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The shifting dynamics of Western Australia mine decarbonisation

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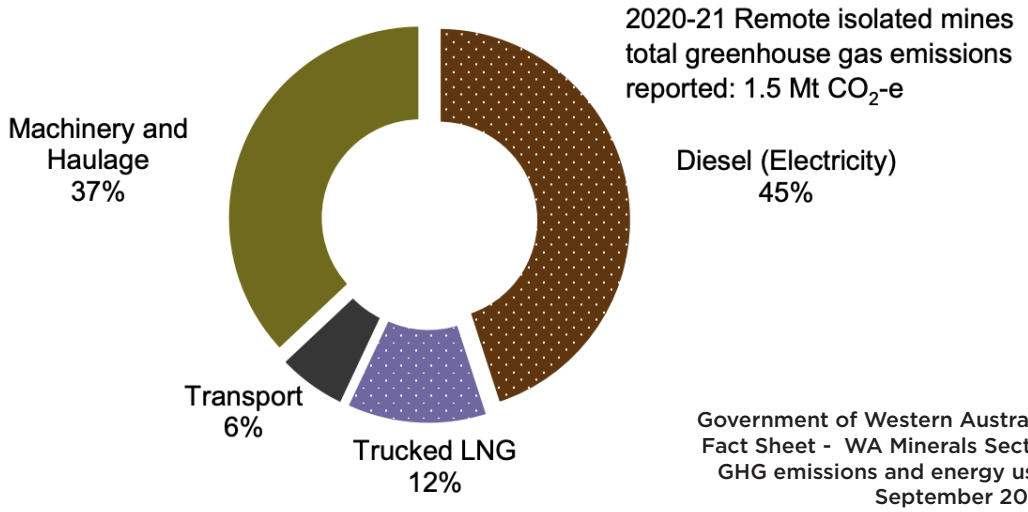
The shifting dynamics of Western Australia mine decarbonisation

Western Australia (WA) mines are some of the most ambitious in the world when it comes to renewable energy adoption. This drive is in no small way helped by the abundant availability of solar and wind power in the region, making renewable power cheaper than fossil fuels in many cases. Additionally, a significant proportion of WA mines (43 out of about 120) are not connected to an electricity grid or gas pipeline. These off grid mines are forced to bring diesel or gas to their sites by truck, adding to the cost of power and to the appeal of on-site renewables.

Figure 4: Western Australian remote isolated mines, greenhouse gas emissions by source



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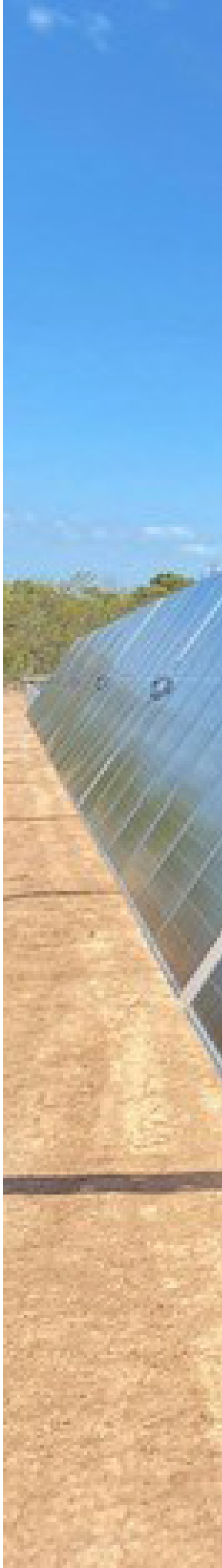
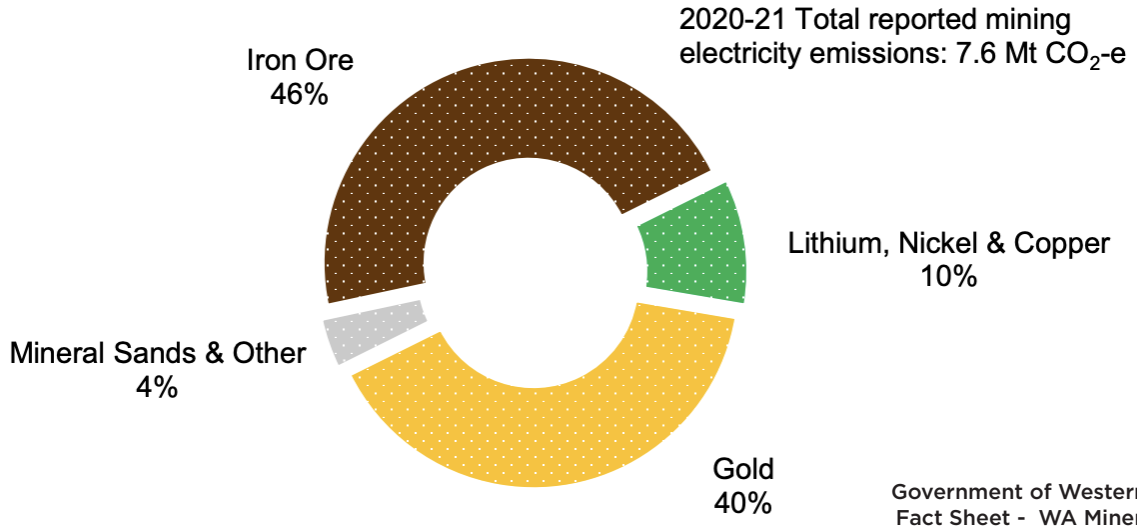


Weipa project.
Image courtesy of JUWI

The transition is also driven by the fact that WA supplies most of the minerals used for wind and solar generation, batteries and electric vehicles. Based on the latest statistics report from the WA Department of Mines, Industry Regulation and Safety, iron ore remains the region's main mining commodity, with 244 million tons (Mt) sold in 2021-22 for US$137bn. Iron represents 76% of all mineral sales for that year, and is followed by gold, with sales of 6.9 million ounces valued at a record US$17bn.

