and fulfil their responsibilities as actors within a landscape.

Joe Hedger—Partner, Indigenous Services Group, Deloitte Australia, says, "What we are seeing now is Indigenous people standing up for themselves and wanting to take more agency in shaping the future of their nations.

That means the legal, economic and social relationship between Indigenous people and the rest of the nation will change dramatically."

Awareness of indigenous rights has grown hugely in the past decade, particularly regarding the social license. Social license ties into investment, project risk, and the environmental

component of project permitting, as well as regulatory and legislative functions for mining project proposals in many jurisdictions.

Governments keen to sustain industry investment are slowly developing their processes and legislation to reflect both parties' need for greater consultation and ownership. For example, in Canada, modern treaties are now being negotiated between First Nations and Crown Governments that cover a range of rights for Indigenous people concerning land, water, and resource development. At the federal and provincial levels, various legislative acts incorporate principles from the United Nations Declaration on the Rights of Indigenous People Act.

PROGRESS THROUGH PARTNERSHIPS

Developments like these are positive steps toward a better future and, going forward. There is enormous potential for the mining industry to work collaboratively with Indigenous peoples in different countries to advance their business strategies and goals, particularly around critical mineral deposits. However, a new paradigm for Indigenous involvement in mining must be established before this can happen. Where injustices have occurred, proper reconciliation must occur, and a new equitable foundation is laid for future collaboration, built upon communication, mutual trust, and respect. This will take time, investment, and a shift in governance.

Jason Rasevych—Partner, National Indigenous Services Leader, Deloitte Canada, says, "It is time for resource extractive industries to shift away from standard impact benefit agreements and move towards economic and equity partnership models that focus on developing a long-term relationship with Indigenous peoples.

The future state of mining depends on corporate and government recognition of First Nations' ancestral rights and inherent responsibilities as stewards of the land. We can also look at the many blueprints for success where First Nation rights holders have taken ownership of such projects. For example, in Canada, the Keeyask hydroelectric project was developed by Manitoba Hydro in partnership with four Cree Nations communities affected by the project who own 25% of the equity partnership."

In South Africa's Rustenberg valley, the Bafokeng community has gone one step further. During the 1800s, the group placed some of its land into trusts.

This undisputable ownership has enabled it to lease mineral rights and claim ongoing royalties from platinum miners. These have been reinvested to establish a strong regional administration, civil service, and infrastructure.

Today, the nation's investments are managed through a wholly-owned investment company, Royal Bafokeng Holdings, the majority shareholder and manager of platinum mining and refining company, Royal Bafokeng Platinum.

Cases like these provide tangible examples to governments, industry, investors, and Indigenous people of how a partnership approach could be successfully incorporated into future mining projects.

Push for greater inclusion in standards

Adopting ESG standards has become a basic requirement for most large companies and investment funds. Globally, ESG assets are on track to exceed US$50 trillion by 2025, representing more than a third of the projected US$140.5 trillion in total global assets under management.

While their application should ensure best practices in social endeavours, many leading ESG standards, like those established by the Global Reporting Initiative (GRI) or the Sustainability Accounting Standards Board (SASB), only contain minor references to Indigenous issues.

Professor Deen Sanders OAM—Lead Partner, Integrity, Deloitte Australia, adds, "Currently applied ESG principles undermine the interests and concerns of Indigenous people. Working with Indigenous people on what's best for the land and communities will help corporates, and the wider economies they operate in, to future proof profitability."

Miners should consider lobbying for the evolution of these standards in cooperation with traditional landowners to better reflect the interests of both parties in a way that promotes and fosters reconciliation.

ALIGNING STRATEGIES AND PRIORITIES FOR LONG-TERM GROWTH

Most Indigenous communities are not anti-mining. They simply want to see it done in a way that respects their rights, honours their sacred connection to the land, and helps their projects and communities flourish.

Mining companies should look for opportunities aligning with local communities' goals and priorities when planning new projects.

When opportunities arise for a community to benefit from mining infrastructure, such as a road, rail line, or energy facility, discussions should happen as far as possible to determine whether they are consistent with the community's aspirations and ensure the development won't compete with other interests.

To make projects truly sustainable, the planning process must incorporate the entire mine life cycle to ensure the site continues to represent value rather than a liability from a local community perspective after extraction finishes.

For this reason, it's important to establish overarching strategic ambitions for both parties from the start and regular communication to ensure calibration on practical issues of immediate relevance to both the mining sector and communities on the land.

LAYING THE FOUNDATIONS FOR MUTUAL ECONOMIC AND SOCIAL PROSPERITY

- Re-examine current ESG frameworks: Current ESG frameworks have been developed to be easily auditable. While this is helpful from an audit or compliance perspective, they often don't adequately capture the importance of meaningful consultation. To supplement standard metrics, companies could develop their own systems to record qualitative data such as the number and diversity of their Indigenous employees, whether they have Indigenous people on boards or committees, the number of Indigenous businesses that participate in their procurement and supply chains, and financial support or donations provided to Indigenous projects.
- Develop templates that reduce risk and improve decision-making: There are examples in Canada where First Nations are leading the permitting or regulatory process for major development projects or are involved with the environmental assessment. There are also examples in multiple jurisdictions where Indigenous communities raise funds to increase their participation in a project or take ownership of enabling infrastructure. Mining companies should be vested in building these types of relationships and encourage participation, as Indigenous insights could significantly improve mining projects' economic and environmental performance.
- Early engagement in a culturally appropriate manner: Engagement with communities should begin as early on in a project as possible and continue throughout the project lifecycle. The investment required to establish a meaningful two-way dialogue is far less than that required for legal challenges or to rebuild a relationship after litigation. Reputational costs should also be considered. Information should be provided to communities in a culturally appropriate way and in their Indigenous language so they

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can make informed decisions around consent.

- Diverse governance: Creating seats for Indigenous representatives on boards and in other positions of power within mining companies will give communities greater confidence in the purpose and direction of mining projects. It will also give them a central role in decision-making, including mitigating environmental and social impacts.
- Understand the need for different relationships and roles in different geographies: While a global awakening is underway around Indigenous issues, it is happening differently in different countries and regions. While some common themes exist, there is no universal blueprint for structuring community-mining company relationships and roles. Mining companies should therefore build flexibility into their planning and come to discussions willing to listen, learn and act upon their findings.

TREND 7
CONTINUING THE JOURNEY TOWARD INNOVATION-LED ORGANISATIONS

MOVING TO ACTION BY EMBRACING CHANGE

The topic of innovation is no stranger to Tracking the trends. It has long been on mining companies' agendas, but integrating innovation with core business functions and operations has proven tricky for most.

Fundamentally, traditional mining companies and processes are designed for stability rather than being structured to embrace change and benefit from it. So, why raise it now? Several factors have recently converged, driving executives to embrace innovation and align their organisations behind it:

1. COVID-19 forced the world to embrace digital and remote work practices, changing the world of business for good.
2. Mining companies will need to innovate within their core processes if they are to decarbonise in line with their goals.
3. It is much easier to fund innovation while commodity prices are high and the industry benefits from the super-cycle.

Digital transformation—or the shift from mainly separated physical systems and technologies to integrated virtual, data-driven ones—offers huge opportunities in every instance. It provides a means to leverage data for enhanced decision-making, quickly simulate changes to the value chain, and analyse the impact of new technologies and designs before implementation, among many other benefits. It will also open the doors to a new generation of fresh, diverse talent with the vision and cultural expectations required of more agile mining and metals organisations.

Over the years, in Tracking the trends, we have spoken about putting in place innovation-capability systems, operating in ecosystems, moving toward integrated operations, and addressing different organisational barriers to innovation. We still believe the time is ripe for change, and this year we focus on some areas where we continue to see organisations struggle.

CHALLENGING THE STATUS QUO

It takes visionary leadership right from the top to create an organisation that can question industry-standard processes, test different ideas, and implement new ones without fear of failure.

