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Funding the energy transition

Annelie Wressmark
Group Editor

The Australian federal government has since the release of its budget in May been consulting on an array of new policies and strategies related to Australia's energy transition.

The centrepiece of the latest budget was the $22.7 billion Future Made in Australia package, which aims to accelerate investment in renewable energy, green hydrogen, refining and processing of critical minerals, green metals, low carbon liquid fuels, and clean energy technologies.

Firstly, to grow the renewable energy sector, the government will allocate funding to strengthen and accelerate approval processes for these projects, which will help developers in obtaining approvals faster, a process which can be very complex.

Separate to this, the government is consulting on a strategy to build skills in the energy sector, as well as a new guideline which will help developers in engaging early with communities on new transmission projects, another area of high contention.

The government has also proposed a tax credit scheme which will pay developers $2 for every kilogram of green hydrogen, for projects that reach final investment decisions before 2030. According to the budget, the government expects to be paying $1.1 billion in credits every year from 2027.

The budget also includes another round of the Hydrogen Headstart Program, with $1.3 billion allocated over 10 years from this financial year, to bridge the gap for early-mover green hydrogen projects.

The government further proposes to establish another tax incentive for critical minerals, providing operators a tax offset of 10 per cent for the costs of processing the 31 critical minerals currently listed in Australia.

Another area which Australian producers and operators are already trailblazing is the green metals industry, with the government allocating $18.1 million to explore and support the production of low emissions iron, steel, alumina and aluminium.

Furthermore, to grow Australia's low carbon fuel capacity, the government is allocating $20.9 million over four years to consult on incentives to support production of, and demand for, low carbon liquid fuels.

Clean energy technologies also gained support, including $1 billion to grow Australian solar photovoltaic manufacturing, while $523.2 million will help the development of Australia's battery manufacturing sector.

As the Australian government provides incentives to speed up investments in these areas, it is crucial to draw on past examples to ensure funding is allocated efficiently, since it is of little use if it does not entice additional investment from the industry.

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Australians support green energy but concerns around impacts grow

A new study has found support for Australia transitioning to renewable energy is strong across the country with 59 per cent in favour, but 41 per cent are concerned about the negative impacts of the transition to green energy on cost-of-living and household energy bills.

The 2024 Ipsos Climate Change study found that Australians are concerned about the negative impact of the shift to green energy on cost-of-living, which rose by 10 percentage points since 2022, and household energy bills, up 7 percentage points, plus reliability of energy supply, up 11 percentage points.

This is despite almost six in 10 Australians supporting the energy transition away from fossil fuels towards renewable energy generation.

The spike in cost-of-living worries has also changed Australians' priorities around the energy transition. Most Australians (59 per cent) now want to see energy prices – up 13 per cent since the same time last year - and energy supply reliability to homes and business (57 per cent) prioritised.

Australian scepticism about national climate change action and information is also high.

Half of Australians don't think there are any plans around the energy transition, or that it simply won't happen, while 54 per cent say they don't understand the actions being taken around climate change.

Reshaped Green Star Performance tool to help sector meet net zero

The Green Building Council of Australia has launched Green Star Performance v2, a comprehensive update to its sustainability rating tool, designed to meet evolving expectations.

GBCA's Senior Manager of Buildings, Fitouts and Market Engagement, Jamie Wallis, said when Green Star Performance first entered the market in 2013, the landscape of ESG and sustainable finance was vastly different.

"Investors are now looking for assets on a clear path to net zero, and the sustainable finance community needs to know whether assets are aligned with global decarbonisation goals," Mr Wallis said.

Accordingly, Green Star Performance v2 has been rebuilt to incorporate the latest megatrends and investor demands into a single, user-friendly digital tool.

It aligns with frameworks such as the Climate Bonds Initiative (CBI), GRESB, TCFD, and 14 of the 17 UN SDGs. Buildings with NABERS ratings can earn up to 27 points towards a Performance rating.

The tool takes a holistic view of sustainability, embedding circular economy principles into operations and addressing key areas such as fit-out waste, embodied carbon, health and wellbeing, social impact, nature, and climate resilience.

It also supports better corporate reporting and disclosure, aiding investors and banks in making informed decisions while providing facilities managers with a clear pathway to improvement. It is also more easily applied to all asset types, including social infrastructure.

"Our focus was on 'sustainability at scale'," said Wallis. "Where version one was designed for single buildings and adapted for portfolios, version two makes portfolios the default. We've developed a digital platform that harmonises with NABERS and helps sustainability teams manage the deluge of ESG reporting requirements, easing the burden and enabling smarter work."

All new projects must register with Green Star Performance v2 from 1 January 2025, and all projects must submit under Green Star Performance v2 from 1 January 2026.

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Strong commitment needed to progress hydrogen budget measures

The Australian Hydrogen Council (AHC), industry, government and diplomatic representatives recently gathered for the second Australian Parliamentary Friends of Hydrogen meeting.

The meeting followed significant support for the hydrogen and derivatives industries in the Federal Budget, which aims to support hydrogen production, technology development and skills.

Key policies include the Future Made in Australia, Hydrogen Headstart and Hydrogen Production Tax Credit, with consultation recently completing for the latter.

Dr Fiona Simon, CEO of the Australian Hydrogen Council said while Australia was starting to prioritise uses for hydrogen, she stressed the importance of the federal government progressing its recent budget measures quickly.

"Incentives such as Hydrogen Production Tax Credit and Hydrogen Headstart are absolutely vital. The public interest is in decarbonisation, and without very strong economy-wide price signals to value carbon – and even with them – we need to look at incentives from government to help bridge the gap and get major projects over the line for the 2030s and 2040s."

Leigh Kennedy, General Manager Supply Chain and Industry Development for the Australian Hydrogen Council, said the pipeline of technologies under development demonstrates Australia's capabilities across the hydrogen value chain.

"The recent budget announced $1.7B in funding for ARENA to establish a manufacturing innovation fund. This funding will work alongside the $3B earmarked under the National Reconstruction Fund for clean technologies – in effect, creating a pipeline of funding for the pipeline of technologies as they commercialise.

AHC's focus now turns to critical industry consultations on the Hydrogen Production Tax Incentive, green metals, low carbon fuels, and broader transport decarbonisation whilst continuing to foster Australia's trading relationships with Japan and Korea.

Social housing redevelopment's use of CLT sets new precedent in NSW

A social housing redevelopment by Homes NSW is on track to become one of the first and largest cross-laminated timber (CLT) social affordable apartment buildings in the state when it is completed in early 2025.

The $65 million development in Glebe will provide 75 new fit-for-purpose social homes across two eight-storey towers and separate three-storey terraces.

Designed to achieve a 6 Star Green Star rating, the renewal project will set a precedent in construction methodology for future built forms using CLT, while addressing critical housing needs in Sydney's inner west.

GroupGSA was engaged as the executive architect to deliver the pioneering project from tender to construction, in partnership with the builder, Kane Constructions. Since the initial concept, designed by Johnson Pilton Walker, the project has undergone several DA amendments to accommodate the use of CLT.

GroupGSA Associate Director and project lead Noura Thaha said the built form would comprise 85 per cent CLT, which was manufactured offsite. Less than 5 per cent of the whole building was steel.

"There tends to be a stigma associated with social, affordable housing, but this project is going to break that," Thaha said.

"This building is a high-end product in terms of sustainability and achieving a 6 Star Green Star rating. It will be a precedent for future CLT Class 2 buildings."

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The SST4 Micro is a unique four-gas device that stands out with its ability to detect hydrocarbons, toxic gas, and oxygen levels using three Solid Polymer sensors (O2/CO/H2S/SO2*) and an LPC (Low-Powered Catalytic). It also features built-in NFC and induction charging, ensuring a one-working-week runtime. Despite its rugged and compact design, this device doesn't compromise on essential features like a display having the most significant screen-to-front-face ratio on the market and clear alarm indicators that provide easy notifications and alarms.

The SST4 Mini is versatile and similar in design to its slightly smaller brother, the SST4 Micro. It offers an optional NDIR* or traditional high-powered catalytic bead as the detection method for LEL. It is essential in some applications where silicone may be present or more significant hydrocarbons may need to be detected.

The SST4 Pump* is a pumped four-gas device with WatchGas' in-house designed pump that allows a draw of up to 110 feet or 33 metres. It is ideal for confined space entry or sampling tanks, ship holds, or LPG units, and coupled with a wide range of accessories, it makes sampling easier than ever. The device can be used in diffusion mode, making carrying out permits to work for confined spaces faster and easier, providing you with the convenience you need in your operations.

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KAPITOL GROUP USHERS SUSTAINABLE PROGRESS IN CONSTRUCTION

Kapitol Group is leading sustainable change in the construction industry, with an environmental vision driven by effective client collaboration and the innovative implementation of technology.

Kapitol Group's vision showcases to construction companies how they can reduce their environmental impact through design and material choices together with sustainable construction practices.

Kapitol Group is the second largest privately-owned construction company in Victoria, with work on diverse projects across the commercial, education, industrial and residential sectors, and plans for national expansion.

It recently released its first environmental, society and governance (ESG) strategy, with the aim of driving significant change across the whole construction industry.

Along with its focus on sustainable design, Kapitol is committed to diverting an average 92 per cent of waste from every project as well as 100 per cent renewable grid power for all operations.

Amanda Clements, Head of Health, Safety, Quality and ESG at Kapitol Group, explained to Green Review that there was an unfounded mentality across the construction industry that solely developers – not builders – were responsible for ensuring projects were designed and built sustainably.

She said: "We believe we have the opportunity to make a big difference for the whole industry by being leaders in sustainability – it's something we're really passionate about."

Clements pointed out that Kapitol informed the design process of its projects during early contractor involvement (ECI); by influencing D&C projects through design decisions and through what is within its financial control as builder for 'construct only', such as waste recycling, green concrete, and replacing diesel equipment with electric.

She added: "Throughout the ECI process, we partner with specialist consultants to analyse upfront how to reduce embodied carbon by changing materials or designs, and we will work with our client to review Green Star requirements at the ECI stage too.

"Our ESG team works with our estimating and tendering teams to include green initiatives in our tenders, so they're included in our price and not something we have to add after-the-fact.

"This helps to mitigate issues relating to green initiatives often being more expensive than traditional materials."

Clements said that even with non-ECI or 'construct-only' projects, the design was never 100 per cent complete and there were always changes and improvements to be made as the project came to life.

Construct-only projects typically involve a contractor entering into an arrangement for the construction of a project for which the design has already been undertaken by a third party.

In these situations, Kapitol can influence sustainable design by providing business cases that utilise information and data the client may not already have, showing how sustainable design can be achieved.

Clements added: “Even if the options put forward are not accepted on the current project they are proposed on – because the design is already partially completed – then that information can support and influence decisions on future projects.”

Material selection is a key area where Kapitol is working to reduce embodied carbon, with cement-reduced or low-carbon concrete implemented across its projects as a minimum standard.

There are many benefits for replacing energy-intensive materials like cement, which releases additional greenhouse gases through the chemical processes that occur when making it, as well as depleting sand resources and eroding ecosystems.

While it may not always be feasible or practicable for some structural elements, Kapitol consistently utilises cement-reduced concrete for both slabs and pre-cast panels.

Tayla Fairthorne, ESG Manager at Kapitol, noted that the longer setting and curing times of cement-reduced concrete had greatly improved, but implementing it in pre-cast panels enabled it to be managed in a controlled environment offsite.

She said: “We choose to use cement-reduced/low-carbon concrete because it’s the right thing to do, even though it’s more expensive and has a longer curing time.

“Specifically, we’ve pursued the use of low-carbon concrete in precast panels for both build-to-rent and data centre projects, and recently achieved a cement reduction of 32 per cent in precast panels on a CBD student accommodation project.”

Fairthorne explained that Kapitol undertook an embodied carbon assessment on its data centre portfolio, specifically calculating the upfront carbon associated with the superstructure and substructure of the data centre’s various stages.

She continued: “This assessment netted tangible outcomes and data that could be used to inform more sustainable design, as well as providing an industry benchmark based on other similar data centre projects, which allowed us to understand how its designed compared in carbon intensity.

“Understanding the upfront carbon early in the project lifecycle can inform design decisions regarding the minimisation of embodied carbon.”

Kapitol’s use of the cement-reduced concrete blend on two of its data centre projects together resulted in an emissions reduction equivalent to taking 676 cars off the road for one year.

Other areas where Kapitol has exercised control to reduce its carbon footprint is in its construction practices during project development, with a primary method being the substitution of diesel-operated plant equipment for electric alternatives.

All of Kapitol’s new tenders have an option for an electric crane or electric battery set up, which has the potential to reduce emissions associated with traditional diesel generators by 80 per cent.

Kapitol trialled two AMPD Enertainer battery storage units from Blue Diamond on a large data centre construction site to power three electric tower cranes and onsite amenities, reducing diesel consumption on site by 7,600 litres a month.

Fairthorne said: “We hire most of our plant and equipment, so our ESG team works closely with our procurement team to identify and develop relationships with our suppliers to ensure that electric alternatives are always first priority on Kapital projects.

“We also work with our supplier to trial new electric plant and equipment, providing vital feedback on performance capabilities to ensure progression in this space.”

By Berkay Erkan

BATTERY STORAGE TRANSFORMING ENERGY MANAGEMENT FOR BUSINESSES

The growing availability of renewable energy and efforts to reduce operational emissions are increasingly making battery storage a critical technology for commercial and industrial organisations.

Battery storage solutions can enable businesses to store electricity when demand is low and dispatch it when high, providing significant advantages and allowing businesses to operate more efficiently and sustainably.

Stored energy can be derived from different sources, including the grid during off-peak hours or from renewable energy installations such as solar panels or wind turbines, and can then be dispatched during peak hours to reduce energy costs, used as backup power during outages, and potentially even fed back into the grid.

An important component of battery energy storage systems (BESS) is smart energy management, allowing the systems to be programmed to optimise energy use based on cost, peak demand times, and the business's energy needs.

Importantly, battery storage provides resilience and reliability with uninterrupted operations, which is essential for businesses that rely on a constant power supply, such as hospitals, refrigerated facilities, and manufacturers.

The three main types of BESS are pre-packaged battery modules (enclosed factory-connected batteries), a pre-packaged system (enclosed factory-connected batteries with other components, such as a charger control or inverter), and custom-made battery banks (individual batteries installed with other components and interconnected).

The main device that converts power between DC battery terminals and the AC line voltage – allowing power to flow both ways to charge and discharge the battery – is the bidirectional inverter or power conversion system.

The other primary device of a BESS is its energy management system, which coordinates the control and operation of all the system's components.

Whether paired with renewable or non-renewable energy generation, battery storage can help reduce energy costs, reduce grid dependency, and enable frequency control.

Moreover, battery systems that are co-located with solar, wind and gas generation technologies can maximise land use and improve efficiency, share infrastructure expenditure, balance generation intermittency, lower costs, and maximise the national grid capacity.

A 2017 study by the University of New South Wales found that the return on investment for commercial battery storage systems in Australia could range from three to 12 years, depending on factors such as the size of the system, the cost of electricity, and the availability of incentives.

However, battery storage technology has advanced significantly since 2017, which will have only enhanced the benefits to businesses.

Australia's battery storage market had a record-breaking number of installs in 2023 across the grid-scale, commercial, and residential segments – while the market is still dominated by utility-scale projects, the deployment of 402 megawatt-hours to commercial and industrial applications is still the most substantial growth yet.

Global consultancy McKinsey explained battery storage was an essential enabler of renewable-energy generation, helping alternatives make a steady contribution to the world's energy needs despite the inherently intermittent character of the underlying sources.

McKinsey said: "The flexibility BESS provides will make it integral to applications such as peak shaving, self-consumption optimisation, and backup power in the event of outages, [and] those applications are starting to become more profitable as battery prices fall.

"More than US$5 billion was invested in BESS in 2022, according to our analysis—almost a threefold increase from the previous year.

"We expect the global BESS market to reach between US$120 billion and US$150 billion by 2030, more than double its size today."

McKinsey has forecast a compound annual growth rate of 13 per cent for the global commercial and industrial battery storage segment, meaning it will reach between 52 and 70 gigawatt-hours in annual deployments by 2030.