But the state also produces substantial amounts of lithium, nickel, copper, rare earth, cobalt and zinc: these are critical minerals for the net zero transition, and their value is rising tremendously. According to a WA government spokesperson, in 2021-22, Western Australia's battery and critical minerals industry sales rose to US$15.3 billion and employed over 15,000 full-time employees within the state. But special attention must be paid to

Figure 3: Western Australian minerals mines, electricity emissions by primary mineral



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Strandline Resources Coburn Site.
Courtesy Strandline Resources

their extraction, to ensure that greenhouse gas (GHG) emissions at the source don't counteract the benefits of transitioning to renewables and electric vehicles. "With this opportunity also comes a challenge, in ensuring new and increased demand for these minerals meets rising environmental, social and governance (ESG) expectations and does not negatively impact on the competitiveness of the mining sector," the spokesperson told Energy and Mines.

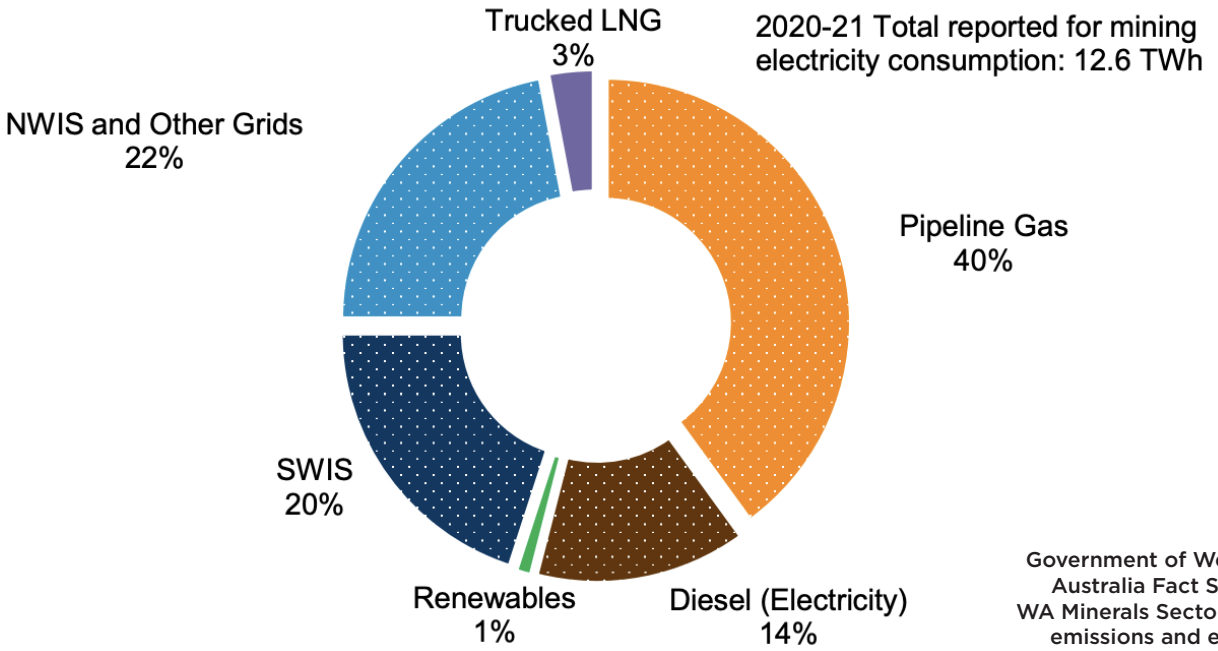
FINDING THE GOLDEN OPPORTUNITY

Almost half of the GHG emissions reported by mining companies come from electricity generation, so it makes perfect sense that green energy is such a big priority for mines in the region. But to turn this priority into a reality, miners need to identify their windows of opportunity.

In 2019, Gold Fields' Agnew site was the first gold mine in the state to commission a hybrid plant including solar, wind and storage. Stuart Matthews, Executive Vice President, Australasia, explains that the timing was perfect to make this happen. "We had a 20-year power purchase agreement in place, which was coming up for expiration. It was a good opportunity for us because it came at a time when we were expanding the mine, and the existing infrastructure couldn't meet our power needs going forward. So we quickly investigated the option of a renewable solution and standing alone on our own two feet for power, because we saw a great chance of the mine growing further," he said.

The company entered an agreement with EDL Energy, received

Figure 5: Western Australian minerals mining electricity consumption by source



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funding from the Australian Renewable Energy Agency, and the project was completed by January 2023. Today, Agnew gets 57% of its power from renewables on average, and up to 85% in optimal conditions. Gold Fields plans to increase the average to about 75% by adding more solar capacity in the near future. “In seven or eight years’ time, we will own this outright after we repay capital back to the people that built it for us, and then our cost base drops off a cliff. So it makes sense financially, too,” added Matthews.

For those coming into the market now, there is a chance to do things right from the start. For Darren Stralow, CEO of Bellevue Gold, integrating renewables was a no brainer. “Typically when you’re an exploration or development company, you’ll take the path of least resistance through to production, and then you worry about improving things after you’re already a cashflow company. We wanted to take advantage of the new technologies available, try and differentiate ourselves in the ESG space and make sure that there is strong value creation not just for ourselves but also for the communities that we operate in. So we took a deliberate view of improving things now so that when we’re in cashflow we’re already a leading company, and then we can improve off a better base,” he explained.

Bellevue is currently finalizing a power purchase agreement (PPA) with EDL, and is close to beginning construction of a hybrid power plant including solar, wind, thermal and a battery to enable up to 80% renewable power.

Strandline Resources went through a similar process for its Coburn Mineral Sands Project, which is powered by a hybrid energy solution operated by Pacific Energy Limited through a 15-year electricity supply agreement. The solution integrates a large solar plant and battery storage inverter technology with high-efficiency gas-fuelled generation. “As a new mining company, Strandline has benefited from starting with a clean slate at the

Coburn project in terms of mine design and operational practices. We were able to align immediately with modern ESG thinking and practices, and adopt the latest technology in mining equipment and renewables. This has given us a leading position compared to some older mines," Luke Graham, Managing Director and CEO of Strandline Resources, told Energy and Mines.

FROM LEAP OF FAITH TO 100% RENEWABLES

One thing is for sure: once miners take the leap, they never look back. Instead, they look to increase the proportion of renewables in their power mix. "The most noticeable shift we are seeing at the moment is the move from low and medium renewable energy penetration solutions to high-penetration solutions targeting around 80% renewable energy," noted Niklas Günter, Business Development Manager at JUWI.