Mining project delivery is one area that could benefit significantly from innovation. Yet, the status quo remains unchanged—cost overruns on construction projects in the energy and resource sector, including mining, typically exceed 30%.

Steven Walsh—Mining & Metals Leader, Deloitte Australia, says, "Traditionally, in project delivery, we see designs that were originally created 50 years ago, or more, that have been progressively updated, rather than starting from first principles and innovating. Part of the problem is that, in traditional mining projects, after first ideation and the vision setting phase of a project, almost every process after that is designed to eliminate risk and therefore also eliminates innovation."

Progressive leadership combined with realistic target setting, the use of different models, and better communication between teams offer the opportunity for mining projects to be more efficient and less capital-intensive. Traditional approval and delivery processes must be challenged and refreshed to achieve this.

LEARNING FROM OTHER INDUSTRIES

There are other asset-intensive industries, particularly those with complex logistics chains, that can offer learnings and inspiration around innovation for mining. For instance, transport and logistics operators often have lower margins than those seen in mining and have used this as motivation to adopt new innovations that offer greater efficiencies.

Much could be learned from the agile work employed in the technology and financial services industries. For example, in a financial services organisation, the last step in an innovation project will often be to deploy software or a new rule or policy—something that can be done at the touch of a button—whereas, in mining, a physical piece of equipment usually needs to be installed.

Therefore, innovation emphasis in mining tends to be skewed toward equipment or technologies, and these projects

take time. But it's worth remembering that this is only one piece of the puzzle; efficiencies and opportunities can be achieved more rapidly through innovative processes, policies or systems. Again, this emphasises the need for a holistic approach to innovation initiatives.

CREATING A CULTURE OF INNOVATION

Companies that are good at innovating will have a wide risk tolerance and allow for production fluctuations when testing an idea that could prove valuable. Trying something different, that might temporarily lower production in an industry that measures its success by delivering to targets can be frowned upon. But planning at an acceptable level of risk is key to testing and deploying new solutions.

Much of this relates to culture and how success is measured, not just at the company level but also at the industry level. Unlike in safety, where the risk of any kind is unacceptable, and controls are added and rarely removed, mining innovation has two types of risk: risk of failure and success—and both are equally valuable.

Because mining companies are more familiar with risk around safety and the industry's measures of success are geared towards higher production, there is an unwillingness to remove controls that hinder innovation in case something 'goes wrong.'

Roland Labuhn—Partner, Consulting, Deloitte Canada, says: "In some ways, this culture is now holding us back because we can design and develop new innovations and model them with technology, but at some point, they need to be tested in operations. Companies that can plan for minor interruptions and incentivise their teams to both achieve production targets and successfully innovate will realise greater opportunities to learn and improve ahead of their peers."

Problem-solving around things that occur today should be automatic and planned well in advance. To really move the dial in innovation and become truly agile, companies should focus on solving problems three months away or more.

Workforce evolution will also serve to accelerate innovation culture in mining. Companies are already seeing workers frustrated by current generations' willingness to adopt new ideas. This will only accelerate as zoomers move through the ranks. Greater innovation will, in turn, increase workforce diversity and boost retention through job satisfaction.

Walsh adds: "I'm a passionate believer that differences in thinking and background are critical to innovation, and anything we can do to make mining more attractive and inclusive to a broad range of people will result in more innovative ideas. In any conversation about innovation, we should look around the room and challenge ourselves on how diverse the thinking really is."

MAKING INNOVATION A CORE PART OF MINING BUSINESSES

- Challenge policies and controls that stand in the way of agile principles: Mining organisations have multiple layers of controls to ensure actions that are dangerous, inefficient, or could negatively impact productivity do not occur. These are important, but for the purposes of ideation and problem-solving, staff should be encouraged to challenge controls and policies that stand in the way of agile principles and ask the question: 'why not?' rather than 'why?.'
- Accept some short-term reductions for longer-term improvements: In truly innovative companies, there will be times when testing new ideas means sacrificing production, and that's ok. If there is a relentless focus on maximising the numbers, it discourages the next wave of innovation. Leaders should implement systems to encourage and reward short-term performance and longer-term improvement. When failures happen, teams should be supported to analyse, assess, and document them from a value perspective; a failure is only truly a failure if we do not learn from it.
- Don't underestimate change management: To get the full value from a new technology or business offering requires its integration with other systems, technologies, and procedures and adoption by the workforce. Approximately 30% of the innovation effort could be dedicated to the period after deployment to ensure the change is effective. Innovation processes and budgets should reflect this and allow for ongoing personnel training.
- Take low-hanging fruit: Success inspires further innovation, and if there are quick, cheap changes that will generate fast returns (even if a technology or system will be replaced in a few years), then consider taking them. Innovation teams also need to be incentivised to hand projects over to operations before moving on to the next, rather than becoming attached or obsessing over perfectionism.
- Structuring research and development (R&D) teams: There have been multiple instances where mining companies have invested heavily in establishing R&D teams that are distanced from their operational counterparts, with varying degrees of success. However, this is rarely an optimal approach. Instead, consider embedding innovation functions or roles within operational teams.

TREND 8
UNLOCKING VALUE THROUGH INTEGRATED OPERATIONS

USING DATA TO DRIVE THE LONG VIEW

Mining and metals companies are on a journey to drive understanding and efficiencies holistically throughout their organisations. Digital transformation has already contributed to this by providing real-time visibility from mine to market, but many mining companies have failed to see benefits from digitisation.

This is because often too much focus is put on the technology and not enough on how the organisation will interface with that technology and use it to drive effective integrated decision-making that optimises the system versus an individual function.

The next steps in achieving company-wide efficiencies and unlocking value are to use those insights to change how decisions are made at every level. Actions that benefit the organisation as a whole, rather than specific departments or functions, will enable companies to become more agile in their response to changes, both in the operational and business environments, and create greater value.

The current heightened focus on environmental, social, and governance (ESG) measures has placed additional pressure on companies to manage their operational environment and social and regulatory challenges. The need to be responsive requires organisations to empower their workforces to make these decisions.

With traditional business structures, this is tricky for two reasons. First, many roles lack the appropriate authority; for example, even if an operator who is running a process in real-time can see that its product is harming community sentiment further down the value chain and it knows how to improve that, in many cases, the authority to make that decision still sits three or four levels above within the organisation. Second, there is a lack of focus; organisations don't generally include qualitative metrics in their operations decision-making.

In both cases, the business structure must be updated to support a decision that would benefit the organisation.

SUPPORTING DIFFERENT DECISIONS

The types of decisions that operators need to make are also changing. Traditional operator-style decisions are usually either/or type decisions. However, when considering how mining organisations relate to local communities, the decisions that need to be made become more ambiguous and complex.

For instance, a company might have four mines operating that feed through a single port. Dust levels at the port must be controlled to avoid negatively affecting surrounding communities.

In a traditional mine environment, operators on site wouldn't think about how the level of dust their product generates adds to aggregate levels at the port; their job only requires them to deliver a certain tonnage at quality. Now, however, organisations are asking frontline workforces to think about the potential impact of their decisions on the downstream value chain and the company's long-term viability.

The challenge lies in not only empowering but also helping operators to make good decisions based on these highly ambiguous and complicated situations, some of which, on the surface, would appear to have nothing to do with their targets.

Eamonn Treacy—Director, Consulting, Deloitte Canada, explains, "The traditional mine value chain includes several steps, each with a series of metrics that teams need to make to hit performance targets. Sometimes, in the context of the organisation, hitting those targets is the wrong thing because it creates more waste or risk for the value chain as a whole."

The drill and blast team wants to reduce costs by minimising the use of explosives. Still, by improving isolation, costs might increase downstream if the material delivered isn't within the engineering specification of the processing plant. For example, before the ore can be dug up and processed, it needs to be drilled and blasted. While a 5% cost saving might look like a success to the drill and blast team, the total cost to produce one unit of material might have increased by 8%.