The four subsegments of commercial and industrial battery storage are electric vehicle charging infrastructure; critical infrastructure such as telecommunication towers, data centres and hospitals; public infrastructure, commercial buildings and factories; and harsh environment applications such as mining, construction, oil and gas exploration, and events such as outdoor festivals.

McKinsey noted that public infrastructure and commercial buildings mostly use energy storage systems to help with peak shaving, integration with on-site renewables, self-consumption optimisation, backup applications, and the provision of grid services.

Notably, McKinsey suggested BESS had the potential to reduce energy costs for commercial and public infrastructure applications by 80 per cent.

Recent critical mineral oversupply and the subsequent drop in critical mineral prices – a result of mineral production exceeding growth in battery production – is expected to continue at least in the short-term, keeping battery storage costs competitive for the rest of 2024 and into 2025.

Nickel, lithium, and cobalt prices have fallen from their peaks by 60, 80, and 65 per cent respectively, while growth in battery production last year did not meet forecasts, despite the significant global uptake.

There are several kinds of battery chemistries used in BESS, with lithium-ion batteries such as lithium iron phosphate and lithium nickel manganese cobalt oxide the most common in battery energy applications.

Lithium-ion batteries are popular due to their small and lightweight design, as well as high capacity and energy density, which requires minimal maintenance and provides a long lifespan.

However, while they can be rapidly charged and have a low self-discharge rate, lithium-ion batteries can be cost prohibitive and have specific risks such as inflammability and intolerance to extreme temperatures.

Lead-acid batteries are widely available, low-cost, recyclable, and can perform effectively in both hot and cold temperatures, but compared to lithium-ion technology they have a low energy density and are slow to charge.

Other battery chemistries that have emerging applications for commercial energy generation include molten salt-based sodium-sulphur batteries; flow batteries such as the vanadium redox battery; and zinc-bromine batteries, which were developed as an alternative to lithium-ion for stationary power applications of all sizes.

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By Berkay Erkan

GREEN CLEANING SOLUTIONS MAKE WORKPLACES SAFER WHILE PROTECTING THE ENVIRONMENT

The growing emphasis on sustainable construction and more environmentally-friendly practices has seen the intersection of green buildings and green cleaning to create solutions for sustainable post-construction cleaning.

Green cleaning refers to efforts to protect human health and the environment by reducing toxicity, waste, and exposure to harmful substances found in conventional cleaning products.

The environmental and health risks associated with non-green products include volatile organic compounds (VOCs) that negatively affect air quality, chemicals that irritate eyes or skin, overexposure to dangerous ingredients for janitorial and other cleaning staff, and pollution from disposing of unused chemicals in waterways.

According to US environmental advocacy group Clean Water Action, factors to consider in safe green cleaning products include biodegradability; toxicity; recyclable packaging/packaging made from recycled materials; phosphate-free; comprehensive label of all active and inactive ingredients; natural fragrances; and free of dyes, hypochlorite, and chlorine.

There are several challenges businesses may face when incorporating green cleaning, including the perceived higher cost of eco-friendly products, their availability and accessibility, and resistance to change from cleaning staff and management.

A lack of standardisation across the green cleaning industry can also create confusion and reluctance to adopt green practices, while misconceptions around eco-friendly products being less effective than traditional chemicals still persist.

Paula Clasby, Head of Engagement and Marketing at non-profit Good Environmental Choice Australia, explained facilities management and cleaning product manufacturers were very aware of the benefits of green cleaning programs, but the products they have specified were not actually being used by cleaning staff in a lot of cases.

She said: “Often it’s simply a case of a cleaning staff member not understanding the importance of green cleaning products, or perceiving them to perhaps be inferior to the conventional products they’ve been using for years already.

“We’ve heard stories of staff members adding bleach to cleaning units that are designed to use only water, or insisting on using bathroom cleaners with a strong fragrance because that’s perceived as an indicator of an effective clean.

“It then becomes a matter of making sure that all cleaning staff understand what they’re using and how it will benefit them.”

The global contractual cleaning services market was worth about US$181 billion in 2023, according to Future Market Insights, while demand for cleaning services was expected to expand at a compound annual growth rate of 4.3 per cent leading to a total value of US$276 billion by 2033.

Increasing worker health and workplace sustainability concerns are driving this growth, primarily with the substitution of cleaning products that include dangerous compounds and carcinogens with all-natural chemicals and products.

Green cleaning products should not contain hazardous chemicals and pose fewer health risks, making them safer and more suitable for use around people with weakened immune systems or health conditions.

Along with health and environmental benefits of green cleaning solutions, their positive impact on air quality has been shown to increase the productivity of people using the space.

A study conducted by Harvard University researchers in 2016 examined office workers exposed to three different levels of air quality over a two-week period, that of a typical building, a green building, and an enhanced green building.

Study participants in the green building reported cognitive function scores 61 per cent higher than those in the typical building environment, while workers in the enhanced green building had a significantly higher cognitive function score of 101 per cent.

The enhanced green building had VOC levels reduced to about 50 micrograms per cubic metre, and provided 1.1 cubic metre per minute of outdoor air per person.

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SOLAR POTENTIAL OF UNTAPPED URBAN AREAS GROWS AS LOW CARBON TARGETS LOOM

Substantial underutilised car parks offer immense opportunities to integrate solar PV systems, enabling increased renewable energy production, solar shading, and electric vehicle charging.

Over the last two decades, rooftop solar photovoltaic (PV) systems have become one of the most cost-effective renewable energy technologies to be applied in densely populated urban areas.

While it is becoming increasingly more common to install these systems in cities, there are still challenges in deploying them at scale in urban areas due to density, and the orientation and the architectural configuration of these areas.

On the other hand, open car parks, which commonly cover enormous spaces within cities and urban areas, have higher flexibility and can accommodate structures that are optimally designed to integrate PV for higher energy yields.

These car parks are normally located in close proximity to workplaces, shopping centres, or airports and often frequented by a large number of people.

As such, car parks with shading structures can better protect people and vehicles from various weather conditions, providing vehicles with pre-cooling, which can effectively reduce energy consumption.

These structures also provide additional opportunities, for instance in utilising the electricity generated for local energy demand, including charging EVs.

A study published in the *Energies* journal, found that large-scale PV deployment in untapped car parking areas, which are estimated to represent up to 6.6 per cent of the urban footprint within cities, could have power outputs that are as large as PV installations in buildings, and provide another pathway for cities to achieve low carbon targets.

The study findings were underpinned by a university campus case study, with a car park footprint similar to those in cities, and demonstrated that less than 1 per cent of the available parking spaces were affected by shadows from surrounding buildings or vegetation.

Car parks have not been systematically utilised for PV deployment, but in recent years they have become increasingly more recognised for their huge potential in energy production.

In July 2023, France made it mandatory to install solar panels on parking lots containing 80 to 400 spaces, with compliance needed to be achieved within five years. Car parks exceeding 400 spaces must reach that goal within three years.

By 1 July 2026, all outdoor car parks with a surface area greater than 10,000 square metres and car parks with a surface area of between 1,500 and 10,000 square metres must be covered by 50 per cent with solar panels.

According to the French government, the photovoltaic parking lots could generate approximately nine to eleven gigawatts of energy, nearly as much as 10 nuclear reactors.

Another aspect of the French mandate is that by 1 January 2025, non-residential buildings with a car park of more than 20 spaces must have electric vehicle charging stations.

Car park solar installations that are equipped with EV charging can complement each other with the solar generated enabling on-site charging of EVs, offering both convenience and incentive for businesses, employees, visitors and customers.

According to a 2020 report by the ACT government, approximately 80 per cent of prospective customers were projected to install electric vehicle charge points with their solar car park systems.

While Australia has not yet introduced legislation to scale up solar car parks, installations are still growing in both number and size.

Australia's largest car park solar installation is located in South Australia, with 1,400 solar shaded car spaces at Elizabeth City Centre. More than 12,000 solar panels have been installed, covering approximately 22,000 square metres.

The projected annual renewable energy generation is more than 11.5 gigawatt hours – enough to power more than 2,000 average homes for a year.

Experts in Solar Car Park Solutions

Solar Car Parks was established in Australia in 2019, but its popularity has notably increased over the past year or so. This surge in popularity can be attributed to several factors:

- Increasing demand for electric vehicle (EV) chargers, necessitating more onsite clean energy generation.
- Recognition that rooftop solar alone may not suffice to meet the energy demands of sites.
- Growing demand for shaded parking to cool vehicles and mitigate the "heat island" effect.

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SOLAR CAR PARKS

About 40 per cent of overall waste in Australia comes from construction and demolition, underscoring both the substantial impact circular economy principles can have on carbon footprints, as well as the value opportunity it presents for the industry.

CIRCULARITY AN OPPORTUNITY TO GENERATE VALUE FOR CONSTRUCTION SECTOR

By Berkay Erkan

By replacing new materials with recycled or re-adapted ones, the construction sector can take advantage of circularity by reducing new resource production and waste.

Construction and demolition waste includes concrete, bricks, wood, glass, metals and plastic, comprising waste from the construction and demolition of buildings and infrastructure, including the planning and maintenance of roads.

A paper published last year in the *Waste Management & Research* journal explained that a circular economy depicted a system based on business models, which replaced linear production and disposal practices with circular ones.

It added that linear economic models were based on a 'take, make, dispose' mindset, implemented in raw materials extraction, onsite production, construction and disposal.

The authors said: "Circular economy replaces the end-of-life concept with reduce, reuse, recycling and other alternative waste management practices and strives in keeping products and materials 'in the loop'."

Key to incorporating circular principles into the built environment are sustainable design approaches that ensure a building can be deconstructed at the end of its life, with its various materials reused and recycled in a circular economy which mitigates or eliminates waste material.

It is estimated that with circular economy approaches integrated into its operations, the Australian

construction industry could reduce 165 million tonnes of carbon emissions each year by 2040.

Another distinct aspect of the circular economy is adaptive reuse, which can be described as an eco-friendly process of converting an existing structure, often unused or heritage buildings, to new uses and more appropriate contemporary functions.

Sustainability is central to the design principles of adaptive reuse, as it negates much of the embodied carbon and associated greenhouse gases that are created during the construction of new buildings.

Published last year by Built, the Demystifying the Circular Economy report outlined four principles necessary to transform the construction industry from one defined by wastage to one supporting resource conservation – design for disassembly, building materials as a service, adaptive reuse, and waste as a resource.

The authors wrote: "The most important phase is the first one – how we develop materials and make key design decisions.

"We need to question the technical and functional aspects of a product, to select more durable and better performing materials, [and] to design with future uses in mind.

"How we maintain and extend – use and reuse – a product's lifespan is also at the core of circularity."

A number of factors are driving up the demand for recycled building materials, including higher materials costs, increasing number of construction projects, high government recycling targets, and consumer pressure for more sustainable products and practices.

The cost of conventional construction materials in Australia has been increasing for several years, while consumer surveys show nine out of 10 Australians are more likely to prefer ethical or sustainable products.

Using recycled or reclaimed building materials in construction often has lower cost than virgin materials, and allows for the implementation of a circular economy approach to construction, which minimises waste, energy use, and carbon emissions.

As awareness of the benefits of recycling construction waste grows, recovery rates have improved, but are still not widespread.

A circular approach not only reduces pressure on finite natural resources, but also reduces the amount of construction waste materials going to landfill, which has both commercial and environmental costs.

Circular buildings can be achieved through several avenues, including using durable products made of secondary, non-toxic, sustainably sourced, or renewable,

"We need to question the technical and functional aspects of a product, to select more durable and better performing materials, [and] to design with future uses in mind."

reusable or recyclable materials; disassembly, reuse or recycling of embedded materials; and lifecycle assessment (LCA), lifecycle costing, and readily available digital information such as building material passports.

A material passport describes the characteristics and value of building materials and products for recovery, reuse and recycling purposes in larger volumes in open markets.

The concept is currently being developed by multiple parties, particularly in European countries, and there are several existing market tools linked to material passports, such as LCA and environmental product declarations.

Information about the material resources of a building can be useful for refurbishment purposes, or when a building is deconstructed and the products become available for other buildings or applications.

Helene Carpentier, Global Head of Circular Economy & Zero Waste at CBRE, explained that one key area in the building sector where resource consumption and waste generation were a challenge were space fit-outs, which are responsible for a third of emissions over the life of a building.

Carpentier said: "A fit-out is a process whereby interior building materials and components are installed, including flooring, wall and window coverings, partitions, doors, furniture and equipment.

"Before each fit-out, interior spaces are stripped of their components, with most products considered waste, [and] on average, fit-outs happen every eight years.

"By adopting a circular approach to building fit-outs, we can eliminate waste across the value chain and limit the negative impacts associated with the over-consumption of materials.

"There are three principles to a circular economy: design out waste and pollution, keep products in use for as long as possible and regenerate natural systems.

"Considering these principles, the built environment can reduce waste and embodied carbon while creating jobs and new capabilities locally through promoting repair, reuse, remanufacturing and closed-loop recycling."

NTEX: Leading circular economy in the NT

NTEX, under the dynamic leadership of owner Gerry Breen, has revolutionised environmental sustainability in the Northern Territory with its innovative approach and clear vision.

Established in 2010, NTEX has positioned itself as a leader in environmental rehabilitation, demolition services, and emergency waste management. However, it's their commitment to the circular economy that truly sets the business apart.

"Our goal has always been to transform waste into valuable resources," says Mr Breen.

"The NTEX Code Red Resource Recovery and Recycling Facility is a prime example of how we're achieving this."

The NTEX Code Red facility specialises in the recovery of construction and demolition waste, turning materials like concrete into high-quality aggregates.

Mr Breen explains: "Since July 2020, we've recovered over 71,000 tonnes of concrete and asphalt waste from our own demolition projects, which we've recycled into aggregates used in new construction projects. Now with the Code Red facility, we're accepting uncontaminated concrete waste from other contractors in the greater Darwin region and providing sustainable aggregate materials for the industry."

NTEX Code Red also proudly stands as the first tyre recycling facility in the NT, tackling a significant environmental challenge head-on. The facility shreds used tyres and exports the material for recycling into tyre-derived fuel, contributing to a global circular economy. This innovative approach mitigates local environmental hazards and supports sustainable practices worldwide.

NTEX has achieved its impressive circular economy outcomes through introducing groundbreaking recycling technology, importing state-of-the-art crushers and shredders from Germany, the first of their kind in Australia.

These advanced machines can recycle four different waste streams: concrete, tyres, light steel and car bodies, and green waste. This innovative technology not only enhances NTEX's recycling capabilities but also supports circular economy opportunities in regional and remote areas of the NT, ensuring that valuable resources can be recovered and repurposed locally.

NTEX's innovative approach extends beyond recycling, being heavily involved in environmental rehabilitation and remediation projects.

Mr Breen highlights the Jabiru wastewater treatment plant and Holtze land remediation works as key projects.

"These projects showcase our ability to handle complex tasks while maintaining our environmental integrity," he notes.

The company's commitment to sustainability is evident in its range of niche services, which include demolition and deconstruction, environmental rehabilitation and remediation, asbestos removal, emergency waste management, and circular economy consulting.

"We aim to be a one-stop solution for all environmental and waste management needs," Mr Breen adds.

Mr Breen and the NTEX team are particularly proud of the company's high standards, reflected in its certifications.

"Our management systems are certified to ISO standards for Occupational Health and Safety, Environmental and Quality. We work hard to maintain these certifications which are a testament to our commitment to safety, environmental stewardship and quality."

Mr Breen's vision for NTEX is clear: to lead the NT towards a more sustainable future.

"We are reshaping the Territory by pioneering the circular economy and setting benchmarks for the construction industry," he concludes.

As NTEX continues to innovate and expand, its work will undoubtedly leave a significant mark on the Northern Territory's environmental and economic landscape.

NTEX: Pioneering Circular Economy Solutions in the NT

ntex CODE RED

RESOURCE RECOVERY & RECYCLING

At NTEX, we transform waste into valuable resources. Our NTEX Code Red facility is at the forefront of recycling in the Northern Territory, specialising in the recovery of construction and demolition waste. From concrete to tyres, we recycle and repurpose materials, reducing landfill and supporting sustainable construction projects.