This is because, when done correctly, the addition of renewables to a mine's power mix brings only benefits. As Matthews pointed out: "When we transitioned the power over, it was seamless." Now Gold Fields is completing the feasibility study on a hybrid project for its biggest mine site, St Ives. The project is almost four times as big as Agnew, and is set to deliver 85% renewable energy for the mine. According to Matthews, it will lower the mine's power costs from about A$0.19 to just A$0.06 per kWh — a very compelling drop.

Strandline's hybrid plant already delivers 30% renewable energy through solar panels, and the company is now considering the addition of wind turbines to reach 65% renewable penetration.

Meanwhile, despite aiming high from the start with 80% renewables, Bellevue is already looking at the next frontier. "The big opportunity for us from a storage perspective is long-duration storage. There's a technological barrier to that at the moment,

Weipa project. Image courtesy of JUWI

but that's a growth area that could push us beyond 80% RE penetration in the future," added Stralow.

It's clear that first movers in the WA mining sector have helped the entire market overcome its initial fears around changing the power supply. But current and upcoming technological advances are also supporting mines' journey towards 100% renewables. As Günter explained: "There are continuous improvements in renewable energy technologies such as more efficient solar panels as well as larger, more cost-efficient wind turbines. We are also seeing a trend to longer duration batteries, around the 2-4-hour timeframe."

CRITICAL MASS BRINGS NEW RISKS

Now that most miners in Western Australia are on their way to implementing renewable power, it is fair to say the first-mover advantage has dissipated. Instead, high demand is putting pressure on renewable equipment supply chains. "Being an early mover was probably easier for us because the supply chain risk wasn't there. We could go and get the wind and the solar immediately. Right now, manufacturing and supply is struggling to keep up with demand, so the timeframe to implement is probably longer," said Matthews.

Bellevue mine camp.
Courtesy Bellevue Gold

But another, potentially bigger issue looming on the horizon is the shortage of skills needed to make this transition. About a year before committing to net zero at the start of this year, the WA government established the Energy Industry Development team. The team consulted with the mining sector and local, renewable energy companies as well as other stakeholders to understand the key opportunities and challenges, and one conclusion quickly emerged. "Both the mining and renewable energy sector raise the issue of skill shortages and difficulty in recruiting staff as a key challenge," noted the WA government spokesperson.

At Gold Fields, Matthews admits that talent is "pretty scarce", adding that to counter that, the company is investing in a program to visit high school and even primary school students to talk to them about professional opportunities in mining.

But innovative miners that have clear decarbonisation goals should take comfort in knowing that a strong ESG strategy is

likely to be a selling point for talent. While Bellevue expects to be able to sell its green gold at a premium in the future, Stralow told *Energy and Mines* that the real value of the company's net zero ambition lies elsewhere at present. "The next generation coming through are very climate-conscious. They see what we're trying to do with Bellevue and say 'that's a place where I want to work'. We have very low turnover and availability of jobs, and our ESG strategy is a big driver for that," he added.

There remains a lot to do before the WA mining sector reaches its net-zero targets, and technological challenges around long-term storage and fleet electrification are yet to be overcome. But after a 71% increase in emissions over the decade to 2019, emissions declined for the first time — albeit only slightly — from 28 megatons of CO_2 equivalent in 2019-20 to 27.9 megatons in 2020-21. It seems as though the growing momentum around mining decarbonization is finally delivering the first glimpse of positive results.

‘Get started and get boots on the ground’

With a total of 9 projects in Australia, renewable power provider JUWI has proven that a hybrid system actually increases the reliability of a mine’s power system. *Energy and Mines* spoke to Business Development Manager Niklas Günter shortly after the company successfully commissioned the 5 MWp solar PV system at Rio Tinto’s Weipa operations, and as it approached completion at BHP Nickel West’s Northern Goldfields project.

Energy and Mines: Tell us about the challenges mines are facing in trying to draw down Scope 2 emissions from electricity use?

Niklas Günter: The primary challenge of the tier-1 miners is the sheer scale of the required emissions reductions. To achieve their net zero targets by 2030, they need to build gigawatts of renewable generation capacity in the Pilbara. These require lengthy permitting processes, both externally and within the mining companies themselves. And in the end, somebody will have to be on the ground building these projects to the expected high standards, which is a challenge given the limited availability of quality contractors.

Junior and mid-tier miners are usually more agile on the permitting and approvals side, but often don’t want to have capex-heavy renewables projects on their balance sheet. This leads to an additional layer of contracting via IPPs and overall longer process than direct EPC contracting. In addition, the lifetime of many mines is significantly shorter than the design life of renewable energy solutions, which can make the amortization of these projects challenging.

Integrating various types of energy sources into existing mine infrastructure in addition to fleet electrification poses further challenges, which requires a sophisticated and proven control system. Many manufacturers only focus on one or two subcomponents, however, from the mine’s perspective, you need an overarching control system with a holistic approach, which focuses on overall system stability and allows optimization during operation along with flexibility of future additions. The JUWI Hybrid IQ, based on a Siemens platform, offers exactly this.

E&M: How can mines run their sites on fully decarbonised power affordably?

NG: To fully decarbonise power supply at your mine site, you will need to look at a whole suite of measures which will complement each other. This starts with large solar PV and wind power generation and long-duration batteries. It should also include mine fleet electrification and smart charging strategies to align with renewable energy generation. Another important aspect is the actual operation of the mine and processing plant. Can you add flexibility in your crusher, mill, or even underground operation to increase throughput during sunny and windy hours and run at a lower rate during times of low energy generation?

You really want to align the demand with the supply as much as possible to avoid oversizing your power system and spending unnecessary capex. To reach the last few percentage points for a 100% clean power supply, you will need to

look either at seasonal storage or clean fuels like green hydrogen-based fuels or biodiesel.

E&M: What do you see as the main challenge for mining companies to achieve their net zero targets?

NG: Many miners set a target of reducing emissions by 30%-50% by 2030, with net-zero in 2050. To achieve these targets, massive investments in renewable energy, energy efficiency and electrification are required. And while the money is often ready to be spent, long external permitting and lengthy internal approval processes delay the implementation of promising projects. This bureaucracy could seriously jeopardize the company's ability to reach their intermediate targets in time.

On top of that, you have to remember that there is a shortage in construction resources. There will be many upcoming projects competing with each other, the closer we get to 2030, so the earlier you get started and get boots on the ground, the higher the likelihood that you will actually achieve your net zero targets.