In these cases, companies need to harness digital insights to shift their focus and that of their frontline operators from delivering against performance targets to delivering the best possible outcome for the organisation, even if it goes against KPIs that a function has been set.

CLARIFYING ROLES AND RESPONSIBILITIES

One way to do this is through implementing more structured rights and responsibilities. For example, a general manager (GM) is traditionally accountable for all onsite decisions; they carry the responsibility from a regulatory perspective because they are on the ground. This creates a situation where the GM is expected to handle anything from short-term production targets to safety, costs, and long-term goals rather than focusing on their role-specific targets.

However, with improved visibility and a better understanding of the system

through digital technologies, other groups can become more of a 'business partner' by providing trusted advice and taking the lead in developing, for example, five-year or life-of-asset plans.

The GM will likely still have the final say, but instead of being accountable for driving the result, their focus now lies in actioning the best advice and driving shorter-term goals, like the mine's quarterly plan.

Dominic Collins—Energy, Resources & Industrials Leader, Deloitte Chile, says: "With these changes, the GM role becomes much more adaptable and agile, with a narrower scope of focus but significant leeway in how the individual works. That agility is created through greater role clarity and allowing people to focus on areas where they can deliver the best value for the organisation."

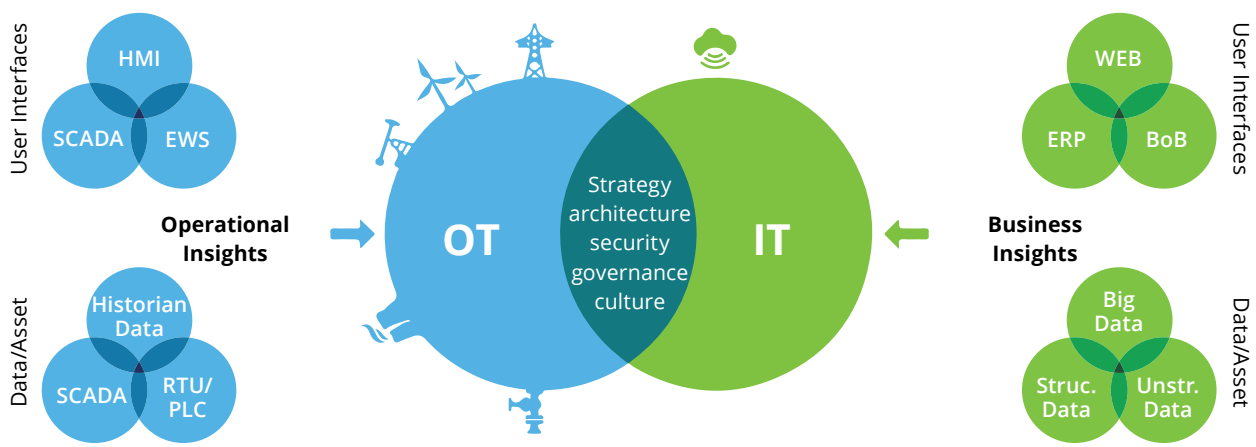
RELATIONSHIP TO THE MARKET

How mining and metals organisations view and relate to the market is also maturing. While, conventionally, many organisations operate with a multi-asset strategy – where each asset group has differing strategic objectives and investment strategies – much of this decision-making remains relatively opaque to the individuals operating within each asset. Ultimately, most strategic communications occur at the corporate level, with, at best, some partial involvement from senior asset leaders. This often results in a poorly understood strategy at the operational level, where cost becomes the only focus for improvement opportunities which can start to impact value. A more nuanced and effectively integrated strategy enables a much broader consideration of all the ways to maximise asset effectiveness.

Fully communicating and integrating these different operational strategies could be realised more effectively by individual assets to generate better organisational value. In turn, communication quality and timing improvements also allow the organisation to pivot faster when faced with changes in the market.

MAKING AGILE AMBITIONS A REALITY

- Lean on new and existing frameworks: A system-based decision-making framework can help mining, and metals companies transition teams from focusing on performance indicators to business indicators. This uses integrated decision-making to overcome the limitations associated with current key performance indicators (KPIs) when variability occurs in the mine environment.
- Review and restructure rights and responsibilities across the value chain: This is time-consuming, but the returns are worthwhile and will allow the full value of digital implementations to be realised. Rights and responsibilities should be reviewed when considering major operational changes to assess whether there are better ways that procedures can be handled.
- Different targets need different people: Historically, mining organisations have the most valued people who can diagnose issues quickly and make immediate operational adjustments. However, the advancement of digital analytics and artificial intelligence (AI) is now de-emphasising the need to understand the problem and emphasising the need for ambiguous decision-making that



Source: Deloitte analysis

- HMI: Human Machine Interface
- SCADA: Supervisory Control and Data Acquisition
- EWS: Engineering Work Station
- RTU/PLC: Remote Terminal Unit/ Programmable Logic Controller
- ERP: Enterprise resource planning

Figure 2: IT-OT environments in mining are becoming increasingly connected

can foresee problems and prevent them from becoming a reality. Refocusing organisations on value-chain outcomes will require different types of personnel and will also affect how employees advance through the organisation. Companies need to think now about their talent-sourcing models and how to foster these skills within their current workforce.

TREND 9
CLOSING THE IT-OT VULNERABILITY GAP

THE NEXT FRONTIER IN CYBERSECURITY

Over the past five years, the acceleration of digitisation, information technology (IT) and operational technology (OT) convergence and value-chain integration in the mining sector has produced new levels of efficiency, driving down miners' costs, and created exciting new business opportunities.

However, with the opportunity also comes risk and, for many companies, rather than security efforts keeping pace with their digital growth, the gap between risks and controls has widened.

According to computer security firm McAfee, the global cost of cybercrime is US$1 trillion, with monetary losses accounting for US$954 billion. Higher metal prices and the strategic importance of certain metals have brought the mining sector to the attention of criminals in recent years, and several firms (both metal producers and METS companies) have found themselves victims of security breaches. For example, Norwegian aluminium and renewable energy company Norsk Hydro faced a ransomware attack in 2019 that affected more than 35,000 employees across 40 countries. The financial impact was estimated at US$71 million. More recently, Weir Group PLC was the victim of a ransomware incident in September 2021. This led to disruptions in the company's engineering, manufacturing, and shipping operations, resulting in revenue deferrals and overhead under-recoveries.

Vulnerability through IT-OT convergence
Traditionally, mining companies have placed heightened security focus on protecting data and systems in functions like finance or human resources, but not enough on the ground at mine sites. However, IT-OT convergence is increasing, and more devices are connected than ever, sometimes without the proper due diligence for security. The result is that today, some of the industry's biggest cyber vulnerabilities are around OT, industrial control systems (ICS), and the Industrial Internet of Things (IIOT).

René Waslo—Global Risk Advisory & Cyber Leader, Energy, Resources and Industrials, Deloitte US, explains, "While companies have begun to place more emphasis on the operations side of their businesses, we still see opportunities for improvement in the OT environment. We'll continue to see breaches until there is equal focus on the front and back office."

Historically, OT systems were designed to be isolated, running less-known industrial protocols and custom software. Those systems had limited exposure to cyber-related threats whereas, today, as an enabler of business innovation and efficiency, OT environments are becoming increasingly connected to other networks and are remotely accessible to allow remote process monitoring, system maintenance, process control, and production data analysis/integration (see figure 2).

The adoption of remote and hybrid operating models as 'the new normal' means that now is a good time to review cybersecurity measures around interconnected or segmented networks and ensure they are robust enough to sustain current practices and support future business growth.

Other key challenges include the high cost associated with ICS upgrades, patching, or changing configuration files on legacy systems and a lack of redundancy in production schedules as supply chains move to more integrated or just-in-time models.

RESTORING TRUST IN THE VALUE CHAIN

Twenty years ago, cybersecurity in mining was a technology implementation issue; security measures were added as solutions were scaled up. While there's still an association element today, the ubiquity of digital technologies and work practices means businesses need to factor security threats and solutions into every decision they make. As value-chain integration accelerates, there are touchpoints where miners must ensure that third-, fourth- or fifth-party organisations with whom they are doing business have a strong cyber posture. There is also a reputational element to consider. In the future, a mining company's security stance could affect its ability to engage or trade with other organisations.