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SOIL TESTING AND REMEDIATION CRUCIAL FOR SUCCESSFUL PROJECTS

By Berkay Erkan

Effective soil testing is an integral first step for construction projects, as it can prevent future structural issues and identify the presence of harmful contaminants.

Soil can be contaminated from a wide range of activities, such as mining, fuel storage, steel works, landfill, and demolition works, as well as from leaks of human, agricultural, and industrial waste.

Moreover, different types of waste – such as metals, coal slags, and contaminated dredge spoil – have been used historically as backfill in low-lying urban areas, which can pose problems when the waste is disturbed by modern-day construction projects.

Even just close proximity to contaminated sites can cause issues for development, as contaminated soil can be transferred through flooding or groundwater flow.

A study from 2022 published in the *International Journal of Environmental Research and Public Health* explained that construction activities often led to a deterioration of the physico-chemical properties in and around construction sites.

The researchers said: "Through loss and compaction of topsoil, mixing of topsoil and subsoil, and occupation of the land by residual materials and waste materials, construction activities have potential long-term effects on the physico-chemical properties of the construction site soil, ultimately influencing land use and productivity."

They noted the physical and chemical parameters of soil differed significantly in pre- and post-construction, with the very fine sand content of soil in post construction at 6.91 per cent significantly higher than pre-construction at 0.82 per cent.

Furthermore, the soil organic matter of pre-construction road was 3.57 times higher than post-construction, while the soil bulk density of post-construction soil was 10.3 per cent higher than pre-construction.

The researchers added: "Topsoil stripping, a current method used in international practice to protect topsoil

Uncovering soil testing: Its purpose and importance in construction

Soil testing, also known as soil investigations or geotechnical investigations, is used by geo-technicians to gain an in-depth understanding of ground conditions. The soil composition is then further utilised to ensure project planning with confidence and mitigates risks.

WHAT CAN SOIL TESTING UNCOVER?

Once soil testing has been conducted, project managers are then able to do the following:

- Determining the suitability of the soil allows project managers to assess whether the construction project can be undertaken at the chosen site location.
- By conducting tests at different locations across the site, project managers can identify the types of soil present and adjust their strategy to match the soil's characteristics and suitability.
- Through testing the soil for strength, density, compaction, contamination, etc., project managers can assess the type of impact that the soil may have on the construction project.
- Soil testing allows geo-technicians and project managers to compile data that will drive technical and safety data reports, which is a necessary part in in ensuring approval from local councils to commence works.

BENEFITS OF SOIL TESTING

Quality Assurance and Control

Project managers are reassured that the soil samples they are utilising meet NATA specifications. As a result, the construction project will maintain a consistent level of quality throughout.

Safety Assurance

Ensuring that soils are complying with industry standards are critical to preventing structure failures, as WHS issues such as accidents, injuries and fatalities are all causes of structural failures.

Cost Expedient

Soil testing leads to significant cost savings in the future, as the structural integrity of the project is more secure due to the implementation of pre-construction testing processes.

Efficiency and Performance

Soil testing provides critical data that helps project managers determine the best practices and solutions for construction, therefore maintaining the longevity of the project.

SOIL TESTING SERVICES AVAILABLE AT COFFEY TESTING

Coffey Testing has a wide range of soil test methods available, such as soil classification, material quality and conformance, compaction testing and specialised soil testing to assist clients with their next project. Alongside an extensive network of geo-technicians, the company has both base and mobile laboratories located across Australia, ready to mobilise on a large scope of projects within the mining, transport infrastructure, residential, energy and defence spaces.

For more information, go to www.coffeytesting.com, or contact on 1300 175 331 to be redirected to your local Coffey Testing laboratory.

resources, involves removing topsoil from the construction site just before construction, stockpiling it in a fixed location, and reapplying it to the site when construction is complete.

"Topsoil application promotes the establishment of a persistent vegetative cover and improves revegetation success."

Pre-construction soil analysis comprises an assessment of various characteristics, such as moisture content, load-bearing capacity, chemical composition, compaction strength, and permeability.

The soil testing is critical because if done effectively, it can ensure the structural stability of the upcoming development by safeguarding against potential geotechnical risks.

What type of foundation that can be safely installed is determined by the bearing capacity of the soil, while its reaction to moisture can lead to specific risks that could compromise structural integrity over time, such as swelling, shrinkage, or erosion.

Moisture content analysis allows an understanding of soil compaction, settlement, and overall stability of the site.

REMEDIATION METHODS FOR CONTAMINATED SOIL

There are a broad range of biological and physiochemical remediation methods that can be used to reduce soil contamination, both in situ and ex situ.

In-situ techniques, which mainly involve some manipulation of the soil to introduce substances that stimulate remediation, can also consist of separating or concentrating contaminants so the pollution can be extracted and treated on-site or disposed of elsewhere.

These methods can be advantageous as they allow soil treatment without having to excavate and transport the soil, reducing costs and environmental impacts.

Importantly, in-situ methods can retain the soil's structure, organic matter, and biodiversity, which are typically difficult to restore after more invasive ex-situ methods.

A low-cost, energy-efficient, and environmentally-friendly method advocated by researchers is phytoremediation, which uses the transpiration process of plants to sequester essential elements and nutrients from the soil into their biomass.

Phytoremediation plays two principal roles in remediating polluted soils: stabilising contaminants so they are less mobile and less available, and removing them through degradation or transferring them to other media.

A limitation of phytoremediation is that it has a relatively slow rate of heavy metals removal.

However, the method was advanced recently by a research team at the University of South Australia, which developed a process that greatly accelerated this rate.

The remediation technique uses a super-efficient solar evaporation surface to draw water from the soil through a sponge-like filter that traps contaminants, mimicking the process of transpiration.

Dr Gary Owens, who worked on the research, said plants naturally drew mineral components out of the soil when they move water from their roots into their stems, leaves and flowers, where those mineral components are trapped.

Owens continued: "This means plants can be used to extract contaminants from soil, but the process is very, very slow, often taking multiple growing seasons, particularly in heavily contaminated situations where the soil toxicity means the plants struggle to grow and often die.

"We have created a system that mimics this process – a form of biometric plant – but one that does so at a much faster rate and without any of the problems caused by toxicity."

The new process can remove contaminants in as little as two weeks, followed by a relatively simple process which removes the captured contaminants from the biometric plant body.

This allows the plant materials to be harvested for reuse, and the adsorption material – having a very high saturation point – can be reused multiple times.

The solar evaporator used in the system was a variation of technology they had developed for many purposes, including desalination and wastewater purification.

Both the evaporator and contaminant-capture component are made from low-cost and abundantly-available materials with long operational lives, and the system has minimal maintenance, setup, and running costs.

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SOLAR POWER DRIVES COST SAVINGS AND SUSTAINABILITY IN BUSINESS

There has been a significant increase in solar energy systems investments within the commercial and industrial sectors in recent years.

By Shalinn Yeap

According to the International Energy Agency, global investment in solar photovoltaic technology is projected to exceed US$500 billion in 2024 — which will surpass investments in all other generation sources combined.

Driven by technological advancements and policy support, this rise in solar deployment is expected to decrease wholesale electricity prices in some countries, but also underscores the need for complementary investments in flexibility and storage capacity.

In order to mitigate rising energy costs, contribute to achieving net zero targets and stay ahead of competitors, many businesses and major corporations are rapidly making the switch to solar power.

While there are many incentives and benefits to adopting solar energy, it requires a substantial initial investment, depending on the system installed.

The fast payback is a major driver, as solar energy can drastically lower energy costs by offsetting energy consumption and allowing businesses to sell excess energy back to the grid.

The typical cost of grid electricity ranges from approximately 20 to 40 cents per kilowatt-hour, which can become quite expensive for large businesses or major corporations that require an unusually high amount of energy to sustain their daily operations.

Therefore, harnessing solar energy can significantly reduce overall electricity costs by decreasing the amount of energy purchased from the grid.

Transitioning to solar energy systems can offer businesses both financial and environmental advantages.

Key government incentives include the Small-scale Renewable Energy Scheme, which provides upfront discounts through Small-scale Technology Certificates, and various federal and state government rebates and grants.

For eligible small businesses, the Instant Asset Write-Off allows for immediate tax deductions on solar installations up to $20,000.

Additionally, green energy loans can provide favourable financing

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terms. These incentives can significantly reduce initial installation costs, lower ongoing energy expenses, and offer long-term savings, ultimately aiding businesses financially.

Both commercial and industrial solar systems offer substantial returns on investment. Commercial solar energy systems typically provide a shorter payback period and higher return on investment (ROI) due to their smaller size compared to industrial solar systems. Businesses can often recoup their initial investment within just a few years.

In contrast, industrial solar systems involve higher upfront costs because of their large scale and the advanced technology they employ. However, these systems can yield much higher ROIs over time, especially when they generate surplus energy that can be sold back to the grid.

As decarbonisation is rapidly prioritised across various industries, renewable energy sources — particularly solar energy — emerge as the best alternatives for helping businesses reduce their overall carbon footprint.

Not only does this transition help enhance a company's brand image but it can also widely appeal to the growing consumer and shareholder demand for environmentally responsible practices.

This is significant considering that only 100 companies are responsible for 71 per cent of global greenhouse gas emissions; as reported in The Carbon Majors Database published by the Carbon Disclosure Project. This ultimately highlights the impact that companies and investors possess when it comes to addressing climate change.

Rising energy costs and market volatility pose significant challenges for businesses and major corporations.

A surge in prices can have a direct impact on operational costs — particularly for companies in energy-intensive sectors such as manufacturing and hospitality. This can lead to various issues, such as reduced profit margins.

However, businesses that generate their own renewable energy are better positioned to safeguard against rising costs, achieving both energy independence and stability.

For companies in remote locations or those with unreliable grid connections, off-grid solar solutions and solar farms can provide significant advantages.

Commercial and industrial solar systems, while both harnessing solar power to generate electricity, differ significantly in scale, purpose, and design. Commercial solar systems are typically smaller and designed to meet the electricity needs of businesses, public institutions, and smaller facilities like schools, hospitals, and retail stores.

These systems, which range from a few kilowatts to several hundred kilowatts, often integrate with a building's existing infrastructure and may employ innovative technologies such as tracking systems to optimise energy capture.

These tracking systems adjust the position of the solar panels to follow the sun's trajectory, maximising energy absorption throughout the day.

Despite their smaller scale, commercial solar systems play a crucial role in offsetting a portion of a facility's electricity consumption, contributing to energy savings and sustainability efforts.

Industrial solar systems, on the other hand, are much larger and designed to meet the substantial energy demands of large manufacturing plants, factories, or utility companies.

These range from hundreds of kilowatts to several megawatts, utilising more advanced technologies and specialised solar panels, such as Concentrated Solar Power and extensive solar farms.

These systems not only offset a significant portion of a facility's energy consumption but also contribute to the larger grid or local utility, meaning they can supply power to entire on-site communities or industrial complexes.

The rapid growth of commercial and industrial solar investments reflects a transformative shift in the energy landscape.

As businesses increasingly recognise the financial and environmental benefits of solar power, the industry is poised for continued expansion.

With technological advancements, supportive policies, and a growing commitment to sustainability, solar energy is becoming an integral part of the commercial sector's strategy for a cleaner, more cost-effective future.

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CONFERENCE AND EXHIBITION

By Shalinn Yeap

AUSTRALIA'S WIND ENERGY REVOLUTION — FROM LAND TO SEA

Australia, with its extensive coastline and diverse landscapes, is uniquely positioned to harness the power of wind energy on a never-before-seen scale.

As the country strives to best satisfy the needs of a successful energy transition, wind power has steadily surfaced as one of the most favourable renewable energy resources.

The wind energy landscape in Australia has witnessed significant achievements, with its impressive array of well-established onshore developments as well as a plethora of promising offshore projects on the horizon.

The nation's vast coastlines and extraordinary wind conditions also present outstanding potential for both sectors to flourish.

Onshore wind energy has been thriving in Australia's renewable energy landscape for over 20 years. The start of this new era in Australian energy production began when the country's first wind farm — the Salmon Beach Wind Farm in Western Australia — commenced operations in 1987.

Today, similar onshore wind farms are scattered around the Australian countryside in all

states, with Victoria, South Australia, New South Wales and Western Australia ranking in the top four.

According to the most recent data, WA currently features 20 operational wind farms, while SA has 21 operational wind farms. However, WA has a larger number of proposed projects, with 31 additional wind farms in the planning stages; compared to SA's 17 proposed projects.

There are several factors why Australia has been so successful in securing onshore wind as a reliable source of energy.

First of all, it is extremely cost-effective as it has become one of the cheapest forms of new electricity generation within the country.

Technological advancements and large-scale efficiencies over the years have also reduced overall costs. On top of this, wind farms usually take just a few months to reach the commissioning stage after commencing construction and this has allowed Australia to swiftly scale up its renewable energy capacity.

Additional factors behind the success of onshore wind include its compatibility with existing land use, with wind farms usually built on agricultural land.

This incentivises farms to lease their property to wind energy companies, allowing them to earn extra income without disrupting their operations.

Additionally, Australia's geography facilitates exceptional wind conditions in many areas — especially along the southern coastline and in elevated inland regions.

These circumstances have enabled the onshore wind sector in Australia to continue to grow in recent years.

In 2021, the nation had more than 8GW of installed onshore wind capacity, while the most recent data estimates Australia's total installed onshore wind energy capacity at around 11.3 GW.

This steady increase can be attributed to successful government policies, such as the Renewable Energy Target (RET) and state-based renewable energy auctions.

However, the onshore wind sector faces challenges, including grid connection issues in some remote areas, community concerns about visual impacts and noise, and the need for careful planning to avoid impacts on wildlife, particularly birds and bats.

Despite these challenges, the future of onshore wind in Australia looks bright. The Australian Energy Market Operator's 2022 Integrated System Plan projects that onshore wind capacity could reach up to 50 GW by 2050, playing a crucial role in the country's transition to a low-carbon electricity system.

While onshore wind has been powering Australian homes and businesses for years, offshore wind is just beginning to make waves in the country's energy landscape.

"In 2021, the nation had more than 8GW of installed onshore wind capacity, while the most recent data estimates Australia's total installed onshore wind energy capacity at around 11.3 GW."

The potential for offshore wind in Australia is enormous, with the Global Wind Energy Council estimating that the country could generate up to 5,000 GW of electricity from offshore wind — a staggering 100 times the installed capacity of Australia's two largest electricity networks.

The Australian government has recognised this potential and is taking steps to develop an offshore wind industry.

In 2021, the Offshore Electricity Infrastructure Act was passed, providing a framework for the development of offshore renewable energy projects in Commonwealth waters.

Several factors make offshore wind an attractive proposition for Australia. Offshore areas typically experience stronger and more consistent wind speeds, leading to higher energy production.

Further, many of Australia's major cities and industrial hubs are located near the coast, reducing transmission distances for offshore wind projects.

Offshore wind farms can also utilise larger turbines than their onshore counterparts, increasing energy output per installation.

Moreover, by moving turbines offshore, some of the land use and visual impact concerns associated with onshore wind farms can be mitigated.

There are several priority areas for offshore wind development that have been identified.

The first area to be declared suitable for offshore wind projects is off the coast of Gippsland, Victoria, in the Bass Strait.

This was followed by a second declaration of the Hunter region of New South Wales.

These areas have been chosen for their strong wind resources, proximity to existing transmission infrastructure, and potential to support industrial decarbonisation efforts.

One of the most advanced offshore wind projects in Australia is the Star of the South, proposed for the waters off Gippsland. If built, it could become one of the largest offshore wind farms in the world, with a planned capacity of up to 2.2 GW — enough to power around 1.2 million homes.

However, the development of offshore wind in Australia is also facing challenges.

Offshore wind projects are more expensive to develop and construct than onshore projects, although costs are expected to decrease as the industry matures.

Australia's deep waters may require the use of floating wind turbines in some areas, a technology which is still evolving.

Careful planning is also needed to minimise impacts on marine ecosystems and migratory bird routes. Additionally, while the Offshore Electricity Infrastructure Act provides a foundation, the regulatory landscape for offshore wind in Australia is still developing.

Despite these challenges, the potential benefits of offshore wind for Australia are significant. Beyond clean energy generation, the industry could create thousands of jobs, drive regional development, and support the growth of green hydrogen production for domestic use and export.