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JUWI has a strong local presence in Australia with projects across the country and offices in both Brisbane and Perth.

The core focus of the JUWI Australia business is on hybrid energy solutions particularly for mining companies. JUWI delivers both remote off-grid projects on islanded microgrids and grid connected projects whether behind the meter or through other arrangements.

JUWI has been delivering integrated renewable energy projects on Australian mine sites since 2014.

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Mastering the hybrid energy equation

Hybrid power is a crucial step in the transition to net zero mining, but configuring a power plant that combines one or several renewable sources with a thermal source and energy storage is no easy feat. Adam Hentschel, Head of Operations for AusPac at Aggreko, shares his expertise on how to reach maximum efficiency.

Energy and Mines: Where are we at in Western Australia in terms of hybrid power uptake? Are there still mines running 100% on fossil fuels?

Adam Hentschel: The big iron ore miners are slowly adding renewables but have a long way to go to meet their targets. The mid tier miners are leading the way with companies like Gold Fields further advanced than most by including wind as well as solar and batteries. There are still a lot of mines running on 100% fossil fuels in WA. However, we are expecting the roll-out of renewables to keep increasing as it will no longer become a choice for the miners.

E&M: What tends to be the most cost-effective ratio between renewables and thermal power in this region at this point in time?

AH: A mine's location, the contract term and conditions have the biggest impact on the cost effectiveness of energy sources. If a mine is directly connected to the Dampier Bunbury Pipeline (DBNGP), like Citic Pacific, gas will be the cheapest source. Whereas, if the mine is not close to a gas pipeline and has at least 15 years or so of mine life and good wind resources, you might achieve about 80% renewable energy penetration cost-effectively. For a gold mine with three years of life left, diesel may still be the most cost-effective option.

Hybrid energy solutions are continuing to be developed and are improving efficiency and bottom lines massively. Whether the mine uses waste products or renewable sources the high risk of intermittency and unreliability means diesel will continue to play a significant role for the time being. Having a hybrid solution puts miners at an advantage however, as they can more easily integrate new developments in technology and renewables as they emerge.

E&M: How do miners view the different contract models for renewable energy and storage - owner operator vs. power purchase agreement (PPA)?

AH: Some mining companies want to own

their own infrastructure while others will assess it based on value and the cost of capital. Aggreko provides energy as a service which means miners have no costly up-front investment and their capital can be retained for business operations. Under the contract model, we tailor power plants to suit the site's size, environment, and compliance requirements. As a major investor in the project we continue to operate and maintain the plant, so it continues to work cost-effectively and efficiently. This includes the site's evolving power needs, including technological upgrades. This model essentially helps customers de-risk the threat of future innovation. It also frees up your working capital for profitable uses without increasing the project's debt ratio.

E&M: Last year in this interview, Aggreko mentioned that a rapid increase in activity for mining hybrids was expected over the next two years.. Has this turned out to be true? Can you give us some examples of new projects and their ambition?

AH: Big miners have been progressively trying to strengthen their climate commitments in the past two years, albeit there have been bottlenecks in supply chains and manufacturing since the pandemic.

A great example of a miner taking huge strides to support the Queensland Government's renewable energy targets is Rio Tinto. The miner called for proposals to develop large-scale wind and solar power in central and southern Queensland to power its aluminium assets. Doing this helps the miner with its own climate change ambitions, while actively encouraging more

Granny Smith mine.
Image courtesy Aggreko

renewable development and industry.

E&M: What could hamper the build-out of renewable energy systems for mines — where are the potential bottlenecks?

AH: Weak supply chains are a barrier to the energy transition, and in the past two years there has been a marked increase in them. While the war in Ukraine, other geopolitical factors, and the COVID-19 pandemic have caused bottlenecks in manufacturing and supply chains globally, I do believe there are going to be challenges in project delivery capability across Australia due to the shortage of skilled labour.

E&M: Given the rapid evolution of

technological solutions to decarbonise mining, one of the challenges for miners is to choose equipment today that won't limit their decarbonisation potential in five years' time. What are you at Aggreko doing to ensure that your solutions can accommodate miners' future ambitions, particularly around fleet electrification and green hydrogen?

AH: We offer fungible solutions as we support our customers on their decarbonization journeys and want to help them update their energy solutions with new technology and innovations as they become available. With our hybrid power stations – which may include a mix of gas, solar, wind, battery storage and diesel – power can be switched to another source and scaled up or down, depending on the renewable power available and the operation's daily requirements. We invest in the capital, remotely monitor it, and provide all the maintenance and technological upgrades along the way.

We are continually investing in projects to understand the potential of green hydrogen as a fuel source. In the future, once the industry is ready and capable, Aggreko will be able to swap out diesel or gas engines for hydrogen engines. Fleet electrification is also a major undertaking for miners and this will also be more viable with our flexible energy solutions.

E&M: How is the shift to decarbonised power resulting in operational and design changes for greenfield sites?

AH: With regards to design and operation of a mine, we aren't seeing much change yet other than a higher adoption of renewables. Electric vehicle fleets are also not too far away.

Image from Hera Mine courtesy of Aggreko

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The zero-carbon mine roadmap

As miners make their way to the zero-carbon mine, Jason Dickfos, Head of Growth at EDL, discusses how they can reach 100% renewable energy with today's technology.

Energy and Mines: Let's start by talking about Agnew: two years after commissioning the hybrid plant, what are some of the operational results you can share with us?

Jason Dickfos: Agnew was the first mine in Australia to be predominantly powered by wind. The award-winning power station provides 55-60% of the mine's power from renewable energy (RE), sometimes reaching over 80% in optimal conditions. Agnew has increased reliability, lowered operational costs, reduced Gold Field's carbon footprint, and improved energy efficiency. It has also provided flexibility, enabling a balanced mix of energy sources based on changing demands and availability. Our energy modelling aligns with Agnew's real-world results, which is very pleasing.

E&M: What changes did the addition of wind turbines in 2020 bring to these results, but also to the management of the hybrid plant?

JD: The wind farm required interfacing with the thermal station, solar farm and batteries to ensure optimal performance, significantly increasing Agnew's RE percentage. There is a diurnal effect where wind energy produced at night complements solar power generated in daylight hours, enabling a high RE percentage. Incorporating additional wind generation into our remote energy portfolio has been great. EDL's new status quo for renewables is now 80 to 90% RE due, in part, to the incorporation of wind generation.