Andrew Kwong, Partner, Risk Advisory, Deloitte Canada, explains: "When it comes to new technologies and systems, businesses are making strategic choices on how their organisations change, and those changes could have a big impact on security. Today, it's important to put a cybersecurity lens over every business decision or technology implementation and ensure that security processes are in place to support these organisational changes."

Of course, mining companies are just beginning their digital journeys, so it's worth putting the time, attention, and investment in now to ensure operations are not exposed in the future.

SECURING THE MINING OT ENVIRONMENT

- Knowledge is power: Create and maintain a holistic inventory of all connected devices at the shop-floor level. Review this regularly to ensure OT cybersecurity measures are sufficient and properly allocated.
- Uncover asset vulnerabilities: Perform passive network detection by collecting and analysing traffic between OT devices. This will allow vulnerabilities in the discovered assets to be uncovered.
- Perform regular OT security assessments: Assessments allow identifying security gaps and missing controls and can help leaders gauge the maturity level of their organisation's approach to OT cybersecurity. Based on this, recommendations can be made on work lots to achieve target maturity and strategic deployment roadmaps built to support this effort.
- OT third-party risk assessment: Conduct a workshop with critical third-party stakeholders, such as original equipment manufacturers or service providers, to discuss the controls in place to secure the interface between their systems and the mines. Ensure these are robust and up to date.
- Create an OT governance framework: Establish a corporate-wide security objective for OT by defining the OT cybersecurity strategy. Also, create a functional IT/OT governance working model.
- Consider an IT compromise assessment: It's also worth assessing the current IT environment, infrastructure, and selected systems to identify previously undetected backdoors, compromises, or exposures that reveal data and system integrity to significant risks.
- Perform a thorough market review: The traditional OT security market is niche and mature. However, OT/IT convergence is accelerating, and many cyber-physical systems are emerging in operational and mission-centric environments, creating a new security market with shifting dynamics. It's worth scanning the market regularly to ensure access to the latest security systems and services.

TREND 10
PREPARING OPERATIONS FOR A CHANGING CLIMATE

MANAGING PHYSICAL RISKS THROUGH DIGITAL INSIGHTS

While decarbonisation has been the primary focus of most miners' climate change-related targets and investments thus far, mitigation is only one piece of the puzzle. Alongside these efforts, organisations must think ahead and build climate resilience across their businesses and operations.

Some tier-one companies have begun using United Nations climate models and digital risk-management tools to quantify both physical and transitional risks at new and existing mine sites. In some cases, these efforts even extend to scoping the exposure of their suppliers. But, this is unchartered territory for most mid-tier and junior miners, particularly those in geographical areas where climate impacts to date have been limited.

However, in time, the effects of climate change will touch all businesses across all sectors, regardless of their size and status. The level of transparency and integration of mining supply chains today means that organisations have the chance to prepare their own operations and also help their suppliers and customers ready themselves for whatever operational effects a changing climate might bring.

IMPACTS OF A WARMING CLIMATE

Physical risks resulting from climate change can be event-driven (acute) or longer-term shifts (chronic) in climate patterns. Both can carry financial implications for organisations, such as direct damage to assets and indirect impacts from supply chain disruption.

In certain geographies, extreme weather events such as droughts and flash floods pose a growing threat to mining activities as global temperatures rise. For example, BHP reported an 11% drop in output from one of its mines in New South Wales in 2019 due to poor air quality caused by bushfires. Scientists estimate that if global temperatures rise by 2°C, the hot, dry conditions that encourage bushfires will occur at least four times more often.

Record heatwaves in North America during 2021 are another example. In June, temperatures in British Columbia reached 49.6°C, breaking the country's highest recorded temperature, and wildfires triggered evacuations in California and northern Nevada. This clearly has a significant effect on workers in the field.

Organisations' financial performance may also be affected by changes in water availability, sourcing, and quality, as well as issues around food security and extreme temperature changes affecting premises, operations, and transport needs.

In their 2020 metals and mining survey, 'Emerging ESG Risks in the Metals and Mining Value Chain, ' Fitch Ratings and CRU named water scarcity as the greatest emerging risk to the mining and metals sector. The authors state: "Pressures such as localised water shortages and competition for water are likely to increase in the coming decades, causing increasing challenges for battery and low-carbon technology production."

Most mining operations rely heavily on water for various purposes, including dust control, machinery cooling, and mineral processing. Nowhere is this risk more evident than in copper. The increasingly arid conditions in northern Chile and southern Peru (the world's largest copper-producing regions) are forcing many large miners to invest in desalination plants. The Chilean Copper Commission (Cochilco) estimates that, by 2029, seawater will account for 43% of the water used in copper mining, up 230% from its expected level in 2018.

In highly water-stressed areas, closed-loop extraction processes can help to lower abstraction requirements, and innovative tailings, pond linings and coverings can reduce losses through seepage and evaporation. However, in areas where prolonged arid conditions are expected, dry processes and tailings storage solutions might be more sustainable in the long run.

SUPPLY-CHAIN VULNERABILITY

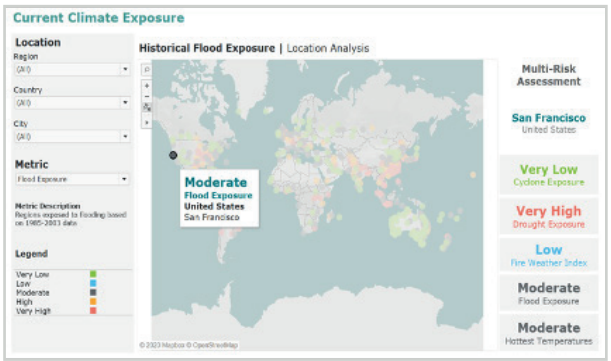
For mining companies, the physical risks from climate change can extend much further than their own sites. For example, meteorological events can potentially significantly disrupt key transport corridors.

In March 2021, heavy rain in Australia's New South Wales and Queensland impacted global thermal coal supplies. Glencore was forced to cut capacity at some of its mine sites, while Yancoal suspended production at two open-pit mines. The Australian Rail Track Corporation temporarily ceased operations through parts of the Hunter Valley network due to localised flooding, a key transport corridor to the Port of Newcastle.

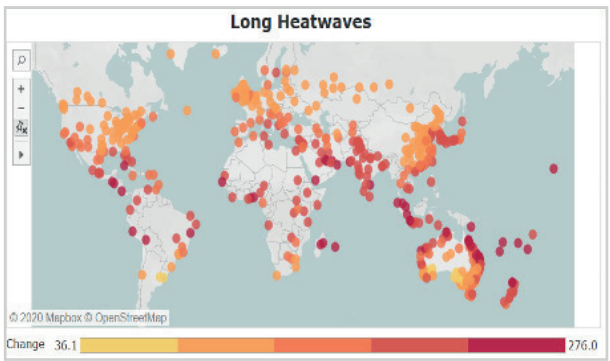
Meanwhile, ship loading at the port was suspended for two weeks to repair storm damage to key equipment. This, plus flooding, caused Australian coal miner Whitehaven to slash its 2020-21 June–July coal production, and the number of vessels grew around port limits.