The integration of onshore and offshore wind will be key to maximising the benefits of wind energy for Australia.

This could involve complementary generation profiles, as offshore wind often peaks at different times than onshore wind, potentially providing a more consistent overall wind energy supply.

Onshore and offshore projects could also potentially share transmission infrastructure, reducing overall system costs.

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By Berkay Erkan

CLEAN ENERGY GROWTH BOOSTED BY HIGH DEMAND FOR RENEWABLE PPA

An increasingly popular solution for businesses to secure reliable and cost-effective renewable energy is through a power purchase agreement (PPA), which also promotes the growth of the renewable energy industry and can hedge against rising energy prices by allowing businesses to lock in a fixed price over the term of the agreement and ensure price certainty.

Businesses consume the bulk of Australia's energy supply, particularly energy-intensive industrial sectors such as manufacturing, mining, construction, agriculture and utilities, which together account for 51 per cent of national energy use.

Less energy-intensive sectors such as retail, education, healthcare and commercial transport account for another 27 per cent, while only 22 per cent of net energy use is by Australian households.

Developing a clean energy strategy can help businesses achieve 100 per cent renewable energy and emissions reduction, through an individually crafted mix of measures to reach clean energy targets.

Benefits of a strategy stretch across all aspects of a business, enabling growth through improved facility design and enhanced brand loyalty, better risk management by meeting investor expectations and improved energy security, more environmentally-friendly operations, and higher productivity.

Measures can include energy reduction, energy efficiency, onsite solar or other renewable energy, offsite procurement of renewable energy, and the purchase of carbon emission offsets.

Having a strategy can provide a better understanding of a business's energy profile; identify where its energy costs come from; and give a roadmap to improve competitiveness, reduce costs, and enhance reputation.

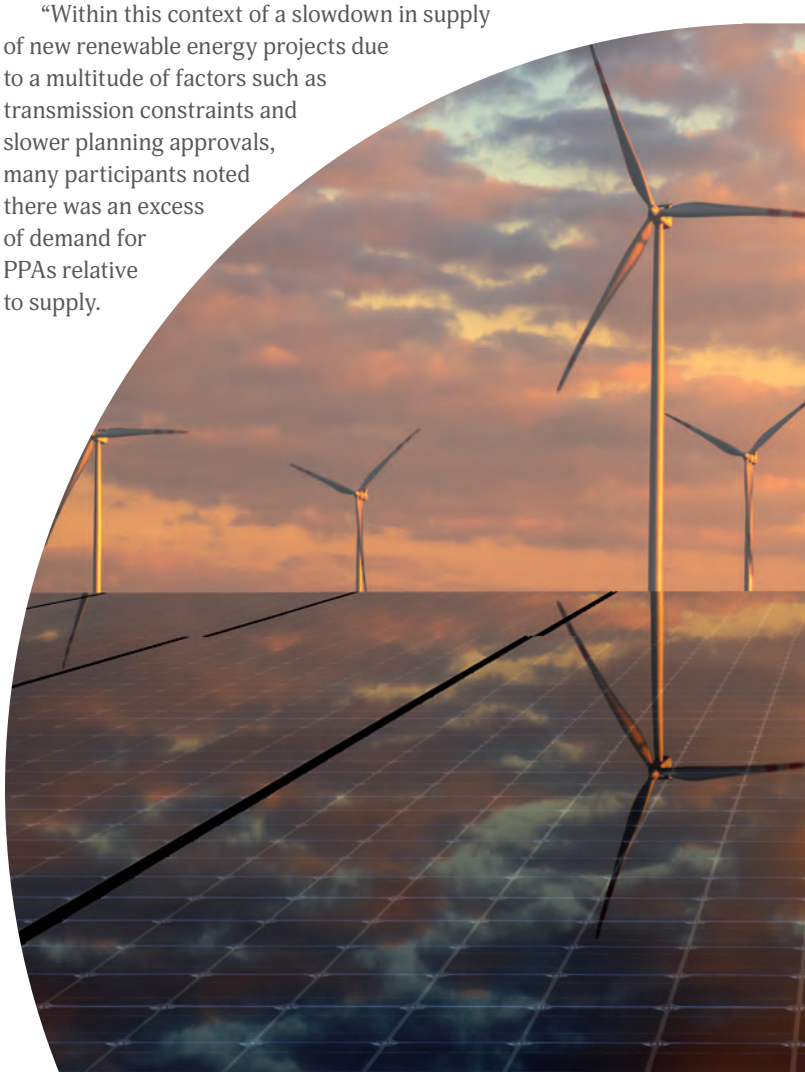
It is increasingly optimal for medium-sized and larger organisations to develop and implement a PPA, which is a contract between an energy generator and an off-taker, such as a utility company or a large commercial and industrial consumer, that defines the terms of sale for clean electricity.

Corporate renewable PPAs reached a record high in 2023 with more than 1,700 megawatts contracted, up from the previous year's record of about 1,500 megawatts.

According to the 2023 state of the market report by Business Renewables Centre Australia, there have been 165 corporate PPAs negotiated since 2017, contracting more than 7.4 gigawatts of renewable energy generation.

The authors wrote: "Many participants described the Australian corporate renewables PPA sector in 2023 as a 'seller's market'.

"Within this context of a slowdown in supply of new renewable energy projects due to a multitude of factors such as transmission constraints and slower planning approvals, many participants noted there was an excess of demand for PPAs relative to supply.



"Buyer demand, underpinned by net zero and sustainability targets, remains high.

"There were various manifestations of a seller's market including higher prices (also reflecting supply chain cost increases) and reports of developers conducting quasi-auctions among buyers."

> "Growth in renewable energy production has mostly stemmed from solar photovoltaics (PV), with high state-level targets and power purchase agreements driving the expansion of utility-scale renewables."

In February, Rio Tinto signed the largest renewable PPA in Australia to date for energy supply to its Gladstone operations in Queensland, contracting the majority of power from Windlab's planned 1.4-gigawatt Bungaban wind energy project.

The Gladstone production assets include the Boyne aluminium smelter, the Yarwun alumina refinery, and the Queensland Alumina refinery.

The Windlab PPA contracts 80 per cent of all power generated at Bungaban over 25 years, while the remaining 20 per cent will supply the National Electricity Market.

Rio Tinto also finalised a PPA with European Energy's 1.1-gigawatt Upper Calliope solar farm the previous month, making the miner the biggest industrial buyer of renewable power in the country.

The two PPAs combined will provide 2.2 gigawatts of renewable energy to Rio, with the potential to lower carbon emissions by about five million tonnes a year and generate the equivalent of 10 per cent of Queensland's current power demand.

Rio is aiming to halve its global Scope 1 and 2 carbon emissions this decade, and the two PPAs combined with more renewable power and suitable firming, transmission, and industrial policy can provide the core of its Gladstone repowering solution.

Rio Chief Executive Officer Jakob Stausholm said the agreement with Windlab built on Rio's momentum in its work to repower the Gladstone operations and provide a sustainable future for heavy industry in Central Queensland.

Stausholm said: "The task remains challenging, but we have a pathway to provide the competitive, firmed power our Gladstone plants need, and we are continuing to work hard with all stakeholders, including the Queensland and Australian governments, on getting there.

"Competitive capacity, firming, and transmission, are critical to developing a modern energy system that can ensure more large-scale renewables development in Queensland and help guarantee the future of Australian industry."

Growth in renewable energy production has mostly stemmed from solar photovoltaics (PV), with high state-level targets and power purchase agreements driving the expansion of utility-scale renewables.

Global solar panel installations reached a record 268 gigawatts in 2022 and are projected to reach 1,000 gigawatts by 2030.

A report by think tank Climate Energy Finance noted that the prices of polysilicon, which are used to make

thin panel wafers, have gone down by two thirds since December 2022, contributing to a global solar boom that was disrupting energy markets and speeding up the clean energy transition.

Australia leads the world in both solar deployment and integration, according to the Australian PV Institute's (APVI) National Survey Report of PV Power Applications in Australia 2022.

APVI pointed out 2022 saw commercial and industrial rooftop installations exceed residential installations for the first time, with 1.35 gigawatts of installs on residential roofs and 1.47 gigawatts on commercial and industrial over the year.

Professor Renate Egan, APVI Secretary and coauthor of the report, explained that the rooftop market was expected to remain strong through to 2030, with increasing interest due to price pressures related to the supply of coal and gas and increasing reliability issues with old coal-fired plants facing decommissioning in the next decade.

She noted that interest in AgriPV, or the use of photovoltaics in agriculture, continued to grow with a number of case-study plants built in Australia over the last few years.

Prof Egan said: "Large-scale solar is seeing a pipeline of projects that are being supported by state-led incentives, while ultra-large-scale plants – between 10 and 30 gigawatts – are also growing in interest for industrial use and electricity export, with several of these projects in the planning stage.

"All Australian states now have a zero carbon by 2050 target and plans for renewable energy zones.

"The newly elected federal government has made firm commitments to net-zero emissions, which stands to improve investor confidence leading to a projected growth in the solar PV sector."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We have so many opportunities to work with customers to reduce their energy consumption, and give them a cost-effective green solution.

David Hayes
CEO, Next Green Group

In the face of unstable electricity prices and a growing emphasis on sustainability, Australian households and businesses are actively seeking ways to reduce their energy consumption and embrace renewable energy solutions.

The Melbourne-based Next Green Group was formed to help its customers achieve this transition. Next Green Group combines the well-established Next Business Energy with the energy-efficiency and solar market leaders, The Green Guys Group.

Reimagining Energy

According to Next Business Energy, businesses that seek a better deal may make savings of up to 10 per cent. But shopping around is still critical, as energy regulators indicate up to 20 per cent of SMEs are still paying equal to unfavourable default rates.

Next Green Group chief executive David Hayes says that while retailers are often perceived as profiteering from high prices, industry margins are thin.

"There's very little opportunity for electricity retailers to reduce the cost to consumers when their underlying costs - the price of wholesale power - is going up," he says.

Founded a decade ago, Next Business Energy shifted its focus from being a plain-vanilla retailer to helping its 20,000 customers slash their power bills and embrace the renewables revolution.

"Shopping around and shaving a few per cent or more off the cost of electricity can help," Next Green Group chief executive David Hayes says. "But if you reduce your electricity consumption you go a long way towards reducing your costs long term."

The Green Guys Group plays a crucial role in this process, offering customers a wide range of initiatives, including government-backed LED lighting upgrades, heat pump hot water systems, energy-efficient HVAC, and solar installations.

After helping customers reduce their power consumption, Next Business Energy then focuses on getting them a better rate.

While this approach all sounds like Business 101, it is a rarity in a sector that is motivated to maximise customer usage.

Next Green Group understands that true savings come from a holistic approach: first reducing energy consumption and then securing competitive rates.

Lowering Business Energy Costs

For businesses, upgrading to LED lighting is a simple yet highly effective step, significantly reducing lighting energy consumption by up to 70%, and consequently lowering carbon emissions. Solar solutions can save 30 per cent or more, hence they are the core of Next Green Group's commitment to lower-cost renewable energy. Additionally, businesses can reduce their energy consumption and carbon footprint further by upgrading their hot water and HVAC systems to more energy-efficient models.

Next Green Group understands that upfront costs can be a barrier for some customers. To ease this burden, Next Green Group offers "behind the meter" arrangements through which the installation is paid off via a blended tariff over time, eliminating the need for large upfront capital expenses.

Above: Solar and lighting projects completed by The Green Guys Group.

Next Green Group also assists businesses in accessing available government subsidies and rebates, further reducing the cost of these energy-saving upgrades. "For customers who don't have the upfront capital for the investment but has the roof space, we can make that work for them," Hayes says.

"We recognise that businesses more and more would like to demonstrate their green credentials, and we have products available for them such as the nationally accredited GreenPower scheme," says Hayes, highlighting Next Business Energy's commitment to providing green energy solutions that help customers save money while also reducing their environmental impact.

This commitment is further solidified by the company's recent purchase power agreement (PPA) with a large solar generator, a long-term deal expected to ensure cheaper, greener power for local end-users. Hayes adds that this PPA "is likely to be the first of many as we green up our entire portfolio, to service customers who can't directly access renewables such as rooftop solar".

Combining these strategies as part of Next Green Group's tailored, comprehensive energy solution can significantly lower a business's energy costs, while also reducing its carbon footprint.

Empowering Households

Next Green Group's commitment to energy saving extends beyond the commercial sector, reaching into the heart of Australian homes. The company recognises that households are facing the same challenges of rising energy costs and the need for sustainable solutions.

Next Green Group brings its expertise to the residential market, offering a range of energy-saving solutions for homes, backed by government subsidies and rebates.

One of the most impactful upgrades for households is replacing from ducted gas systems to energy-efficient multi-head split air conditioning systems. This switch can lead to significant savings of up to 70% on heating and cooling costs, a major expense for many families.

Additionally, transitioning from old gas or traditional electric water heaters to energy-efficient heat pump systems can result in similar savings of up to 70% on water heating costs and lowering household carbon footprints.

Next Green Group's vision of being the ultimate energy-saving partner is further realised through community-based events and sponsorships. These initiatives raise awareness about sustainable energy options and empower homeowners to make informed decisions that align with their financial and environmental goals.

By extending its expertise and comprehensive suite of services to the residential sector, Next Green Group is helping Australians take control of their energy future.

Whether it's through energy-efficient appliance upgrades, or simply providing guidance on reducing consumption, Next Green Group is committed to empowering households to make informed choices and achieve lasting energy savings.

The Next Chapter

In a landscape where energy, energy efficiency, and renewables are featured more regularly in customer conversations, Next Green Group is poised to meet the evolving needs of Australians.

Households are grappling with rising living costs and energy prices, while many companies need to abide by environmental regulations. Customers are also conscious of soaring fossil fuel power costs as the country moves to government-mandated net-zero status by 2050.

Despite a decade of experience and solid growth, Next Green Group believes they have only scratched the surface of Australia's vast energy market.

To discover more about the Next Green Group and explore partnership opportunities, visit **www.nextgreengroup.com.au**

NEW TECHNOLOGIES MITIGATE CARRIER RISKS FOR ENERGY PROJECTS

By Berkay Erkan

The transport of parts and equipment is one of the most critical aspects of renewables installations and can account for a substantial amount of the total cost – for onshore wind farms, transport represents about 7 to 10 per cent of project expenditure.

Renewables developers face unique logistical challenges around the transport of individual components and the management of various specialised equipment, which can be further exacerbated by disruptions in global supply chains, requiring thorough planning to reduce the associated risks, complexities and costs.

This planning includes not only the efficient transport of components, but also transport of all supplies to the project site, ensuring imports and exports comply with regulations, and potential storage needs for materials.

According to consultancy group McKinsey, renewables developers and OEMs will have to tackle several challenges in order to mitigate risk and build more resilient supply chains.

McKinsey explained: “The installation of new wind and solar capacity is going to require a lot of talent and a lot of machinery – yet developers often face a shortage of both.”

Material stockpiling and storage can help reduce the number of unforeseen events during the construction of a renewable energy project, particularly for solar photovoltaic projects which have a highly systematic installation process.

Most photovoltaic components are imported from manufacturers in Asia and require early procurement when demand is high.

A key challenge entrenched in transport is to reduce carbon footprints, a factor that is especially relevant to renewables projects.

About 10 per cent of a project’s overall carbon emissions are from the installation and transportation phases and require strategies to reduce environmental impacts, particularly during the transportation phase.

Some solutions include optimisation of the logistics process such as positioning production plants closer to renewables locations, or grouping shipments of different components and projects to reduce the amount of freight.

New propulsion technologies such as ships powered by ammonia (which can be produced from green hydrogen) or electric motors can also substantially reduce the carbon footprint of project logistics, while enhancements for road transport include electric vehicles as well as route planning, load consolidation, and vehicle sharing.

A common element across logistics for renewables projects is the size of the components and equipment, which often need specialised transport, further

"The installation of new wind and solar capacity is going to require a lot of talent and a lot of machinery – yet developers often face a shortage of both."

compounded by the remoteness of many projects.

The weight and dimensions of wind turbines are growing increasingly larger to improve efficiency, however, this can make their mobility more complicated and even become a limiting factor in their design.