E&M: What are some of the lessons you learned from Agnew and are bringing to the design of future solutions?

JD: We learnt a couple of important lessons–the first was configuring and operating the thermal plant; another is how batteries are used in a hybrid solution. We experienced challenges with the thermal plant as the stop/start and lower loads approach differs from how gas engines have traditionally operated. This learning has been incorporated into future projects. Most of our new opportunities have diesel as the thermal component instead of gas since diesel is more flexible at higher RE penetrations and better suited. We will still use gas in the future, but we're looking

at configuring plants to manage these issues. With batteries, we're very confident with how they respond in extraordinary circumstances and safeguard against frequency/voltage trips or spikes, providing a secure energy solution. We've benchmarked Agnew's real-world performance against our in-house energy model, so we can reliably predict how new projects will perform. It's great to have renewable projects like Agnew, Jabiru and Coober Pedy that continually provide real-time data to refine our model. This enables us to accurately determine high RE levels whilst installing less capital—providing the lowest cost of electricity and maintaining reliability.

E&M: Many of your new projects are based on a renewable energy level of 80% or more: what are some of the challenges EDL has overcome to achieve such a high percentage?

JD: We're reliant on increased energy storage and can viably develop 90% RE solutions. Beyond that, cost curves increase dramatically. We're investigating 100% RE using long-term energy storage and renewable fuels. Our Coober Pedy project has achieved 75% RE since 2017, often running at 100% renewables for extended periods: our record is 97 hours, and we've achieved approximately 22,000 hours of 100% RE to date. In fact, it has run at 100% RE for around 45% of the time! But it uses systems no longer implemented on new projects. When we built Coober Pedy, we relied less on the battery providing transition support to balance the intermittency of renewables. Now, the battery is our only transition source, producing a lower

Jason Dickfos with EDL CEO James Harman at the Agnew project

levelized cost of electricity (LCOE). Other improvements have helped us achieve higher RE and lower LCOE, with capex improving significantly.

E&M: Wind is part of the solution for Agnew and future projects in WA: tell us more about the opportunity wind represents for Western Australian mines, as well as the considerations mines need

to keep in mind when leveraging wind as part of a hybrid plant.

JD: Wind provides a significant opportunity for mines to reduce reliance on fossil fuels and transition to sustainable energy. Wind delivers substantial cost savings and will increase RE to 80-90%. However, you need a critical mass of wind turbines: at least three to four are required to justify mobilizing cranes and other logistics. Considerations include conducting resource assessments to determine wind energy potential and turbine locations. The typical wind/solar diurnal effect in many regions is also critical to justify different RE sources. As the cost of batteries decreases, we can install extra units to store more energy. We're always balanced: is it better to install more RE or energy storage? It's about continually optimizing to create the best outcome.

E&M: What are the latest developments in firming capacity for solar and wind power?

JD: These focus on the microgrid controller, which prioritizes renewables before fossil fuels whilst optimizing energy storage. Using energy storage to transition from renewables to thermal generation is vital to ensuring reliability and reducing LCOE by using the right mix. We continually look at the day-to-day performance of our existing projects to optimize how the microgrid controller schedules generation.

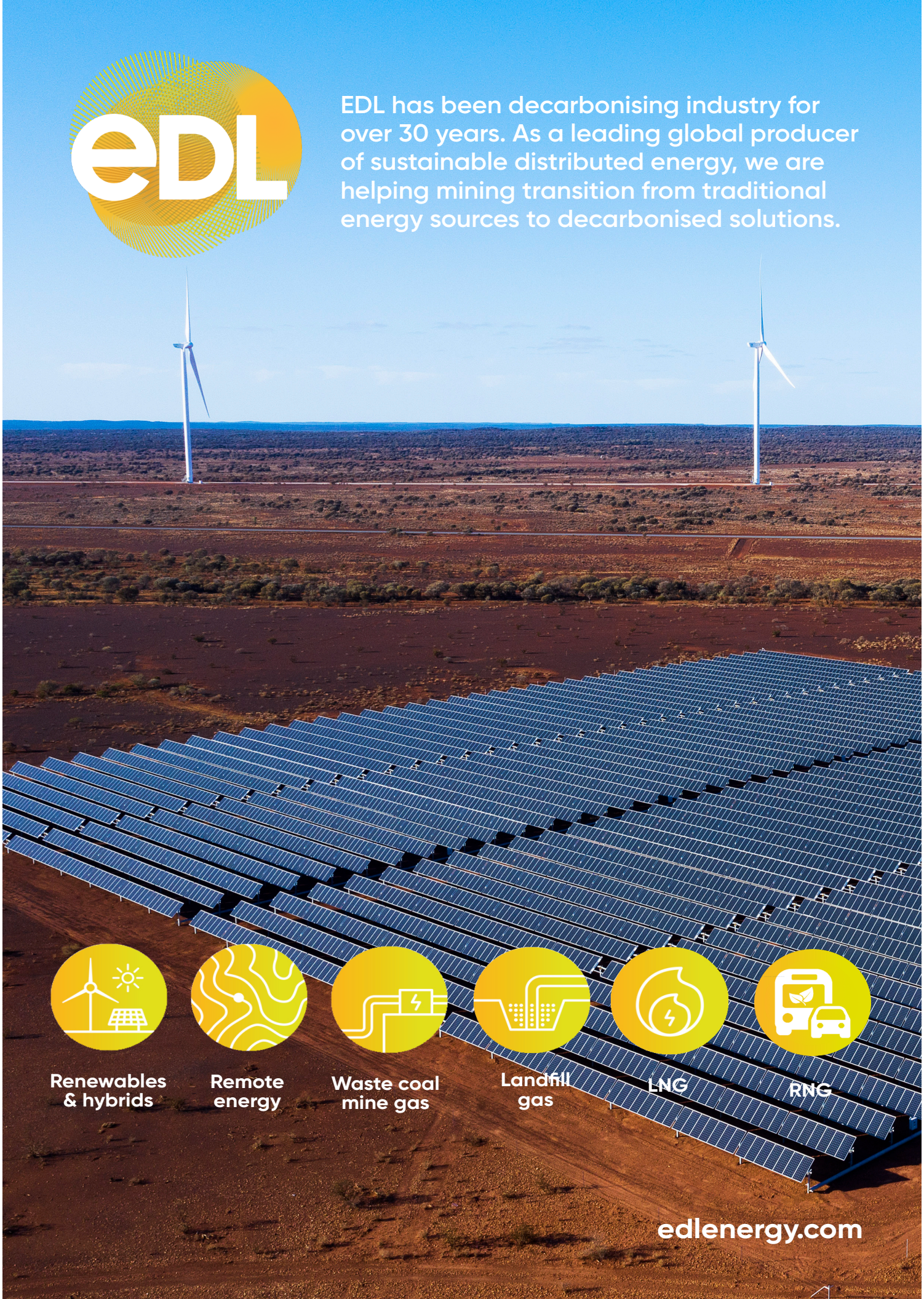
Agnew project. Image courtesy of EDL


Image courtesy of EDL

E&M: How can miners determine the optimal solution for specific use cases?