Flooding and wet weather continued through the Australian summer, and supply issues saw thermal coal prices hit a record US$244.11 per ton on 8 October

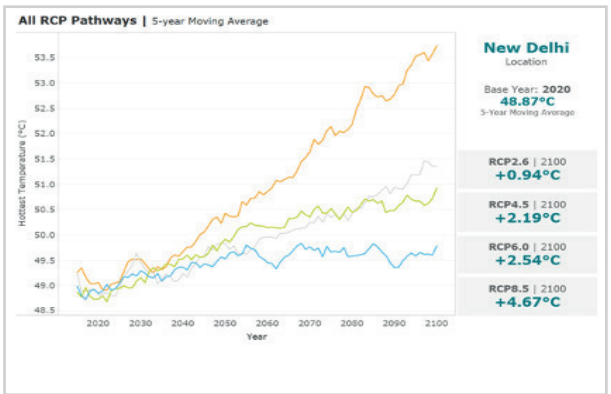
Multi-risk assessment – Assessment of current exposures to cyclones, droughts, fire, flood and heat



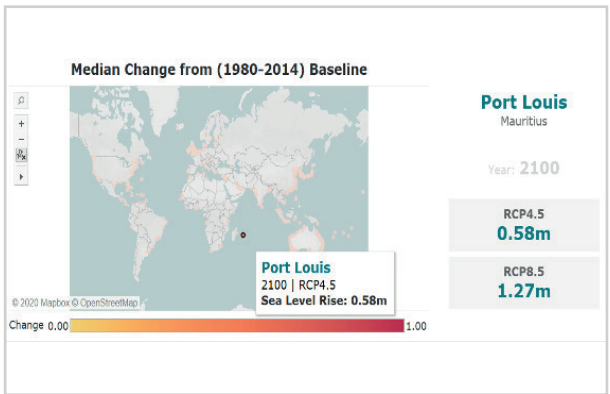
Future scenario analysis – Increase in long heatwaves under a high emission (RCP8.5) future



Local sea level rise – Increase in sea level for 2100 for RCP4.5 versus RCP8.5



Comparing future RCPs – Hottest annual temperature under four Representative Concentration Pathways (RCPs)



Source: Deloitte Decarbonization Solutions™

Figure 3: Physical Climate Risk Module: Providing quantification of physical risks globally

2021. Floods were still affecting prime-production regions in November.

While the cumulative effects of these disruptions are yet to be published, this example demonstrates why a collective and coordinated effort toward building climate resilience is required across the value chain.

Once again, digital tools can offer insights to support. Deloitte is currently helping a tier-one mining company assess operational risks posed by climate change across its supply chain using its Illuminate solution. This provides transparency in complex procurement networks by leveraging augmented intelligence and machine-learning methodologies to enable rapid modelling and represent those suppliers systematically. Multi-tier networks can be overlaid with exposures and opportunities, including those related to climate-change risks.

ASSESS AND PREPARE FOR DIFFERENT SCENARIOS

To mitigate physical risks at both current operations and those under development, a detailed assessment of a variety of future scenarios is necessary.

Based on data from these solutions, mining companies should instigate conversations with their suppliers, make decisions around future capital and resource allocation, and, where necessary, diversify their own supply chains to lower operational risks.

It is reasonable to assume that consumers of critical minerals and metals, including electric-vehicle manufacturers and low-carbon energy technology providers, will soon be looking to do the same with their own supply chains. Mining companies play an important role in these both today and tomorrow.

Where possible, miners should extend their climate risk-assessment exercises to the downstream portion of metal supply chains and encourage customers to ask questions about their suppliers' future exposure and security. Security of supply is everyone's concern, and preparedness could offer miners a competitive advantage compared with their peers.

Ultimately, organisations that build climate resilience will also gain access to more attractive financing, stronger employee recruitment and retention, and cheaper energy costs to name a few benefits.

QUANTIFY RISKS AND OPPORTUNITIES

Deloitte Decarbonization Solutions™ includes an Adaptation/Physical Climate Risk Module that can demonstrate mining companies' current and future exposure to various climate hazards for assets and portfolio locations. The module incorporates business and financial impacts and supports the translation of climate challenges along the value chain. It can also identify opportunities for investment and resilience and quantify climate thresholds for major disruptions. Alignment with Task Force on Climate-Related Financial Disclosures (TCFD) and other major climate risk frameworks helps to support climate risk disclosures, see figure 3.

BUILDING CLIMATE-RESILIENT MINING AND METALS BUSINESSES

- Foster leaders for tomorrow: Building climate resilience across a business requires solid leadership. Leaders who steer resilient organisations share common traits: they are prepared, adaptable, collaborative, trustworthy and responsible. Companies should actively seek out individuals who exhibit these traits and build in measures to help train and retain them.
- Collaborate to accelerate: For all mining organisations, but in particular, smaller and mid-cap miners, collaboration and sharing of experiences between peers can accelerate progress. Everyone is grappling with the same climate-related challenges and will benefit from shared experiences and solutions.
- Invest in business-wide capability: To lower operational risk from climate change requires greater awareness throughout organisations regarding the effects of climate change and how basic decisions today could potentially set the business up for the future. Making physical climate risks a key talking point in the organisation and site briefings will help to ensure continued visibility.
- Talk to your suppliers: This awareness and commitment to lowering physical risk exposure should also be extended to suppliers. This could be through formal communication or discussions with key personnel. Suppliers may even have measures in place already that could help mining companies lower their overall risk exposure.
- Question the value chain: Mining companies must challenge the physical resilience of supply chains they are involved in, both up and downstream. Consider how exposed off-takers and end consumers are and how the business and operations compare to peers and competitors in terms of readiness for a changing climate. As with any change, opportunities and threats will emerge. How miners prepare for disruption and communicate this to the markets could prove critical to their competitiveness and social license going forward. wn

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Why innovation in the mining sector is critical for the energy transition

Amid our global energy transition, corporations and governments are conscientiously building pathways to decarbonise our energy sources. These efforts hinge on how readily we embrace renewable energy sources, yet even renewable-based technologies require a massive input of materials, including metals and minerals.

By: Vivek Salgaocar
Director and Co-Founder,
Vimson Group

Conversely, they are more material-intensive than traditional fossil-fuel-based systems, which creates a vital caveat in the global push to decarbonise.

As this clean energy transition augments the demand for materials, the mining sector is ill-equipped to keep up in its current state. The conditions of ore deposits are changing, and the technologies and processes that have sustained the industry for the past decades are becoming increasingly energy-, water-, and environmentally intensive.

For real progress in making clean energy more accessible, the mining industry requires meaningful transformation.

As Director of Vimson Group, a leading mining conglomerate spearheading efforts to promote environmentally sustainable practices, I have seen the pivotal role of innovation and the global start-up ecosystem in bridging critical gaps in the industry. To make the clean energy transition possible, we must focus on meeting the growing demand for materials while ensuring this growth is sustainable and minimal in its climate impact.

THE SURGING DEMAND FOR METALS AND MINERALS

Our transition towards clean energy currently requires as much as 3 billion tons of metals, and the demand is expected to grow in the coming decades. To hit net-zero emissions globally by 2050, we would require six times more mineral inputs in 2040.

With transportation being the largest emitting sector in the U.S., adopting electric vehicles (EVs) is crucial in decarbonisation efforts. This has been largely successful and presents