Manufacturers of offshore wind components tend to house their facilities in areas with easy access to sea or river transport, from where they can be transported to a marshalling harbour to be assembled and transferred to the project area via the installation vessel.

Onshore wind farms also have specific transport challenges, often being situated in areas with high elevation and steep access slopes.

Specialised vehicles are needed to transport components, not only for blades but also shovels, which can reach more than 80 metres and weigh several tens of tonnes.

Last year, wind developer ACCIONA implemented a unique transport innovation at its McIntyre Wind Farm, using new trucks capable of transporting turbine blades weighing more than 29,000 kilograms.

This eliminated the need for long trailers and large internal access roads, allowing for more than 20,000 square metres of farmland and vegetation to be left undisturbed at the Queensland site.

ACCIONA Energia Director of Engineering and Construction Andrew Tshaikiwsky said the wind farm was built on rough country dominated by hills, ravines, vegetation and rock, and it was a lot of work to build internal access roads to transport turbine blades within the project.

He added: "With this Australian-first equipment, we can now transport turbine blades around the project site and greatly reduce the amount of roadwork and clearing."

The new technology has been dubbed the 'blade manipulators', and ACCIONIA is using similar technology in Peru to navigate roads passing through towns and mountains.

Each of the blade manipulators uses a large hydraulically-driven device mounted on an Australian-manufactured 10-axle trailer, which is capable of transporting a single 80-metre blade.

The blade can be raised up to 40 degrees, lifting the blade over vegetation and obstacles and allowing it to easily take tight corners before being lowered back down.

It is estimated the new transport solution will reduce the earthworks and soil disturbance required by 250,000 cubic metres across the project's 200 kilometres of internal roads.

Tshaikiwsky said: "These new blade transport trucks are a marvel of engineering – we no longer require long rigid trailers that are difficult to move around site.

"With this new transport method, we can use much shorter transport vehicles and greatly reduce the amount of cut and fill needed on internal access roads reducing the footprint of the wind farm overall.

"Lots of projects around the country have rough terrain and we can see technology like this being deployed in the field all over Australia as the industry works to minimise the environmental footprints of projects."

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One Global Logistics is one of Australia's leading freight and logistics providers specialising in shipping, container movements, customs and materials management within the solar and renewables sector.

Through its strong network of transport partners, extensive shipping and logistics experience, and renewable project delivery knowledge, OGL provides solutions to mitigate material supply risks and potential cost and delays impacts on renewables projects.

With supply chain disruption continuing into 2024, there is a need for innovative and improved supply chain solutions as the sector grows and demand for logistic services becomes critical from manufacturing from supply to the site.

Over the past five years, OGL has successfully managed more than 25 (2.1 gigawatts) small to large-scale solar and battery energy storage system (BESS) projects from offshore to sites throughout Australia.

With a focus on offering agile, flexible and cost-competitive solutions in project delivery, OGL has successfully been working with OEMs, EPCs and IPPs with managing ocean shipping, customs and landside logistics solutions to a variety of complex projects throughout Australia.

James Sparke, Chief Executive Officer at OGL, told Green Review that managing the logistics functions and supply chain for solar farm and BESS projects involved coordinating and collaborating within a complex network of overseas and local suppliers.

He said: "This encompasses ocean shipping, landside logistics, and project management requirements to ensure that all components are delivered on time, within budget, and meet quality standards in materials management."

OGL offers an experienced and structured approach to manage all types of projects effectively, with logistics planning and transport methodology, onshore logistics management, risk management, site compliance and regulations, and communication and reporting.

The planning and onshore logistics include detailing the supply chain scope and the project's specifications, as well as budgeting and development of a project timeline, before transportation using an accurate inventory management system that tracks components from the port of loading to site.

OGL's risk management approach comprises early identification of potential risks such as supply chain disruptions and the development of contingency plans for managing such risks.

Mitigation strategies include using alternative shipping lines, ports of loading, or ports of discharge, as well as using alternative transportation routes.

Along with maintaining thorough documentation of all warehouse operations and deliveries to site, OGL ensures all necessary permits and approvals around site compliance are obtained and it adheres to industry standards and regulations for safety, environmental impact, and energy efficiency.

A key part of OGL's structured approach is stakeholder engagement, to keep them informed of materials movements, warehousing, stock on hand, as well as to highlight any changes or issues that may arise.

OGL uses the latest supply chain digital software platforms and integrated reporting solutions for the sector which contributes to an improvement in shipping times, materials management, communication and reporting for key stakeholders.

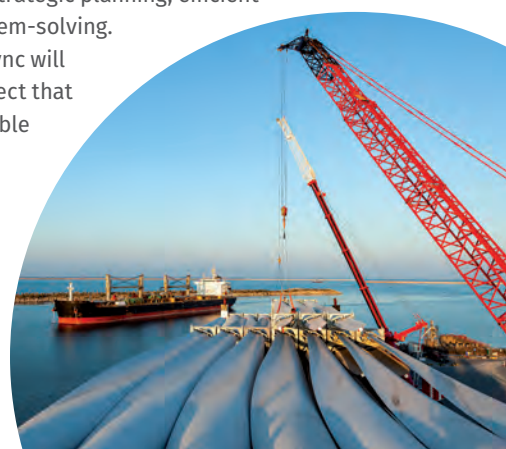
The company also provides weekly shipping and warehouse reports covering container reporting and movement, unpacking reports, and inventory on hand.

As a ISO 9001/45001 certified company with an ethos of continuous improvement, after every project completion OGL reviews the entire process to identify lessons learned and adjust project management procedures and strategies based on feedback and performance data.

Managing a solar farm supply chain project effectively requires a mix of strategic planning, efficient logistics, and proactive problem-solving.

Keeping all elements in sync will help ensure a successful project that delivers reliable and sustainable energy.

For business enquiries, please contact James Sparke on 0458 755171 or email james@oglau.com



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REDUCING STEEL EMISSIONS AN INEVITABLE PASSAGE AS GLOBAL MARKET SHIFTS

PAGE 50

The steel industry is responsible for approximately 8 per cent of the world's emissions, meaning the sector has a big opportunity to play a big role in reducing carbon emissions and achieving the net zero goal.

Steel is one of the most used materials in the world, with more than two million tonnes manufactured every year, with demand projected to escalate further in coming years.

Steel manufacturing requires high temperatures and does so by using coal, oil and natural gas to achieve this – an energy-hungry process.

One solution to reduce steel's environmental impact is through recycling, as the material can be recycled infinitely without losing its properties. Recycling already accounts for 26 per cent of global demand and governments and industry are working to increase that ratio.

Australia ranks high in the world when it comes to its steel recycling share, with 97 per cent of end-of-life structural steel and 83 per cent of all scrap steel being recycled.

However, while steel recycling goes a long way in reducing emissions in the industry, it is not a total solution.

The steel industry's extensive use of metallurgical coal to produce iron, the primary component of steel, is the primary driver (90 per cent) of fossil fuel emissions from steelmaking.

Since at least 30 per cent of the demand for steel still comes from virgin material, it is essential new manufacturing technologies are developed.

Currently, green hydrogen-based processes, supported by renewable energy, have the biggest decarbonisation potential and are the most promising for emissions reductions.

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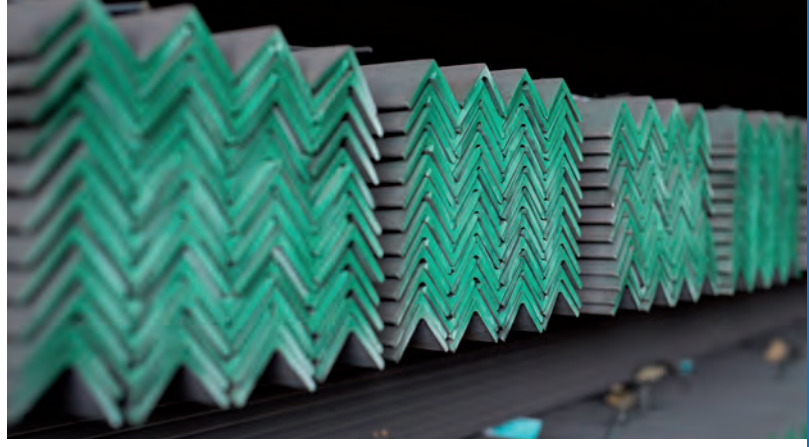

These processes can convert iron ore into direct reduced iron (DRI) or hot briquetted iron (HBI) during the iron production stage.

During the steel-making phase however, using electric arc furnaces (EAF) that run on 100 per cent renewable energy show great potential.

In Europe, there are already several projects that aim to replace fossil fuels with green hydrogen, while the United States is developing direct electrolysis from iron ore, a process similar to that currently used for aluminium.

The first commercial plants are expected to be in operation from 2030, at which date a large part of the European blast furnaces need to be refurbished.

Other steel decarbonisation methods involve gas-based direct reduced iron and other lower-emission technologies which offer some emissions reductions in the near term, and carbon capture utilisation and storage or offsets, but the former still relies on fossil fuels while the latter comes with significant uncertainty around viability and effectiveness.

Earlier this year, the Australian federal government allocated $200m to help ensure a continued supply of locally produced steel, with some of the funding helping to also decarbonise the industry.

Of the funding, $63.2 million will support the purchase and installation of an electric arc furnace at Whyalla Steelworks, enabling green steel production in South Australia.

In contrast, $136.8 million will fund the relining and upgrade of a coal-based blast furnace at the Port Kembla Steelworks in New South Wales, which will maintain the status quo.

Between now and 2030, the Australasian Centre for Corporate Responsibility has estimated that 71 per cent of the world's steelmaking assets will reach the end of their operating lives, necessitating significant investment in the relining of coal-dependent blast furnaces.

"Investors and companies need to reallocate capital towards genuine green steel processes in the next six years to prevent the lock-in of carbon intensive steelmaking methods," ACCR says.

This sentiment was echoed in a new report by WWF-Australia which noted that while methods for producing green iron and steel continue to improve, investment and policy support are required to encourage the use of these and put the industry on track to reach net-zero emissions before 2050.

The report proposes that Australia needs to act fast to boost its green iron production, as international trading partners are looking to decarbonise their steel supply chains.

Global market responses, such as the European Union's carbon border adjustment mechanism (CBAM), which entered into force late last year, are forcing steel makers to reduce emissions.

CBAM mandates that EU importers of steel report on the volume as well as the greenhouse gas (GHG) emissions embedded during their production. From 2026 onwards, a levy – linked to the EU's carbon market price (approximately €70/tonne at the start of August) – will also be payable.

Nicole Wyche, WWF-Australia's Industry Decarbonisation Manager (Steel) said the industry supply chain is starting to shift, and Australia needs to act quickly or lose out to faster movers.

"With fast and deliberate action, Australia could be perfectly positioned to be the green iron key unlocking greener steel manufacturing with our major trading partners in Asia," she said.

The report recommends the establishment of a $10 billion domestic support package to decarbonise the existing iron ore and steel industry and prioritise the development of export-focused green iron projects.

"Iron ore is crucial to Australia's economy, and it's in our mutual economic interests to work together to build out a green iron corridor from Australia to our major trading partners."

One year ago, the WA government released a report to highlight the potential for the state to join the green steelmaking value chain, estimating that just one small scale green iron plant could contribute $31.7 billion to the economy. However, no real action has been taken by the government following the report's release.

Instead, Rio Tinto, BHP and BlueScope Steel have announced they will investigate the development of the country's first ironmaking electric smelting furnace pilot plant. If approved, the pilot facility could be commissioned as early as 2027.

In June, Rio Tinto also announced it will invest in a research facility in WA to convert Pilbara iron ore to metallic iron using raw biomass and microwave energy instead of coal, reducing the process' carbon emissions by up to 95 per cent.

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AUSTRALIAN DECOMMISSIONING IN AN AGE OF SUSTAINABILITY

By Francis Norman, CEO and Managing Director,
Centre Of Decommissioning Australia (CODA)

Sustainability features in pretty much every conversation these days, including those around decommissioning. However, while the term gets a lot of use, it is not always clear in what context.

The concept of sustainability varies among individuals, with many associating it closely with the principles of the circular economy—focused on reducing, reusing, and recycling—and the pursuit of net environmental benefits in all endeavours.

Meanwhile, sustainability in a business context emphasises the need for an organisation to establish or grow a diverse and stable customer and financial base, conducting operations in a way that ensures long-term viability. Without financially sustainable businesses, it is hard to have the circular economy and pursue society's environmental goals.

I would strongly suggest that, appropriately executed and managed decommissioning plays a pivotal role in the energy transition and embodies enormous potential for sustainable outcomes.

This potential is realised when adhering to decommissioning best practices. Wells are meticulously plugged and abandoned; facilities are closed down and either fully removed or partially removed with some materials left in situ with due consideration for the long-term impacts of such decisions; and where removed materials are then cleaned, dismantled and sorted with as much material recycled as possible and finally only intractable waste is safely disposed of in appropriate facilities.

SUSTAINABLE DECOMMISSIONING

So, the question then is, what should sustainable decommissioning encompass?

It is imperative to plug wells effectively, preventing any future flow or leakage, and allowing where appropriate, the potential future use of reservoirs for activities such as carbon sequestration.

Fixed structures must be removed to the satisfaction of the regulators and all removed materials returned to shore for processing.

Floating facilities must be removed from station for either redeployment or disposal, with the final disposal being undertaken to international best practice in safe and well managed facilities.

Subsea infrastructure should be either removed to shore or, where approved by regulators, left in situ. This could either be for future use in applications such as transporting CO2 for injection into abandoned fields, or to be left in a long-term, safe condition in recognition that removal would not be of environmental benefit.

Ideally this work should be executed using energy efficient techniques, technologies, tooling, and vessels, minimising the time vessels spend undertaking the work.

In Australian waters and the Australian context this can be problematic since many of the vessels needed for much of this work are based in other regions, necessitating long transits to Australia for relatively short durations of work.

"Many materials such as steel, non-ferrous metals and concrete, constituting a substantial portion of the 95 per cent and beyond that is routinely recycled, should be prioritised in recycling efforts."

This is exacerbated by the nation's vast coastline and relative shortage of suitable locations to land decommissioned assets for processing.

All removed materials should then first and foremost be considered for their future use, with disposal to landfill seen as a last option.

Many materials such as steel, non-ferrous metals and concrete, constituting a substantial portion of the 95 per cent and beyond that is routinely recycled, should be prioritised in recycling efforts.

However, many of the plastics and polymers used in facilities present unique challenges in recycling, with some materials needing further research to find alternate uses.

Volumetrically, recycling of many of these materials also presents challenges. For instance, some materials are present in relatively small quantities and while they may have a good recycling market, a lack of proximity to customers can make the logistics and financial sustainability of undertaking recycling more difficult.

All these challenges though have solutions. Through open collaboration, careful consideration of methods, and targeted research, industry can execute decommissioning in an increasingly sustainable manner.

Finding this optimum approach requires viewing decommissioning work through a systemic, strategic lens and addressing the work in a holistic rather than in a piecemeal manner.

Adopting this comprehensive perspective entails several changes in how the work is conceived, regulated, planned, and executed, shifting the focus from project-based, often point solutions, to viewing decommissioning as a long-term endeavour within a broader set of operations.

Such a broader, contemporary approach then incorporates not just the scopes of work for the removal of oil and gas assets but also other maritime work that may be executed in the same time window using the same assets such as the installation, sustainment and eventual decommissioning of offshore wind.

A VISION FOR A SUSTAINABLE DECOMMISSIONING FUTURE

As the volumes of impending decommissioning increase, it is timely to envision what a truly sustainable decommissioning future could entail.

One where work is executed collectively, utilising locally sourced skills and equipment whenever possible, where increasingly large percentages of materials are recycled through local, regional or global networks, and where the companies involved form part of a diverse and long-lived pipeline of profitable work.

This allows them the capacity to invest in new solutions, skills and technologies. Such a future also incorporates adjacent industries such as onshore well P&A, ship recycling, and the deployment, maintenance and decommissioning of offshore wind, enabling businesses to diversify their revenue streams.

However, achieving a future like this requires numerous small and large changes. The regulatory landscape needs to embrace variability in the timing of work execution to allow for the planning of campaigns of activity in a low-risk manner.

There is also a need for greater regulatory and legislative clarity to facilitate the cross-border movement of materials. Title holders must be comfortable sharing some of the risk of a more flexible, multi-party decommissioning landscape.