JD: This requires rigorous analysis of many factors, including energy needs, renewable resources, the project term and assumed costs of fossil fuels and carbon. Miners can conduct detailed energy audits to inform the solution sizing. Knowing load steps is essential for remote energy solutions as they produce large loads. Using our proprietary tools, we look at high-resolution demand profiles (under a minute, if possible) over a year and overlay these with available RE. We then overlay the storage required to determine the optimal RE percentage. We run hundreds of scenarios to establish the lowest electricity cost. Some mining operations are becoming more dynamic, where they will schedule loads when renewables are available. With that flexibility, you can create a higher RE percentage. Our comparison of off-the-shelf energy models with our robust in-house solution shows we can produce the same RE percentage using fewer installed components and spending less capital. We can help miners determine the best solution, helping them decarbonize and reduce energy costs over the long term.

Jason Dickfos will be presenting Optimising Renewable Energy for Decarbonisation at 4 PM June 14th, 2023, Optus Stadium at the *Energy and Mines* Australia Summit 2023.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Energy digitization: The quiet revolution

Solar, wind and batteries may take most of the spotlight when it comes to the green energy transition in mining, but digitization is an equally important part of the equation. Manoli Yannaghas, Managing Director at VoltVision, explains how data analytics and centralized energy monitoring are key to achieving a net zero world.

Energy and Mines: How does energy management support decarbonisation and electrification across multiple sites?

Manoli Yannaghas: I often describe what we do as the quiet revolution. Everybody talks about solar and batteries and hydrogen, and that's great. But if we're going to reach net zero, we've got to be looking at how efficient the operations are that we have in place today. Even though it's not sexy or exciting, cumulative small wins add up, and are essential to making the big step towards net zero.

At the moment most people get data out of their SCADA [Supervisory Control and Data Acquisition] systems, which are not designed to give raw power usage data. The result is that the knowledge and understanding of what power is doing across the network is not visible or accessible to the right people at the right time, resulting in inefficiencies.

VoltVision's data and AI platform ViViD effectively shows the mine operator what their power is doing: where they are receiving it from, how it is behaving over the whole network, and exactly where it is being used. We help our clients identify inefficiencies in granular detail so they can make the changes needed to save small amounts of energy in lots of different places. These multiple 'quick wins' add up very quickly. Obviously when you reduce your power use you also reduce your CO_2 as the two go hand in hand. By doing this we help our clients reduce their energy consumption and CO_2 by up to 10%.

The other thing to consider is the impact of making large CAPEX infrastructure investments, such as building a solar plant, before making your mine as power efficient as possible. Baking in inefficiencies means you will waste 10 or 11% of your CAPEX.

E&M: What exactly does it mean to digitize energy management for mines? What are the main steps and equipment involved in this process?

MY: It's a two-phase process.

The first part is data extraction. We've designed a way to retrofit our V-CUBE IoT onto existing equipment. In most cases we don't

need to visit the site: we courier the device and program it from the UK. Access is either through the meters or the HV relays. Relays are mini-computers that watch a particular part of the network to look for faults or issues. They collect massive amounts of data but every 10 seconds they delete it. So, what we do is extract the data from the relay before it's deleted and send it to the cloud. That gets us over 2,000 live, high-resolution data points in milliseconds. For data extraction we don't need any new equipment other than the V-CUBE, it's a low-investment retrofit (all OPEX).

The second part of the process is the transformation of vast quantities of raw power data into actionable information, using our own our cloud-base AI platform, ViViD. VoltVision takes this data and reduces it down to something really useful so clients can access the insights they need in near real-time. We've used our data and electrical backgrounds to design ways to avoid drowning them in charts and tables, instead our insights are presented in user friendly dashboards. What stands VoltVision apart, is our ability to cherry-pick relevant data from multiple sources, analyze and form patterns and relationships from it

and show our clients the minimum amount of information with the maximum impact.

We set up alerts about maximum demand, for example, so you can investigate and take swift action. Our data is also time-stamped at source so it's auditable and can inform SBTi programmes. This is really important when it comes to ESG reporting. When mining companies want to make changes to the power network, like integrating a solar plant or reducing the use of diesel powered generators, they can see very clearly the drop in CO2, and accurately report it.

E&M: What are some of the key takeaways from VoltVision's work with African mines on energy management and digitization?

MY: We have digitized all of Endeavour's west African mines. We did the installation across six mines in four months with no one visiting the site, which is an amazing achievement. We then conducted a deep analysis on two of those mines, and saved them a significant amount of OPEX: on one mine alone, we saved about 7-9% of their static power cost.

They've now got dashboards in all those mines, with Scope 1 and Scope 2 monitoring. Because we can see where every kilowatt comes from, we can also calculate its cost from a CO2 perspective. We have reduced their costs and their CO2 by 15 to 20,000 tons a year.

We've also reduced the amount of power they're using on one of their crushing circuits by about 20%, because they were able to better understand the implications of the harder mixes versus softer mixes on their cost profile. All in all, the return on investment for these two mines was paid back in under a month.

E&M: Why is this digitization necessary for mines' transition to net zero?

The mining sector already accounts for at least 4% of global energy consumption and the growing demand for minerals and metals, for technologies like renewable energy, will only increase consumption in the coming years. Mining plays a fundamental part in facilitating the green energy transition but it must do this as sustainably as possible - in other words decarbonising others whilst decarbonising itself. A key requirement in achieving this is uncovering every single inefficiency and to do that you need transparency. Digitization is about really understanding what you're doing in the moment and making sure it's as efficient as possible.