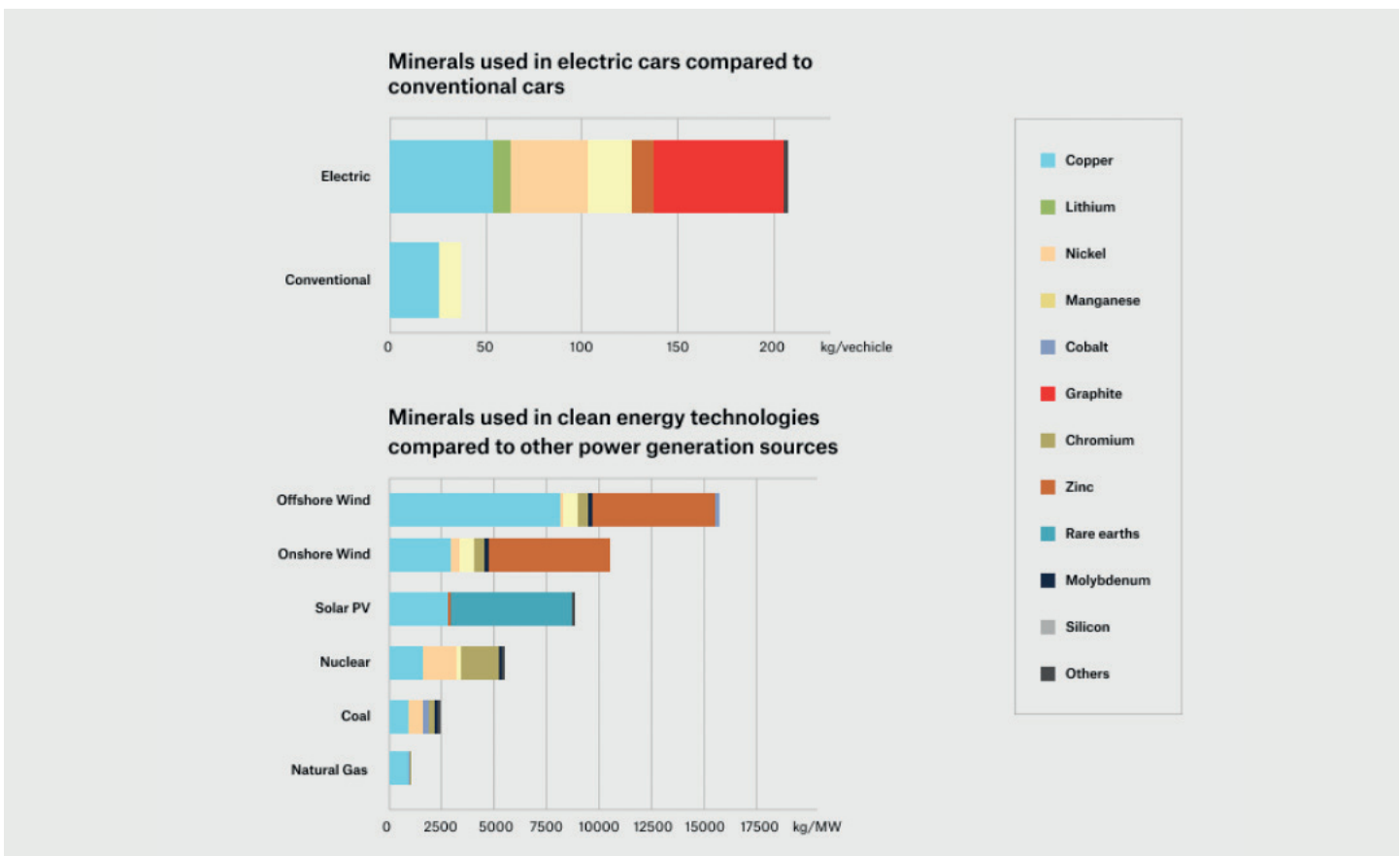

Figure 1: Minerals used in electric cars compared to conventional cars, IEA, Paris.

significant potential. In 2021 EV sales doubled, and today, weekly sales exceed the annual sales turnover of 2012; however, electric cars require six times more minerals than petrol cars. As the adoption of EVs grows, the demand for these materials - most of which are specialised minerals, including lithium, cobalt, nickel, and graphite - puts immense pressure on an already lagging industry.

Material-intensive batteries are driving up the cost of electric vehicles, making government-issued EV tax credits a key tool in promoting and driving down costs. Even so, the Inflation Reduction Act has disqualified most EV purchases from this perk by restricting them to batteries produced domestically. Companies are subsequently re-evaluating their existing mineral supply chain and exploring alternative methods.

The rising demand for raw materials has also led to a decline in the quality of ores produced from mines. Without innovative and updated technology to move and process these lower-grade ore deposits that contain large amounts of waste, mining companies are forced to use energy-intensive, legacy technologies, which further drive up operating costs.

It is more critical than ever that traditional mining processes transform to maintain the momentum of EV adoption. Innovative methods, such as extracting and recycling materials from secondary resources, can augment the domestic supply of metals and minerals.

It will, however, require institutional support to scale further and ensure that demand is maintained.

MINING HAS ITS OWN SUSTAINABILITY CHALLENGES

The mining process, from exploration to operation, is highly energy-intensive. It accounts for 10% of the world's energy consumption, hindering net-zero ambitions and causing significant environmental impact from land-use change.

Though existing processes must be updated, mining is a risk-averse industry - neglected as a platform for innovation and private investment and slow to adopt innovative solutions due to the magnitude of safety, operational, and social challenges.

With the right resources and intention, there are opportunities to reduce life-cycle carbon emissions. These include adopting alternative clean energy like hydrogen and ammonia, breaking and moving ores non-conventionally, and

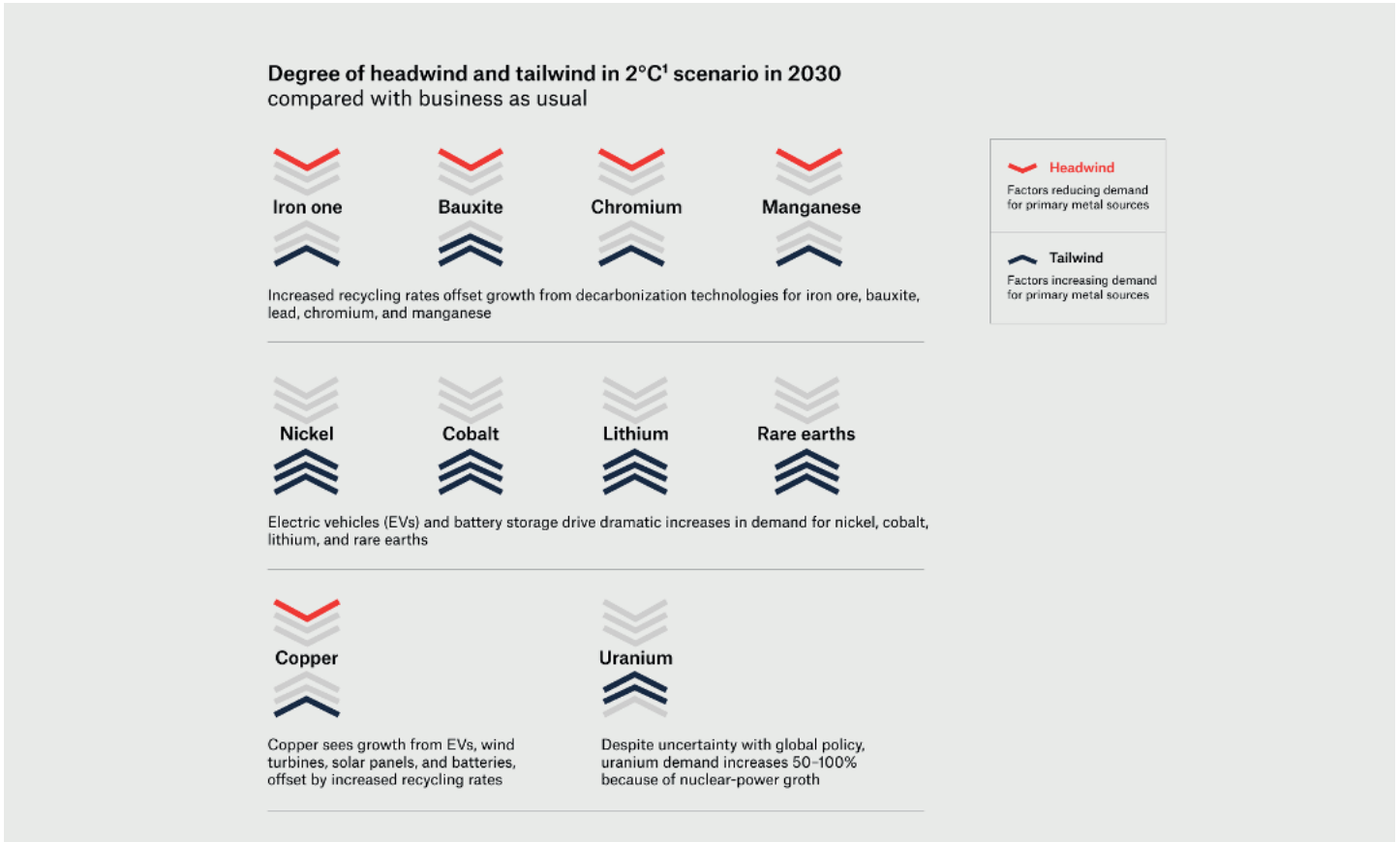

Figure 2: The growing role of minerals and metals for a low carbon future Image: World Bank / IEA / McKinsey & Company

decarbonising metal processing using green hydrogen and carbon capture, utilisation and storage. Organisations like EV providers must look to less energy-intensive mining processes to reduce Scope 3 emissions, which are attributed to the production and use of raw materials and have a massive impact.