This sharing enables them to see the broader benefits of improved access to facilities and cost reductions derived from these campaigns.

The service sector must be prepared to work in new, more collaborative ways to share the risks and opportunities as well as accommodate greater movement of personnel between companies.

The academic community must engage more openly with industry to address real and emerging questions, while education and training providers work to equip the workforce with the skills needed to readily enter the world of decommissioning.

PERCEPTION IS REALITY

If all that is openly discussed in press releases and on stages of energy conferences are new developments and the need to continue to produce hydrocarbons, the trust gap between industry and the broad community will persist, and continue to grow.

This not only risks fostering increasing resistance to the oil and gas industry as a whole, but also erects greater barriers to any new developments. Executing decommissioning work discretely, no matter how efficiently, does a disservice to the industry.

As the necessary last phase in the life of every facility, decommissioning is meticulously planned, budgeted, and executed with the same level of rigour and commitment as any other phase.

However, it receives significantly less external exposure compared to the more glamorous new developments.

Rarely does a decommissioning project feature in the pages of the business or industry press, and it's equally uncommon to hear oil and gas executives discuss their organisation's decommissioning efforts.

This silence represents a significant missed opportunity for the industry to showcase its commitment, and dedication to a sustainable future.

Regardless of how long the transition to alternate energy sources takes, demonstrating an ongoing commitment to environmental responsibility will make the journey much smoother.

Companies openly and proudly sharing their closure and removal of redundant facilities, as they do with new discoveries, will offer multiple benefits to the industry.

In an era where both society and individual employees demand greater environmental stewardship from the business community than in previous years, embracing a future that includes facility end-of-life and material recycling will only become an increasing expectation.

Let's bring decommissioning out of the shadows, build partnerships across the ecosystem, seek allies in industries such as offshore wind to collaborate on common issues, and share the inspiring stories of successful decommissioning project execution, the businesses and jobs created, and the recycling industries supported through these achievements.

Photo by Peter Gudella.

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By Shalinn Yeap

INNOVATIONS PROPEL SUSTAINABILITY IN THE MINING SECTOR

An increase in regulatory demands, investor expectations and the need to meet sustainability goals have placed the mining industry at a critical juncture.

The resources sector now faces pressure to reduce greenhouse gas emissions without compromising overall productivity levels and economic feasibility.

In response, several countries — including Australia, Brazil, Canada, Chile, Finland and South Africa — have seen significant investments and innovations aimed at achieving this goal.

With Australia being a major player in the industry, a recent $91 million investment by the Australian government signifies a pivotal step towards decarbonisation. This funding aims to support various projects across several industries, including mining, and is expected to reduce over one million tonnes of emissions annually — equivalent to removing close to 240,000 cars from the road.

Industry and mining are responsible for nearly half of Australia's total emissions, with the mining sector alone producing significant amounts of carbon dioxide, particularly from coal mining activities.

Fugitive methane emissions from coal beds are a major contributor, with estimates indicating that coal mining can release between 1.5 to 4.6 gigatonnes of methane globally each year.

As the world shifts towards a low-carbon economy, mining companies are increasingly recognising the need to adopt cleaner technologies to mitigate their environmental impact while remaining competitive in a rapidly changing market.

The recent funding is part of a broader strategy to assist traditionally energy-intensive industries in their transition to lower emissions.

Minister for Climate Change and Energy, Chris Bowen, emphasised that the funding will enable industries to contribute to national climate targets, and is also expected to unlock an additional $182 million in private funding.

Among the projects funded, Kestrel Coal in Queensland will receive $37.2 million for methane reduction initiatives, while Incitec Pivot Fertilisers will utilise $28 million for a solar and battery system.

Furthermore, Dyno Nobel's ammonium nitrate facility is set to benefit from $9.8 million aimed at emissions

capture. Other recipients include CSBP Limited, Boyne Aluminium Smelter, and Viva Energy Refinery.

The mining sector is currently embracing a variety of innovative technologies aimed at reducing emissions. These advancements include the use of methane capture technologies, renewable energy integration, electrification of mining equipment, automation and AI, as well as in-situ recovery (ISR) techniques.

Technologies to capture and utilise methane emissions from coal mining are being developed and implemented. These systems not only contribute to a reduction in greenhouse gas emissions but can also convert captured methane into energy, providing an additional power source for mining operations.

As part of a growing trend, mining and petroleum sectors are too undergoing a significant energy transformation, embracing renewable energy to reduce their carbon footprint. Increasingly, solar and wind power are being harnessed to power mine sites, processing plants, and auxiliary facilities.

This shift extends even further to transportation, with many mining operations now deploying electric vehicles powered by renewable sources.

In pursuit of energy independence and reliability, some industry players are developing innovative renewable energy-powered microgrids. These systems ensure a stable power supply while minimising environmental impact.

Additionally, to balance the intermittent nature of renewables with the need for consistent power, many companies are implementing hybrid power plants. These sophisticated systems seamlessly integrate renewable sources with traditional power generation methods, offering enhanced reliability and reduced emissions.

Companies like Fortescue Metals are investing in renewable energy solutions for their iron ore mines, while BHP has begun utilising solar power at its copper mines.

Fortescue has already committed $1.14 billion to its first three green energy projects in Australia and the United States. This shift not only reduces reliance on fossil fuels but also lowers operational costs in the long run.

Automation technologies are also playing a crucial role in enhancing operational efficiencies and reducing emissions across various industries.

Machine learning and AI in mining operations offer benefits such as process optimisation, improved safety and reduced energy consumption.

Another exciting development includes digital twinning, which involves creating detailed virtual replicas of physical mines and their operations. This technology allows for predictive maintenance, operational simulations and real-time monitoring. By optimising processes and reducing waste, digital twins can enhance the sustainability of mining operations.

"In-situ recovery (ISR) methods are emerging as a sustainable alternative to traditional mining techniques, offering several key advantages that make them increasingly attractive in today's environmentally conscious landscape."

In-situ recovery (ISR) methods are emerging as a sustainable alternative to traditional mining techniques, offering several key advantages that make them increasingly attractive in today's environmentally conscious landscape.

This innovative approach minimises landscape disturbance, as it allows for the extraction of minerals directly from the ore body without the need for extensive excavation or surface disruption. By injecting a specially formulated solution, known as a lixiviant, into the ore deposit through a series of wells, ISR dissolves the target minerals, which are then pumped to the surface for processing.

Collaboration among mining companies and technology providers is vital for the rapid development and deployment of emissions reduction technologies.

Partnerships leverage collective expertise, resources, and advanced technologies to address industry-wide challenges, enhance sustainability, and secure necessary funding, ultimately driving the mining industry towards a more sustainable future.

The Australian government's investment in emissions reduction technologies represents a significant commitment to supporting the mining industry's transition to a low-carbon future.

As the industry embraces innovative technologies and collaborative approaches, these initiatives can play a crucial role in achieving national and global climate targets.

The path forward will require ongoing investment in research and development, as well as a willingness to adopt new practices that prioritise sustainability alongside productivity.

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NEW TRIALS TO ESTABLISH VIABILITY OF BATTERY-ELECTRIC HAUL TRUCKS

Battery-electric haul trucks represent a significant decarbonisation opportunity for the mining sector and efforts are being made to develop and refine the technology to suit the requirements of large surface mines.

By Berkay Erkan

When combined with a renewable electricity source, the electrification of mine haulage can eliminate what is likely the single largest source of carbon emissions from modern mines.

There are about 28,000 large mining haul trucks in operation around the world, which collectively emit more than 68 million tonnes of carbon dioxide every year.

There are many diverse benefits for mines that accelerate battery-operated or electric vehicle adoption, including improved health and safety conditions and reduced operating costs.

A key safety benefit is the reduction of diesel particulate matter, as well as 40 other toxic pollutants emitted from vehicles and generators, which pose short and long-term risks to health ranging from minor effects such as headaches and nausea to serious illnesses like cancer.

Moreover, battery vehicles have about 25 per cent fewer parts, leading to lower overall maintenance costs.

Electrifying mines will require large capital expenditure as well as infrastructure improvements – the power infrastructure investment for electrifying the iron ore industry alone could cost between $30 billion and $45 billion.

The infrastructure improvements needed will include upgraded electric-grid connections, additional onsite substations and networks, and installed or contracted renewable power capacity.

A further challenge to electrification is obstacles in battery-electric vehicle technology – battery technologies need to achieve higher density, lower cost, faster charging, and larger scale to make electric equipment competitive.

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However, overcoming these challenges can bring about a host of opportunities for miners.

Electrification can reduce energy costs by as much as 40 to 70 per cent and reduce maintenance costs for mobile equipment by about 30 per cent.

Electric equipment can also allow for steeper ramp designs, lower stripping ratios, faster cycle times, and less frequent breakdowns.

Importantly, a fully electrified mine with renewable power sources will lower its carbon footprint by 60 to 80 per cent.

In May, BHP and Rio Tinto began a collaboration on battery-electric haul truck trials at their Pilbara operations.

It is anticipated ongoing testing, development, and refinement of truck and battery design will occur, to inform the approach for testing a larger number of trucks and the potential deployment of battery-electric fleets into each miner's operations.

Geraldine Slattery, President Australia at BHP, said operational decarbonisation relied on breakthroughs in technology, and partnerships such as the one with Rio would help drive the industry forward.

She said: "Replacing diesel as a fuel source requires us to develop a whole new operational ecosystem to surround the fleet.

"We need to address the way we plan our mines, operate our haulage networks, and consider the additional safety and operational considerations that these changes will bring.

"This is why trials are so critical to our success as we test and learn how these new technologies could work and integrate into our mines."

As of last year, BHP was using roughly 1,500 megalitres of diesel in over 1,000 pieces of equipment, with more than half of this used in its truck fleets, and the company has indicated that electrification was its preferred pathway to eliminate this diesel use.

The company's initial modelling has suggested that battery-electric trucks would cost the same or less to operate compared to diesel.

BHP said it also expected to see overall savings in truck maintenance, as the lack of a diesel engine or mechanical drivetrain meant there were significantly fewer moving parts in electric trucks.

However, the company pointed to a number of unknown costs associated with operating the new technologies, such as the need to replace batteries over a truck's lifetime and the method of charging, as well as the frequency of relocating the charging system and trolley lines.

Rio Tinto Iron Ore Chief Executive Simon Trott said the collaboration brought together two global miners with two of the world's biggest haul truck manufacturers to work on solving the critical challenge of zero-emissions haulage.

Trott said: "There is no clear path to net zero without zero-emissions haulage, so it's important that we work together to get there as quickly and efficiently as we can.

"Testing two types of battery-electric haul trucks in Pilbara conditions will provide better data, and by combining our efforts with BHP we will accelerate learning."

Brazilian miner Vale earlier this year also decided to test battery-electric trucks and energy transfer systems, with the aim of supporting the company in reducing scope 1 and 2 carbon emissions by 33 per cent by 2030 and net zero by 2050.

A 240-tonne battery-powered truck will be tested at Vale's operations in Minas Gerais, while an energy transfer solution for trucks will be tested at its operations in Para over the next few years.

Diesel emissions from mine operations account for 15 per cent of Vale's direct carbon dioxide emissions, and haul trucks are its biggest consumer of diesel.

Jose Baltazar, Director of Engineering for Mine and Plant Operations at Vale, said there had been significant advances in the development of electric truck technology in recent years and those innovations would play an important role in bringing Vale's net emissions to zero by 2050.

He said: "We are offering our mines in Brazil as a testing ground, with their very specific characteristics, in order to contribute to achieving our goals and building a cleaner mining industry."

Mobile Equipment (BME) is an Australian based original equipment manufacturer (OEM), specialising in mid-sized battery electric mobile equipment, such as a 20-tonne fully electric mine spec wheel loader.

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BME's battery equipment offers real benefits for miners

Batt Mobile Equipment (BME) is an Australian original equipment manufacturer specialising in mid-sized battery electric mobile equipment and the retrofitting of battery powertrain systems into integrated tool carriers.

BME's commitment to being 'Australian engineered and manufactured' and '100 per cent Australian owned' showcases the dedication and effort invested in the project, reinforcing its national origin and the pride in contributing to the Australian mining sector.

In addition to the 4 x Gen 1 integrated tool carriers currently deployed, BME has 6 x Gen 2 integrated tool carriers currently in the process of conversion.

BME is building on proven technology to facilitate companies in adopting electric vehicle (EV) technology at affordable prices, offering a range of benefits that improve safety, the environment, and productivity.

BME's 20-tonne integrated tool carrier with a six-tonne rated load capacity is designed to deliver optimal performance.

The machines feature a fully sealed air-conditioned cabin, ensuring operator comfort and protection, which is also a ROPS/FOPS certified cabin, providing a secure environment for operators in challenging mining conditions.

They also have a quick hitch system which enhances operational efficiency by enabling swift attachment changes.

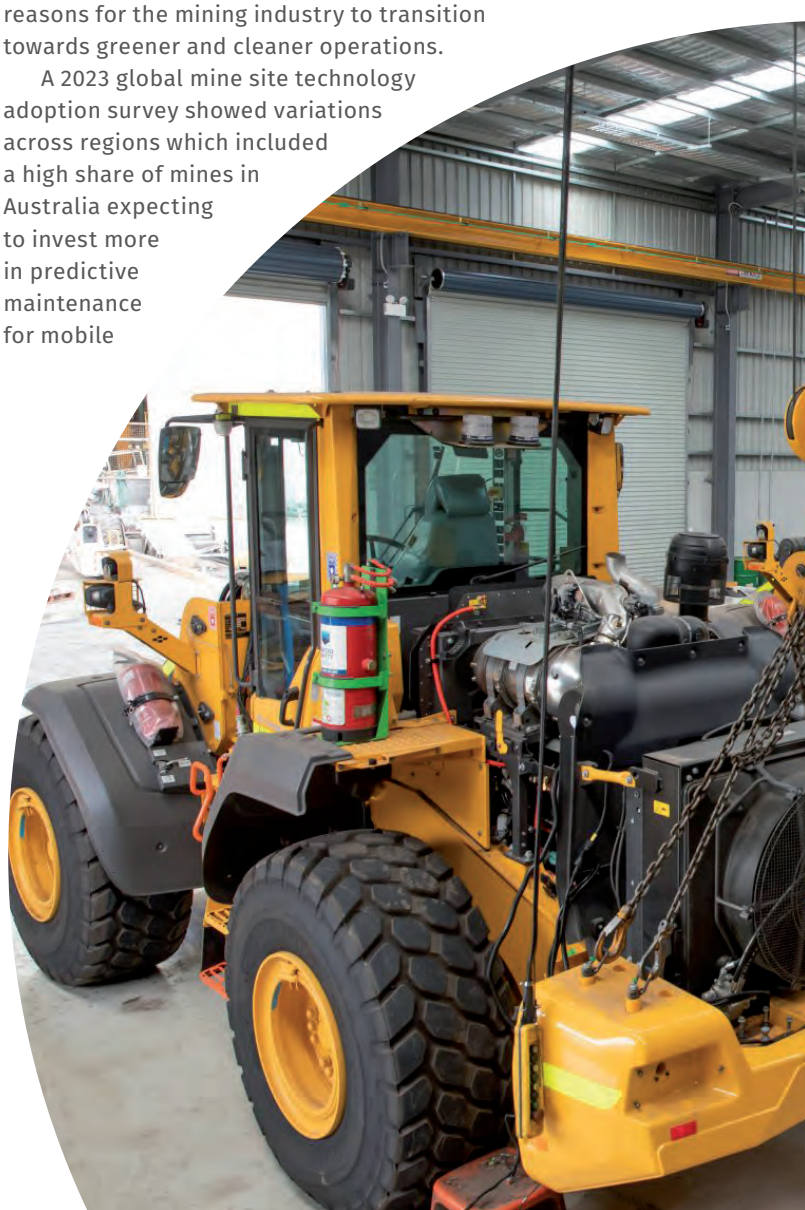
The use of a lithium-ion KREISEL (John Deere owned) battery pack, with a 730-volt nominal voltage, ensures extended operation without emissions or diesel particulates and the patented KREISEL electric immersion cooling technology offers superior safety and performance, maximising battery life.