Manoli Yannaghas will be presenting the case study The Quiet Decarbonisation Revolution: Maximising Efficiencies at Existing Operations, June 14 at the *Energy and Mines* Australia Summit 2023, Optus Stadium.

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Transparent emissions reporting and the Safeguard Mechanism

Between greenwashing claims and evolving emissions reduction requirements, the legal framework governing mine decarbonisation in Australia can be difficult to navigate. Jo Garland, Partner at HFW, clears up miners' main concerns for Energy and Mines.

Energy and Mines: Corporate net zero targets are coming under greater scrutiny: what are some ways miners can avoid greenwashing in developing their net zero emissions plans?

Jo Garland: Based on the greenwashing litigation that we're seeing and the enforcement action that ASIC is taking, we'd recommend that miners:

- ensure that they have reasonable grounds and a scientific basis for representations about future matters, and that assumptions and qualifications are clearly stated to avoid statements being seen as misleading;
- are clear about what standards they are using to assess a product as environmentally or socially responsible;
- do not overstate their green credentials if their operations do not reflect those credentials;
- avoid vague terminology, such as labelling products as 'positive for the world' without considering what the positive impacts are or how the product contributes to those impacts.

E&M: What are the potential implications of changes to the Safeguard Mechanism for miners included under the scheme?

JG: There are three key implications if Labor gains enough support to pass the reforms. The most obvious implication is that covered facilities will need to reduce their emissions baselines by 4.9% each year. This will either require the purchase of offsets such as Australian Carbon Credit Units, investment in technology and processes that reduce emissions, reduction in output or a combination of these things.

Miners should also be aware of a new form of carbon credit under the scheme: Safeguard Mechanism Credits or SMCs will be automatically generated when covered facilities reduce emissions to levels below their 4.9% annual reduction target. Miners

can either 'bank' these credits for their own compliance in future years or sell them to other miners who cannot meet their baseline reduction rate. We expect that SMCs will be in high demand because there will be penalties of $275 per tonne of emissions above a facility's baseline.

Most miners will also be interested in the extra assistance available to 'emissions-intensive-trade-exposed' (EITE) industries. Approximately 80% of facilities covered by the Safeguard Mechanism fall into this category. These will be able to apply for funding from the Federal government's $600 million 'Powering the Regions' fund. The intention is for miners to spend this funding on technologies that will result in genuine emissions reductions. A subset of EITE industries, which are facing an elevated risk of carbon leakage, can also apply for a decline rate of less than 4.9%. However, the minimum rate will be 2% each year and this concession may not be available after 2030.

E&M: What key concerns are miners expressing through the consultation process?

JG: Some miners are concerned because meeting annual decline rates of 4.9% will be harder if all the "low hanging fruit" steps have already been taken: the "proactive facilities" who have actively been reducing their emissions are being penalised. On the other hand, they may also be rewarded if their emissions reductions have taken them closer to the 100,000 tonnes threshold: they will soon have the option of no longer being regulated by the Safeguard Mechanism. They can opt to stay in the mechanism, without any emissions reduction goals, to be able to generate tradeable SMCs for emissions below their 100,000 tonne baseline.

Miners are also concerned that the $600 million 'Powering the Regions Fund' will be insufficient to support transitioning industries: if 80% of facilities are EITEs, that's 170 eligible facilities and each could only receive a maximum of $3.5 million in funding. This may need to be completed by significant investment from companies themselves to achieve decarbonisation goals. We recommend that companies consider as soon as possible if they are eligible for any funding and begin putting an application together.

E&M: What are the next steps for changes to the Safeguard Mechanism and how can mining companies prepare for these changes?

JG: The Labor party managed to secure the

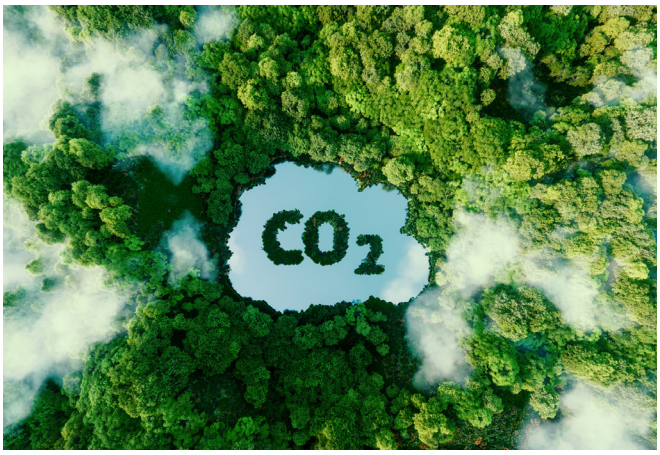
critical support of the Greens at the end of March, based on the imposition of a 'hard cap on emissions'. This 'hard cap' means that all Safeguard facilities combined cannot emit more than 1,233m tonnes of CO2 between 2021 and 2030. Commentators largely expect this to prevent companies meeting their Safeguard baselines solely by way of offsets, though there has been no announcement around restrictions on the use of offsets.

Protections will be in-built for EITE industries: Labor has announced that $400m in funding will be available for steel, cement, lime, aluminium and alumina industries, but not fossil fuel extraction. However, Safeguard facilities who do not fall into any of those categories have been left wondering if any support will be available for them.

The reforms are due to take effect on 1 July 2023, so the expectation is that draft legislation will be released in April 2023. Companies affected by the Safeguard Mechanism should review the draft legislation closely, as it will give further detail on how the mechanism will operate. Given the tight timeframe until the reforms take effect, it is imperative that companies act quickly to prepare for the changes.

E&M: With ESG now a key focus for shareholders and investors, what should mining companies be keeping in mind when reporting on carbon emissions and determining a credible pathway to reduce emissions?

JG: Even for the facilities that are not covered by the Safeguard Mechanism, there is shareholder, investor, financier and consumer pressures for voluntary sustainability



reporting. There are numerous Australian examples of shareholders holding directors to account over the lack of credible plans to decarbonise and inadequate climate reporting. Companies that engage in voluntary reporting may therefore want to familiarise themselves with the voluntary best-practice international standards for climate reporting, developed by the Task Force on Climate-Related Financial Disclosures. Compliance with these standards should lessen the risk of greenwashing allegations or shareholder activism.