Nevertheless, when mining companies increase technology investment, they sometimes struggle to see the ROI because they fail to make crucial foundational adjustments, such as promoting a company culture that embraces digital transformation or instituting management systems that nurture innovation. There is a clear appetite to change and reimagine the industry, but it will take time, resources, and consolidated efforts.

A COORDINATED APPROACH

The only way for the mining sector to meet demand and global climate goals is through intentional, cross-sector collaboration and significant investments in scalable and sustainable solutions. Still, the sector is fragmented, both across the industry and in companies, hampering the implementation of a top-down and coordinated approach. The mining supply chain is complex and accounts for many separate processes, like transportation, equipment and more, to go from mine to market. Organisational silos are common, and business divisions often operate independently with little coordination or information sharing. Companies cannot institute end-to-end solutions or make sweeping organisational changes without viewing the supply chain as an integrated process.

Innovation in the mining sector also requires close collaboration between the public and private sectors, as changes in regulations have pronounced supply chain impacts, while corporate decisions have geopolitical implications.

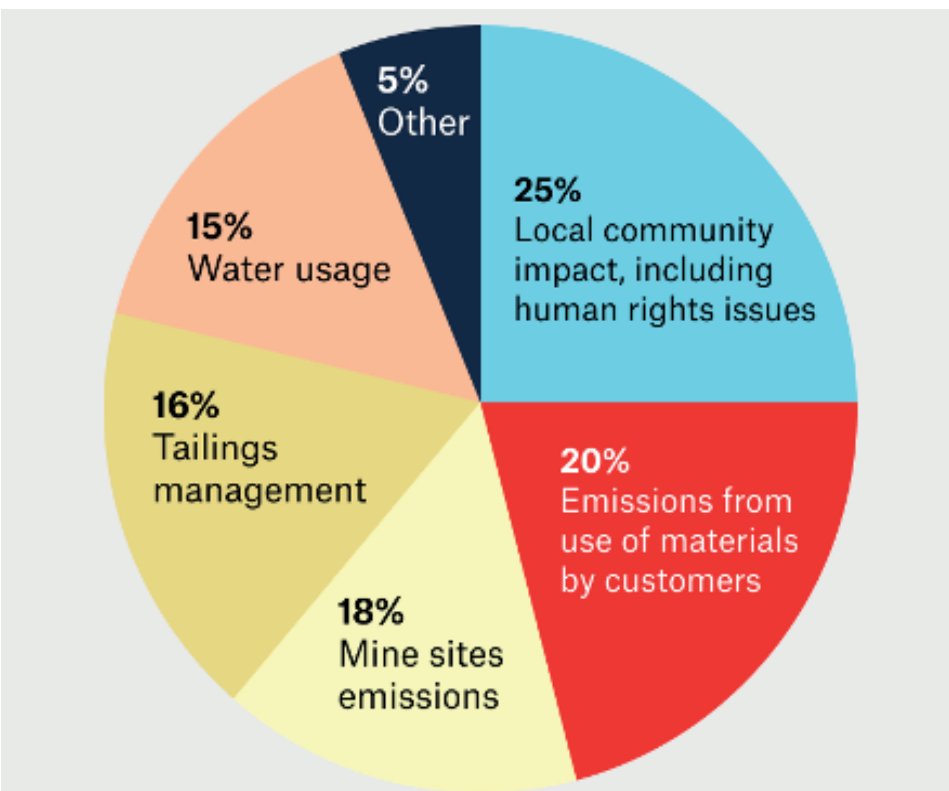

Figure 3: Areas of mining and metals that will face the most scrutiny from investors and regulators realted to ESG and sustainability issues.

In a fragmented industry, this level of partnership is challenging and requires industry-wide, global agreement.

THE GLOBAL START-UP ECOSYSTEM

Vimson Group collaborated with Newlab, a Brooklyn-based community of more than 900 experts and innovators, to co-found the Prospect Mining Studio. The programme supports the top innovators advancing the natural resource and mining industries by connecting them with public and private sector resources.

Using collaborative frameworks inspired by design thinking and open innovation, we seek to leverage the vast potential of the global start-up ecosystem while partnering with industry experts with deep knowledge of the sector's roadblocks. This enables decades of mining expertise to hone these emerging technologies according to how such solutions can be scaled and implemented.

The sector incontrovertibly needs urgent and drastic change to keep up with the energy transition, and the start-up ecosystem and emerging technology can make that possible. By nurturing innovative solutions, mining companies can pave the way towards a more environmentally friendly, efficient industry and, ultimately, a more resilient and sustainable world. wn

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Benefits and Sustainability Assessment and Implementation of the Sustainable Energy Access Planning (SEAP) Framework

Cleaner energy provision is very important and indicates good quality of life.

By | Adimchinobi Daniel Asiegbu (Cand. MEng (Energy))
Co-author | Prof. Raji Atanda

Access to cleaner energy leads to access to high-quality education (access to different academic platforms and institutions globally), a cleaner and greener eco-friendly environment (less environmental pollution), high-quality health services and healthy living, better energy services, energy equality, reduced greenhouse gas (GHG) emissions, reduced biomass combustions and reduced time spent on collecting fuelwood, high production, more employment opportunities, and access to efficient lighting, more time to relax and have entertainment, modern media and access to information and communication technology to mention but a few benefits of access to energy access.

In today's modern way of life, where cities are becoming smart cities and devices are more energy efficient and smart, policymakers and energy users need to know the benefits of clean energy access assessment. This paper discusses the benefits of Energy Access Planning (EAP), the approaches taken to assess data requirements, and the potential benefits.

POTENTIAL BENEFITS OF EAP

Some important benefits of energy access planning guaranteeing 1000kWh for modern urban (exceeding 450kWh for a rural) households of five persons per year, according to Asian Development Bank (ADB), are summarised and shown in figure 1.