Additionally, BME's EVs support CCS2 charging, which allows for approximately one-hour charge time, enabling efficient and rapid battery replenishment.

By combining affordability with advanced technology, BME paves the way for companies to embrace sustainable and efficient mining practices.

With reduced noise, maintenance, and ventilation requirements, along with increased speed and reliability, BME's EV equipment delivers compelling reasons for the mining industry to transition towards greener and cleaner operations.

A 2023 global mine site technology adoption survey showed variations across regions which included a high share of mines in Australia expecting to invest more in predictive maintenance for mobile



"With reduced noise, maintenance, and ventilation requirements, along with increased speed and reliability, BME's EV equipment delivers compelling reasons for the mining industry to transition towards greener and cleaner operations."

equipment and collision avoidance, and 44 per cent of respondents from Asia-Pacific also expected to invest in battery-electric vehicles in the next two years.

A key benefit to electric light-duty vehicles (LDVs) is a significant reduction of 40 to 50 per cent in underground mine ventilation costs compared to diesel units, leading to cost savings and improved energy efficiency within the mine.

As electric equipment generates 20 to 40 per cent lower heat losses compared to diesel machinery, mines will have lower cooling requirements and improvement thermal management within the mine.

Along with the lower heat emissions, electric equipment produces lower carbon dioxide emissions, creating an overall healthier working environment with improved air quality for operators and miners.

Moreover, electric machines generally have lower maintenance costs compared to similar diesel-operated equipment, reducing downtime and increasing operational efficiency.

They also operate more quietly compared to diesel-powered units, reducing noise pollution in underground working environments.

This leads to a more comfortable and productive working environment for miners.

Overall, the adoption of battery electric vehicles represents a promising shift towards more sustainable and environmentally-friendly mining practices, offering tangible benefits in terms of cost savings, efficiency, and improved working conditions.

The conversion of light vehicle fleets on mine sites from diesel fuel to electric power is still in its infancy, but major miners are increasingly considering this a vital part of the energy transition.

By Berkay Erkan

MINERS ACCELERATE TRANSITION TO GREEN ENERGY VEHICLES

For suppliers in the electric vehicles (EVs) arena, the advantages of swapping to this technology are obvious – including increased profit margins, lower emissions, the use of recyclable batteries and improved health and safety standards.

For the Queensland government, however, such a transition is fraught with difficulties given EVs "typically operate at much higher voltages than other battery-powered industrial equipment" such as the ones used by the resources sector.

According to electric vehicle manufacturer EVSE Australia, mining is one of the most polluting industries in the world. In fact, according to the World Bank, the industry is responsible for around 15 per cent of global greenhouse gas emissions.

As pressure mounts on businesses to operate more sustainably, many are turning to EVs to reduce their environmental impact.

One of the biggest advantages of using electric mining vehicles is that they are much cheaper to operate than traditional diesel-powered ones. For example, EVs do not require oil changes, their brakes last longer and they have far fewer moving parts than internal combustion engine (ICE) carriers.

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This means their maintenance costs are significantly lower, while savings are made when it comes to regular checks for things like tyre pressure and engine oil levels.

Furthermore, EVs are more energy-efficient than ICE models.

This is due to a number of circumstances, such as the fact that electric motors are around 90 per cent efficient, while for ICE engines it's only 20 to 30 per cent.

In addition, EVs don't lose power when idling, whereas diesel engines do; and do not produce the same level of air pollution, improving the health and safety of miners as a consequence.

This means that mines can reduce their ventilation costs as they don't need to pump fresh air into the operation to offset the polluted air being produced by the fleet.

Despite higher upfront costs, it is clear that electric mining vehicles offer increased profit margins for miners thanks to lower maintenance, energy and ventilation bills.

Another consideration is that EVs are much quieter than ICE vehicles, thus negating noise pollution.

As the world moves towards a low-carbon future, EVs are set to play an increasingly important role in the minerals sector.

For the Queensland government, though, the arguments for electrifying road fleets and light vehicles in the state's mining industry may not be as clear cut as some would like, as pointed out in WorkSafe's review of the state's 2002 Electrical Safety Act conducted a few years ago.

Work on EVs, for example, could expose workers and the community to the risk of serious injury or death through fire, explosion, toxic gases, electric shocks, arc flashes or exposure to battery electrolytes.

This could be exacerbated by faults in electrical parts or short circuits occurring from damaged parts or unsafe work practices.

When a battery is damaged or heats up uncontrollably, the government said, it may lead to thermal runaway, resulting in an uncontrolled explosion (or violent deflagration).

And, if this occurs and leads to an explosion, there is a real risk of highly flammable toxic gases being released.

"Workers and others may receive an electric shock if they come into contact with components of the electrical system," WorkSafe noted.

"Work on other parts of the vehicle (not involving

> "In addition, EVs don't lose power when idling, whereas diesel engines do; and do not produce the same level of air pollution, improving the health and safety of miners as a consequence."

the electrical system) may also involve the risk of shock if the isolation between the electrical system and the vehicle chassis has been compromised."

As for arc flashes, they may cause burns directly to the worker or through ignition of other materials.

Meanwhile, battery electrolytes in liquid form are highly flammable and can lead to fire risks which may cause injury or illness.

"Work on EVs must be performed in a way that achieves safe outcomes for everyone – the worker, the business, the end user and the wider community," WorkSafe said.

"EVs and other renewable energy technology is constantly changing and being improved.

"As technology changes, the risks and hazards can also change, making it important to consider if any new or existing technology impacts the risk profile of hazards and if additional steps are required to reduce risks (such as procedures, training or education)."

By Berkay Erkan

METALS RECYCLING A KEY COMPONENT OF CIRCULAR APPROACHES IN MINING

A key factor in reducing the impact of mining on the environment is by implementing circular approaches to mine site waste materials, particularly metal scraps and equipment or machinery.

Recycling scrap metals also plays an increasingly important role in reducing demand for the new mines, which can help to reduce effects on ecosystems such as deforestation and pollution.

With the appropriate infrastructure and supply chains, it is estimated recycling can supply up to 15 to 20 per cent of metal production, enabling more efficient energy use and a speedier transition to low-carbon production.

Each stage of mining – from early exploration to post-mine closure – produces varying types and amounts of waste, necessitating recycling strategies that consider these nuances.

Full site deconstructions are an effective way of preventing debris and waste products from affecting the environment and enabling the efficient repurposing of viable scrap metal materials.

With an effective recycling program, miners not only reduce waste disposal costs and generate revenue from selling recycled materials, but they further push the industry to adopt more environmentally responsible methods.

All manner of mine site infrastructure can be recycled, as well as slags, tailings, drill cores and cuttings from mining processes, while even mine water can be used in local agriculture and aquaculture.

A report by the International

Council on Mining and Metals (ICMM) highlighted the link between mining as a process and as a product, noting that both the way materials were produced and used needed to be considered to be truly circular.

It said: "By looking at both process and product circularity in tandem, mines can deliver value to communities and nature at site level, while the materials they produce become resources that can be used again and again.

"In the case of mining, this means having operations that have a net positive contribution to the environment and society, and working with the wider metals supply chain to promote the responsible use and recovery of metals after they enter markets."

Pointing out that circularity was not new to the mining and metals industry, ICMM said the industry had been integrating circular principles at the site level for many years, in part to reduce the negative impact of extraction but also because it made good business sense.

ICMM added: "Reducing waste and tailings, optimising water usage, regenerating closed mine sites, valorising and recycling other waste such as tires and focussing on efficiency is already at the heart of strategy in the industry."

Mining majors have increasingly factored scrap recycling into their business decisions, with Rio Tinto last year investing US$700 million for a 50 per cent stake of Canadian recycled aluminium producer Matalco, to supplement its production of primary aluminium.

Rio Tinto Chief Executive Officer Jakob Stausholm said the company had the lowest carbon-contained primary aluminium in the world, but was missing something [without] a recycled product.

He added that with the purchase of a stake in Matalco, Rio Tinto now had that recycled option.

Rio Tinto projects that demand for recycled aluminium in the United States will increase by more than 70 per cent from 2022 to 2032.

Recycling aluminium, along with environmental and financial benefits, can help make energy use more efficient, as it takes 95 per cent less energy to recycle aluminium than to produce new metal from raw materials.

Stausholm said: "Recycling will continue to increase and that means that there will be more growth in secondary aluminium than primary aluminium – we want to be part of the growth as well.

"There are some customers who don't necessarily need the performance from the primary aluminium and therefore want to entirely use recyclable.

"The way I see it is that it will strengthen our ties with existing customers and open up new customers."

This notion was also shared by BHP head Mike Henry, who said the private sector must turn recycling into a meaningful source of metals for the world, as it would reduce the need for fresh metal and therefore the amount of mining required.

"In the case of mining, this means having operations that have a net positive contribution to the environment and society, and working with the wider metals supply chain to promote the responsible use and recovery of metals after they enter markets."

Though it has yet to make a move comparable to Rio Tinto, BHP has explored the potential of recycling battery scrap and used batteries at its Nickel West operation into nickel-bearing products, as well as working with a US copper cable manufacturer to track how metals flow through downstream supply chains.

The hesitancy to move into metals recycling as a business on BHP's part may be because, as Glencore Head of Recycling Kunal Sinha noted, the risks involved in running a mining operation were very different than those with running a recycling business.

He said: "As a mining company, you actually know how much copper or nickel is in the ground – you have done your tests, so you have a high degree of confidence in how much metal is in the ground.

"In the recycling business, you don't own the resource, you are tapping into the urban mine or this massive ecosystem of waste collection [and] you are not sure what you are getting."

Glencore has for many years developed its metals recycling capability, having recovered 32,000 tonnes of copper, 107,000 ounces of gold, 1.35 million ounces of silver, 6,200 tonnes of nickel, and 1,500 tonnes of cobalt in 2022.

Over the last three years, about US$200 million to US$250 million of annual earnings were generated by Glencore's recycling business, though this makes up less than one per cent of its total earnings.

Sustainable operations at the core of Premier Metals' scrap recycling solutions

Premier Metal's advanced recycling processes not only contribute to the reduction of waste, but also help lower carbon footprints by minimising the need for raw material extraction and reducing energy use.

The mining, engineering, and manufacturing sectors in Western Australia produce substantial amounts of scrap in the form of metal parts, shavings, and discarded base metal stock, made up of copper, stainless steel, iron, aluminium, brass, zinc, lead, and nickel.

The various types of mining equipment and scrap metal that Premier Metals processes include drilling equipment, pipes, cables, and structural components, with the valuable metals extracted and waste disposed of appropriately.

A. Abdullah, Managing Director of Premier Metals, told Green Review that metals recycling was crucial for maintaining sustainability in the mining industry, as it reduced the need for extracting virgin ores, conserved natural resources, lowered energy consumption, and minimised environmental impacts by decreasing waste disposal.

He noted that in recent years there had been a noticeable trend in the mining industry towards embracing recycling, re-use and the circular economy.

He said: "Companies are increasingly adopting sustainable practices, investing in technologies, and exploring innovative ways to reduce waste.

"This shift reflects a growing recognition of the importance of sustainability in the mining sector and commitment to long-term environmental stewardship."

Premier Metals has invested in modern technologies to enhance operational efficiency and reduce our environmental footprint. Its latest tools improve material recovery and waste separation in our recycling efforts.

The company has adopted green technologies, such as hybrid and electric machines, to cut fuel consumption.

Additionally, the business has implemented strict emission controls and transitioned its workshop to energy-efficient lighting and solar panels in 2020, significantly lowering carbon emissions and reducing reliance on non-renewable energy sources.

These advancements are a testament to Premier Metals' dedication to fostering a greener future while maintaining high operational standards.

"We believe that through the implementation of such technologies, we can continue to lead the way in responsible recycling practices," Abdullah said.

Along with reducing ecological harm and improving sustainability practices within the company, Premier Metals is committed to environmental stewardship and works to encourage and promote sustainable initiatives across heavy industries.

Premier Metals firmly believes that the transition to a circular economy requires collaboration between all stakeholders – including businesses, government, and consumers – and is actively involved in several sustainability-focused professional associations, such as the Bureau of International Recycling, Australian Council of Recycling and Waste Management, and Resource Recovery Association of Australia.

Abdullah explained that collaborating with such organisations was essential for sharing best practices, staying up-to-date with industry trends, and promoting responsible mining practices on a global scale.

He said: "By building partnerships and fostering cooperation, we can drive collective action towards achieving sustainability goals and promoting growth in a circular manner."

Premier Metals offers a streamlined metal recycling process that emphasises convenience and sustainability, with its solutions designed to make metal recycling a simple and accessible option for disposing of metals.

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HOW THE MINING SECTOR CAN NAVIGATE CLOSURES SUSTAINABLY

The mining industry now stands at a critical turning point due to an anticipated rise in mine closures over the next few decades.

By Shalinn Yeap

With an estimated 80,000 abandoned or former mine sites in Australia — and around 240 more expected to close between 2021 and 2040 — the impacts these closures will have on the environment present a significant concern.

As the resources sector pivots to prioritise environmental concerns, many mining companies are now increasingly pressured to do more than merely comply with regulatory requirements. Instead, their licence to operate (LTO) now involves fulfilling certain responsibilities to the local communities and ecosystems affected by the operations.

Depleting resources, alternating market conditions and the general cyclical nature of the global mining industry form part of the complex factors behind this trend of mine closures.

Approximately 25 per cent of these closures are reportedly due to the exhaustion of economically viable resources.

Shifts in the market can also often render previously profitable mines uneconomical to run — further contributing to these closures.

Other factors such as the collective global transition to clean energy, increasingly stringent environmental standards, and evolving mining technologies have also accelerated this shift.

As many countries continue to progress towards meeting net-zero goals, there has also been a drastic change in the resources being mined.

The energy transition, for example, has prompted companies to move towards the exploration of critical minerals for the development of electric vehicle (EV) batteries.

At the same time, increased responsibilities and regulations for environmental protection have made it more challenging and costly for mines to maintain operations.

This surge in mine closures can inspire drastically positive changes within the industry.

Specifically, it creates a growing demand for innovative solutions to meet all of the environmental, social, and economic challenges that occur when mines shut down.

Additionally, this leads to a growing opportunity

for countries like Australia to develop and perfect strategies for mining companies all over the world.

As a new 2024 CSIRO report revealed, this could also promote the growth of a new industry worth billions annually.

Other related approaches include community engagement, waste reduction and recovery, mine rehabilitation, and land use transitions — highlighting the prospect of turning challenges into new ventures in this ever-changing sector.

The cyclical nature of mine sites, from exploration to closure, is known to have significant impacts on both the environment and surrounding communities.

Mining operations inevitably alter landscapes, disrupt ecosystems, and can usually lead to long-term environmental challenges such as acid mine drainage and soil contamination.

These environmental issues often persist even after the closure of the mine, hence companies must continue to manage these sites and provide remediation efforts to ensure that any implications are kept at a minimum.

Mine closures can also devastate local economies and communities that have become dependent on these excavation activities for employment and economic stability.

An abrupt end to mining operations can often lead to population decline, reduced social services and a big change in the local economic structure.

Due to these outcomes, there has been an increasing consensus that the current approach to mine closures needs to urgently be improved upon.

Similar to any other problem, prevention is often the best solution, necessitating an integrated and proactive closure planning process during the early stages of development, which considers all possible repercussions relating to the local environment, community and economy.

Mining companies can risk losing their LTO by neglecting proper environmental management practices, such as effective waste management, habitat conservation, water stewardship and air quality management.

Failure to protect the environment while carrying out operations, disputes with traditional landowners, as well as having a lack of transparency and insufficient engagement with local stakeholders can severely diminish public trust.

Despite the Australian mining industry's current contributions to the economy and recent improvements in remediation techniques, public perception remains largely negative — effectively highlighting the need for these companies to uphold better communication of accomplishments and be more accountable for any failures.

Ultimately, the loss of a company's LTO due to environmental failures results in project delays, increased costs, regulatory scrutiny, and possible early closure of operations.

As the mining industry is now pressured to realign priorities, the new challenges that come with the process of mine closures creates an opportunity for growth within the sector.

The forthcoming decades will necessitate innovative solutions, collaborative efforts, as well as a commitment to maintain responsible practices.