There is also increased scrutiny on companies claiming to have reached emissions targets when those claims are purely based on the use of offsets and no real emissions reductions, particularly when the carbon credits used have low integrity. Recent instances of Australian companies purchasing fraudulent carbon credits, such as those generated in Papua New Guinea from a rainforest that was in fact being logged, highlight the importance of proper due diligence.

Jo Garland will be chairing the opening keynote panel at *Energy and Mines* as well as participating in a panel on the Safeguard Mechanism Impacts on Mining on June 14-15 at the Optus Stadium, Perth.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Making hydrocarbon-free mining a reality

Two years after delivering the microgrid that is now powering the Tellus Sandy Ridge mine through 100% renewables during daylight hours, Pacific Energy's Senior Technical Lead Craig Blizard shares the lessons learned from the project.

Energy and Mines: What are some of the operational results and key takeaways you can share from the Tellus Sandy Ridge microgrid?

Craig Blizard: Delivered in 2020, the Tellus Sandy Ridge Facility was the first Australian mine site to achieve 100% hydrocarbons off during daylight hours. Not only is the plant "smart", achieving a high level of renewable energy contribution, the microgrid is also fully autonomous and does not require on-site operational staff.

The utilisation of in-house developed autonomous control and electrical redundancy schemes has resulted in a robust, reliable microgrid, which significantly reduces process downtime.

This not only achieves reduced operational and maintenance costs, but also provides increased resilience to global fuel price fluctuations well into the future: from a site operational perspective, it means less reliance on diesel storage infrastructure and deliveries to site in remote locations.

This approach is scalable and can be applied to any sized mining or process application. The control system functionality has in fact been replicated at most of the Pacific Energy Group operations.

E&M: The mine is powered entirely by solar during the day: what are some of the technological innovations and management software that have made this possible?

CB: To achieve complete solar based generation, our team needed to develop and implement various technological innovations spanning electrical, control and software.

A key part of this is our own intelligent control logic, which seamlessly integrates multiple generation sources, allowing us to co-ordinate and co-optimise our system to generate reliable power while minimising carbon emissions.

In addition to our microgrid controller, we have designed and built a battery energy storage system (BESS) that stores excess renewable energy generated during the day, which also doubles as a prime power device providing ongoing power system stability even when not charging or discharging. The

stored energy from the BESS provides support during periods of low solar irradiance or high customer loads.

In more extreme cases, such as during solar or battery storage outages, resulting in a customer shortfall, our system seamlessly and autonomously transitions to our diesel backup generators, ensuring that security of supply is always maintained.

E&M: What are the next steps in achieving "hydrocarbon free" mining at Tellus Sandy Ridge and beyond?

CB: To address the next milestone, which would be 24/7 renewable-only based generation, will require the deployment of long-duration storage allowing the site to operate hydrocarbon free 24 hours a day. This transition would require detailed techno-economic and power system studies in

collaboration with our client to understand the future growth and demand of the site.

Consideration of new and future technologies entering the mining sector such as EVs (and associated charging infrastructure) can result in increased demand but could be used to unlock greater potential capacity to the mine's electrical network and facilitate access to much more stored energy, providing greater flexibility to remove fossil-fuel based generators.

E&M: How does this project help inform miners currently considering zero-carbon microgrids?

CB: Firstly, it's vital to note that it is indeed achievable to implement and operate zero-carbon microgrids. The technology is available and proven, and can result in safe, reliable, high penetration and autonomously operating mining microgrids. In saying that, it can be a long journey for new entrants to achieve the experience that is vital to understand the many scenarios faced with these systems and takes the right, collaborative relationship with a client to achieve the right outcome.

The largest constraint currently is the capital expenditure commitment for additional energy storage outside of daylight hours. That said, as ESG considerations are becoming a critical factor in the design and operation of microgrids, carbon taxes and/or carbon credits may contribute to making the zero-carbon microgrid cost-effective.

And whilst upfront capital investment can be seen as an obstacle, operating a zero-carbon microgrid will protect clients from future price fluctuations and limited supplies of fossil fuels.

Tellus Sandy Ridge project. Image courtesy Pacific Energy

Learnings from this project have shown that high reliability data acquisition and analysis is vital to understanding the load patterns and renewable energy available on each site to ensure there is correct understanding of the possible power balance.

E&M: What are the pros and cons of a phased in approach to decarbonising power vs. investing in the highest penetration of renewables and storage from the outset?

CB: In general, a faster transition to renewables is seen as an advantage, not only for the fuel price savings, but also to reduce reliance on fuel price escalations and supply chain dependencies sooner rather than later. Furthermore, there are clear advantages from a project delivery and handover perspective to do it one time only.

That said, there can be a number of advantages to a phased approach. One

example is the battery cost reduction curve, which continues to drive downwards. If this continues, there may be some value in staggering capital investment to allow a more gradual roll out and a flexible contracting methodology for expansion. Equipment, such as EV's, and other mining infrastructure are creating more demand on the power system as it continues to evolve. Again, collaboration with a client and flexibility for optimisation is a key requirement for success.

A gradual roll out, however, still requires just as much understanding on the application to ensure the milestones are properly understood and quantified both commercially and technically. Without this, it is impossible to be sure what approach is better as there is no 'one size fits all' solution.

E&M: What are the main considerations for miners considering mobility decarbonisation at a hydrocarbon-free site?

CB: One must understand the availability of renewable resources as well as an understanding on the load dynamics.

There should also be adequate consideration placed on the feasibility of replacing diesel-powered mining equipment with electric alternatives. Such a change adds complexity to the power system arrangement (charging infrastructure and battery technology for example) but may unlock significant potential within the network for greater utilisation of the renewable resources. Maximising renewable penetration at time-of-day charging and use will be critical to achieve the goals of the market.

Companies should also study the suitability of battery systems or hydrogen storage to address fluctuations in renewable energy generation and ensure a consistent power supply for mining operations.

Detailed study and planning of electrical infrastructure is required. The shift to renewables and stored energy, as well as possible EV uptake will require the microgrids to better facilitate bi-directional power flows and address power balance problems that have not been studied until now.

Finally, it is vitally important that companies work with integration partners who listen and deeply understand their operations and tailor the solution for their operational needs and objectives.

Craig Blizard will be presenting the case study First Australian Mine To Operate on 100% Solar Power, June 14, at the *Energy and Mines* Australia Summit 2023.

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