APPROACHES TO BENEFITS ASSESSMENT: GENERAL APPROACHES

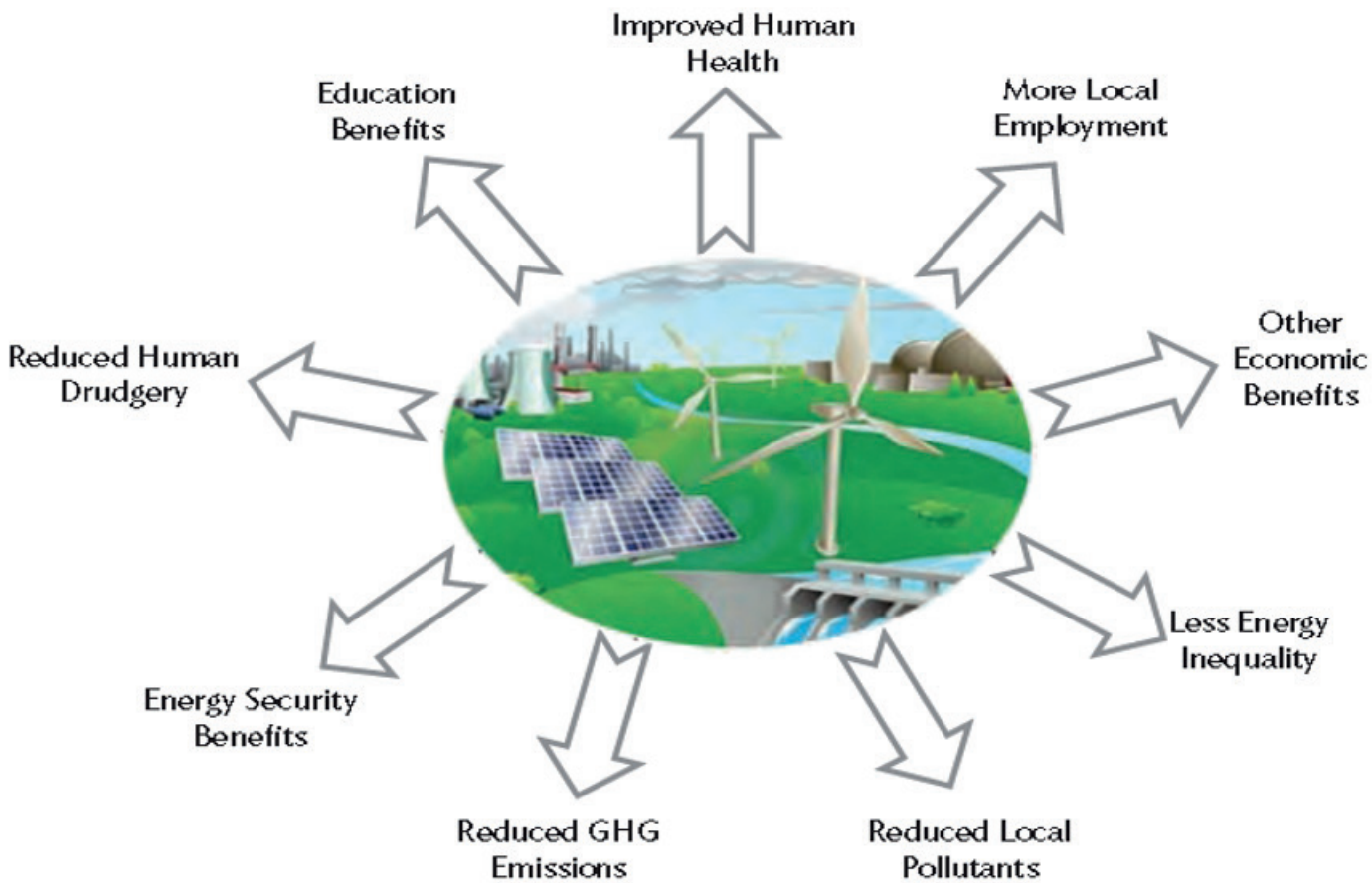
The benefits of energy assessment may not be in monetary form; thus, economists use Human Capital Approach (HCA), Revealed Preference Approach (RPA), and Contingent Valuation Approach (CVA) to do benefit assessment [1].

CAPITAL APPROACH (HCA):

This approach measures a person's economic value through improved personal productivity, education, and health. It shows positive changes in personal economic value, like high productivity due to reduced absenteeism. But it does not show changes in personal welfare from activities that improve the quality of life. Furthermore, this approach has limitations concerning the benefits of people outside the labour like the retired population and children.

REVEALED PREFERENCE APPROACH (RPA):

Marketplace Prices are used to measure the value of goods or services. This method uses techniques such as the time allocation models, the travel cost method, the hedonic pricing method or the estimation of consumer surplus. These methods use actual consumer preferences and choices, including welfare effects, which are the advantages of using these methods. For example, the consumer gain resulting from a switch to electrical lighting is the



GHG = greenhouse gas.
Source: Authors.

Figure 1: Some important benefits of energy access planning guaranteeing 1000kWh for modern urban (exceeding 450kWh for a rural) household of five persons per year according to Asian Development Bank (ADB).

amount by which the cost of lighting using traditional energy exceeds that of the same quantity of electric lighting.

Contingent Valuation Approach (CVA): This method is also called stated preferences. It is based on hypothetical survey methods that reveal people's willingness to pay for goods in a hypothetical market.

APPROACHES TO BENEFITS ASSESSMENT: SPECIFIC APPROACHES

EAPs may use survey-based approaches to assess specific benefits like Time savings, Increased productivity, Consumer surplus, Lower health care costs, longer study hours, better education, Higher future earnings, Less GHG emissions, a cleaner environment, Greater energy security, Reduced energy inequality. The formulas used for analysing specific approaches can be retrieved from the Sustainable Access Energy Planning Framework by the Asian Development Bank, and the needed data values for computation are retrieved from the data below.

Data Requirements

The data required for the benefit assessment include the following tabulated data set, shown in Table 1.

SUSTAINABILITY ASSESSMENT:

The five dimensions of sustainability assessment include Environmental, Economic, Social, Technical, and Organizational or Institutional dimensions or approach. The methods employed include identifying different energy access technologies, followed by identifying different dimensions. Then indicators are defined based on these sustainability dimensions, and weights are specified and assigned to these indicators. The Composite Sustainability Index (CSI) is calculated per technology option based on combined indicator assigned weights per technology option and ranked according to CSI values from

Average wage or salary (or income per capita)	Household size for each settlement category	Number of educations, health, and community institutions in each settlement category
Total population	(Energy-poor or non-energy-poor households)	power generation technologies and cooking options - lifespan
Total number of households	Investment expenditure	Average energy consumption of households and total energy consumption in the area
Total number of households running a business	O&M expenditure	Electricity consumption of households
Number of electrified and nonelectrified households	Expenditure per household	Number of connections per income group
Price of electricity per kilowatt-hour	Amount of fuel required	Global warming potential of GHGs
Cost of fuels	Types and amounts of fuel currently imported	Emission factors of pollutants
Technology costs	Number of energy-using appliances owned by households	Average number of study hours in electrified and Average number of study hours in electrified and
Number of hospital visits made in electrified and unelectrified areas		

Table 1: Benefit Assessment [2]

Mean inhabitants number/household	Sum of electricity consumption/district or area	Stove cost for different kinds and types.
Number of populations still using solid fuel currently	Percentage or share of renewable energy in total electricity supply	Fuel price Stability
The use of electricity by different income group	Forest area changes	Current technology durability of current and new plant or devices
Total household income	Devices/technologies available in the geographic	New technology Reliability of present and new
Amount of household income spent on fuels and electricity	Electricity transmission and distribution losses	The percentage or Proportion of the time spent to collect a particular fuel
Type of energy and amount imported	The sum of primary energy supply	Fuel Price of fuelwood, animal waste, agricultural
The types and amount of fuel consumed for cooking/heating.	Availability of repair and maintenance service	Providers for the different devices/technologies
Different type of fuel used	Instant availability of fuel	Supply interruption duration
Household share/energy consumptions	Fuel - monthly expenditure	Number of hours of electricity received by each household

Table 2: Sustainability Assessment [2]

highest to the lowest value representing the best option to the least option.

REQUIRED DATA

The summarised data required to do a sustainability assessment is shown in Table 2.

CONCLUSION

The Data retrieved from the above data set is very useful in performing Energy Access Planning (EAP) benefits and sustainability summary according to benefits assessment and sustainable assessment of the Sustainable Energy Access Planning (SEAP) Framework by the Asian Development Bank. This matrix format of presenting data is suitable for simulation and computer software development for processing the input data at record speed. It forms an energy benefits and sustainability assessments manual. Unlike usual energy access planning, SEAP retrieves the poor and non-poor household energy demand, using multidimensional energy assessments, incorporating their implementation in realising low carbon footprints, energy access for all, and energy sustainability for all good intentions. The overall achieved minimum energy household threshold is 1000kWh per year, representing the basic household modern energy need per annum, realised through cost-effective clean and modern energy supply. wn

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03/03/2023	Legal Liability: Occupational Health and Safety Act (OHS Act)
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07/03/2023	Operating Regulations For HV/MV Systems - ORHVS
09/03/2022	Photovoltaic Solar Systems
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