Through concocting forward-thinking plans for mine closures, investing in site rehabilitation, and aiding affected communities, the industry can discover new opportunities for sustainable growth.

The future of mining involves much more than resource exploration and extraction — it also requires establishing a positive impact that remains long after a mine's operational life has ceased.

Moving forward, the industry's ability to adapt and respond to future challenges will be crucial in forging its role in a sustainable global economy.

Pillars for building community awareness and trust for successful mine closure and transformation

Mine closure and transformation presents unique opportunities and challenges, particularly in the context of evolving regulatory frameworks, growing community expectations, with increasing emphasis on social responsibility.

This article focusses on community and stakeholder engagement practice for mine closure and transformation and the growing opportunity and potential for diversified post-mining land use.

Determination of post-mining land use requires strategic planning and implementation of rehabilitation and repurposing activities to ensure that the impacts of mining are sustainably transformed for future use.

Rehabilitated landscapes can create natural capital, a balanced and beneficial use of the land that contributes to long-term environmental health and socio-economic development, thereby turning former liabilities into valuable assets for communities, such as recreational areas, wildlife habitats, agricultural lands and renewable energy projects (e.g. pumped hydro, wind and solar).

By equipping you with real-world insights and lessons learnt, we aim to empower stakeholders involved in the consideration of mine closure and transformation, to better understand and effectively manage social risk, foster community acceptance and drive positive outcomes for all.

KEY CHALLENGES

Several challenges impede productive engagement in mine closure and transformation:

Policy

- The machinery of government turns slowly and, globally, there is broad discrepancy in policy thresholds and guidance for good engagement practice.
- Requirements and policies vary across levels of government and between states and territories.

Structural

- Project commitments are subject to regulatory and business decision-making which may change over the course of the project.
- The rise of cumulative impacts and fatigue associated with the sequential closure of assets in regions more venerable to certain commodity's structural decline.
- Non-public land uses are often profit-driven and the risk profile is required to reflect this.

Social

- Community uncertainty, mistrust and/or low levels of awareness can hinder the take-up of new technology and alternative land uses to those that may be been conceived in the past.
- Growing community awareness and advocacy as a result of new platforms for community opposition.
- Cost of living is a central concern and government incentives and concessions to operators may be perceived as costly and met with opposition.

The Unexpected

Global events can interrupt and shift momentum, lead to resource constraints, or even halt projects as policy priorities shift or industrial frameworks adapt to new environments, including global financial crises, pandemics. extreme climate events, as well as political and industrial actions.

Resistance to Change

Engagement is a process of change management. Resistance to change remains a key barrier to effectively embedding projects within the community and enabling productive and collaborative relationships with community stakeholders:

- **Rational Objections** - These stem from a lack of information or disagreement with data. Clear, simple, and timely information is essential to overcome this resistance.
- **Emotional Resistance** - Based on fear of loss, this resistance is deep-seated and can hinder communication and decision-making. A risk-informed approach focusing on building genuine relationships is crucial.
- **Resistance to Process or Organisation** - Mistrust or past negative experiences can lead to resistance, even if the change is understood. Addressing this requires transparency and sufficient time for community response.

PILLARS OF SOCIAL PERFORMANCE SUCCESS

Managing resistance and fostering social license and performance relies on four key pillars:

Understanding Social Risk

- Social risk is specific to populations and influenced by socio-economic factors and social values.
- A risk-informed approach involves establishing a baseline understanding of community sentiment and social risk factors at the project's outset.
- Tailored messaging and proactive risk mitigation help alleviate resistance.

Education

- Projects should embed education and knowledge sharing to help communities navigate the complexities of Mine Closure and Transformation.
- Education empowers communities to become active participants in the transformation journey.
- Considerations include varying levels of energy literacy and the dual potential of information to empower or disempower.

Transparency and Accountability

- Establishing a baseline acceptance of the project's fundamental drivers is key.
- Transparency involves clear communication of regulatory pathways, managing expectations, openly sharing information and discussing potential impacts collaboratively.
- Demonstrating how community feedback is integrated into the project builds trust.

Trust

- Trust underpins all other pillars of social success.
- Relationships – and trust - are cultivated through consistently demonstrating a genuine desire to minimise adverse social consequences and enhance social outcomes (social risk), knowledge sharing (education) and process transparency and closing the loop (transparency and accountability).

SLR'S ROLE IN SOCIAL PERFORMANCE

Social performance refers to an organisation or project's ability to avoid, mitigate and manage the adverse impacts they may impose on communities and enhance and optimise positive social outcomes through project delivery.

Social performance is both the process and the outcome and it applies to all phases of the project lifecycle from pre-planning to closure and transformation.

SLR's engagement practice employs a social research approach. We draw on the principles of Social Impact Assessment to conduct social risk and community sentiment analysis at the outset of our engagement planning. This process informs an engagement approach that meets regulatory requirements and expectations and is designed to suit the maturity of proponents and their communities.

SLR's Social Performance Team are supported by a diverse range of engineers and environmental specialists with significant experience in the physical challenges of mine closure and transformation, including strategy and risk, financial planning and permitting, facility design and construction management, water resources management including treatment and post-closure operation and monitoring.

Reach out to our team for further information, or to discuss how we can help you with your Mine Closure and Transformation objectives.

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SLR

By Berkay Erkan

DRONES RESHAPING MINING PROCESSES WITH WIDE ARRAY OF USE CASES

Multi-sensor drone technologies combined with emerging software innovations are being incorporated into increasingly sophisticated mining processes, substantially enhancing safety and efficiency at mine sites with surveying, mapping, imaging, and monitoring tools.

Drones provide the ability for advanced inspection strategies, such as predictive maintenance and asset management, as well as thermal imaging, stockpile monitoring, ramp and haul road analysis, and in drill and blast operations.

A critical step-change to drone applications in mining has been the integration of artificial intelligence (AI), which is able to systematically process captured data to optimise production and support highly accurate decision-making in real-time.

This can have a big impact on maintenance schedules and help reduce downtime and shutdowns.

BHP has trialled drones fitted with infrared cameras to monitor the temperature – and thus the health and performance – of its mining equipment, specifically iron ore reclaimers.

Thermal imaging enabled BHP to identify and assess critical components such as motors, gearboxes, bearings and pumps in real-time, to ensure they were operating within optimal temperature ranges.

The drones were also fitted with laser range finders for accuracy and safety, so they could maintain an optimal distance from moving equipment while making measurements.

Drones are also being used to collect and analyse data from haul roads in open pit mines, giving miners a more comprehensive understanding of road conditions, enabling them to identify areas of wear and tear, and improving safety and efficiency.

Digital surface and elevation models can be generated from the data, which not only provide an accurate representation of the mine site but enable the optimisation of processes such as ore extraction and waste removal.

Researchers from the University of Queensland's Sustainable Minerals Institute (SMI), along with eight European organisations, have collaborated in an ongoing project to develop new hardware and software innovations that will make hyperspectral remote sensing from drones more effective and accessible to miners.

Hyperspectral imaging provides multidimensional data with comprehensive environmental and mineral information using a single instrument, enabling high-resolution mapping of rock minerals, plant health, and soil-water chemistry.

SMI Principal Research Fellow Associate Professor Steven Micklethwaite explained that one fly-over of an open pit gave chemical, physical and mineralogical insights that could be used to optimise decision-making around everything from resource management and pit operations to mineral processing and tailings disposal.

Prof Micklethwaite said: "Likewise, a single scan of the landscape surrounding an operation can provide [mine] closure professionals and environmental scientists with data on plants, soil and water.

"It can also provide early-stage upstream information on what future mine waste will look like – an increasingly important topic for companies and society – and then be used to characterise the waste and even inform the prospects for re-mining that waste for secondary value."

There are still technical challenges to deploying hyperspectral drones that need to be addressed, including how the sensors are tailor-made to fit a drone, as well as the massive amount of storage needed for the terabytes of data produced in a single flight.

To overcome these challenges, the research consortium is building a multi-sensor drone hardware infrastructure, as well as software that corrects and calibrates the initial hyperspectral data in real-time before interpreting it in terms of material distribution and chemical composition.

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The Elios 3: Revolutionising mining operations

Mining, one of the oldest industries, has always been at the forefront of technological advancements. From the adoption of steam power to modern automation, the sector has continuously evolved to enhance safety, efficiency, and productivity.

Unmanned Aerial Vehicles (UAVs), or drones, have primarily been utilised for surface mapping and surveying, offering a safer and more efficient alternative to traditional methods. Advances in technology have equipped drones with sophisticated sensors, cameras, and software, allowing them to perform a wider variety of tasks, including underground inspections.

The Elios 3, created by Flyability, is engineered for indoor use in complex and confined spaces, aiming to eliminate dangerous jobs for humans. It navigates tight, dark, and hazardous environments effectively, thanks to its protective cage that allows it to endure collisions. Additionally, the drone is equipped to collect both visual and LiDAR data simultaneously, enhancing its functionality in challenging mining conditions.

KEY BENEFITS OF USING THE ELIOS 3 IN MINING

The Elios 3 comes with several advanced features that helps in mining operations:

Safety

Mining is inherently dangerous due to hazardous environments, including unstable structures, heat, and unpredictable air movement. The Elios 3 helps mitigate these risks by:

- Accessing hazardous areas to gather data such as old workings, recent blasts, and established stopes.
- Conducting surveys to assess conditions and safely plan entries, aiding in risk detection and record updates.

- Enabling rapid emergency response through quick deployment and the ability to gather data in confined or hard-to-reach locations.

Access

Accessing certain areas of mines can be difficult, particularly with ore pass hangups or fall-of-ground locations. The Elios 3 drone provides a solution by reaching unreachable areas, flying at heights, and entering confined spaces for surveys. This capability is especially useful in hazardous environments, as it allows for vital information gathering without risking worker safety.

Drones improve access to previously inaccessible areas, enabling inspections of ventilation systems, pipe conditions, and maintenance planning, as well as navigating blocked pipes and tunnels. The Elios 3 enhances mine accessibility and safety by flying beyond the line of sight and using LiDAR live maps and video feeds to navigate tight spaces.

Data Quality

Data is crucial for mining surveys, guiding projects on maintenance, excavation, and backfilling. Drones offer diverse data types, including LiDAR, visual, and thermal scans, to effectively assess mine conditions and layouts.

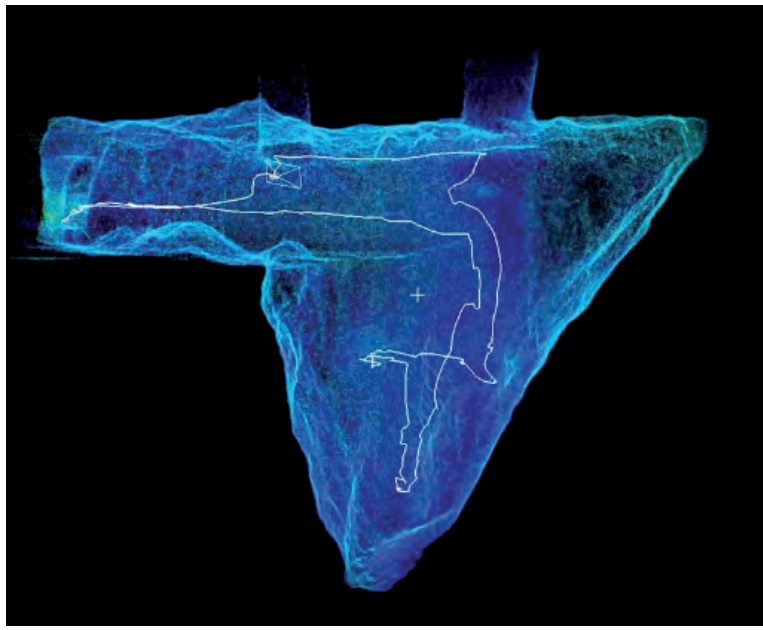
LiDAR Data: Supports projects like stockpile tracking and inspecting old workings. The Elios 3, with its specialised Surveying Payload, provides data accuracy of 1 centimetre, capturing 1.3 million points per second with 10x higher photon sensitivity than standard sensors, enabling reliable data analysis in shorter flight times.

Visual Inspections: Equipped with a 4K video camera and 12,000 MP imaging, the drone allows for detailed inspections to identify machinery faults and compare as-built installations to design plans, facilitating accurate assessments of mine conditions.

High-quality drone data enables operators to create precise digital representations of mines and conduct analyses as if on-site, rather than remotely. Drones enhance access and data quality, making them an ideal alternative to traditional surveying methods, particularly in areas with limited accessibility.

Versatility

The Elios 3 can fit into spaces as small as 50x50 cm. It is portable, deployable in minutes, and can switch from a visual camera to a live LiDAR point cloud view to operate in dusty environments. Designed for complex settings, including small tunnels and asset interiors, its flexibility is proven in various case studies. Additional applications include volume calculations, over/underbreak volumes,



georeferencing, precise measurements, and equipment management.

Efficiency and decision making

The Elios 3 drone eliminates unnecessary downtime. The high accuracy of the data collected is invaluable for updating mine records, presenting to inspector, and better decision making. This data can be used for assessing blast efficiency, over/underbreak volume, and strategising approaches to old workings. This remarkable efficiency and several factors contribute to:

- **Safe Access:** The drone can access areas without needing specialised equipment like scaffolding or specific PPE, enhancing safety and speed.
- **High-Quality Data:** The Elios 3 provides high point cloud density and data quality, offering immediate comprehensive results. Its live LiDAR mapping ensures complete data coverage, reducing the need for repeat visits.
- **Reduced Downtime:** The drone's flexibility and speed significantly cut down inspection time. Stockpile surveys can be completed quickly, and machinery operation can continue with minimal disruption.

The Elios 3 is designed to enhance data collection in mines, offering safety, quality, and efficiency. Its modular design allows for adaptability in complex environments, enabling the use of new payloads to expand its applications in challenging mining conditions.

For more information, visit www.flyability.com/mining-drones

BEST PRACTICE DUST MITIGATION CRUCIAL FOR SAFER MINE SITES

By Berkay Erkan

Coal dust is a continuous concern at Australian coal mines, necessitating improved controls to protect worker health as well as driving environmentally-friendly innovations to control and mitigate dust levels.

Respirable coal dust is generated and released into the air through several different mining processes, including breaking, crushing or milling ore; coal combustion processes; and handling and transport of coal and coal fly ash.

Shutdown maintenance activities and cleaning of workplaces where coal is used can also generate dust.

Respirable dust is very fine dust – generally 10 or less microns in diameter – that can reach the lower regions of the lungs and cause occupational or mine dust lung diseases.

According to Safe Work Australia, workers can develop coal workers pneumoconiosis by breathing in coal dust, often in large amounts, over a long period of time.

Workers in the mining industry or anyone who is exposed to coal and dusts associated with mining work are at risk – coal workers pneumoconiosis is also an increased risk for workers if they smoke.

The generation of dust caused by mining activities can also create a constant safety hazard on sites, which can be minimised by wet drilling or fitting drilling machines with dust collection devices.

In July, the NSW Resources Regulator issued a warning to coal mine operators after levels of respirable dust nearly four times the acceptable limit were recorded at a NSW open cut coal mine.

A dozer and grader operator at the mine recorded a respirable dust result of 4.8 milligrams per

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Before and After Dust Suppression

cubic metre, far above the relevant shift-adjusted occupational exposure limit of 1.37 milligrams.

No unusual exposure conditions were specified by the worker, and they were not wearing any respiratory protection during the exposure period.

The regulator reminded mine operators to ensure the highest level of controls, and that education and training of workers were in place to prevent exposure of workers to the hazards of respirable dust.

It added: "The order in which controls are implemented must follow the hierarchy of controls – personal protective equipment is the last line of defence against exposure."

MEASURES FOR DUST CONTROL

Control measures to manage dust include fitting drills with water injection or dust extraction systems, positioning ventilation to blow dust away from workers, and controlling dust at the source with a cyclone sample collector and during crushing and sample splitting.

Controlling dust at the source requires consideration of each crusher, mill, and grinder, with dust control devices fitted at the primary crusher feed hopper, as well as secondary and tertiary crushers plus screens.

Other areas that may require dust control measures include conveyor belt transfer points, stockpile stackers and reclaimers, and during loading and unloading operations.

An indispensable part of any dust management plan is the implementation of dust monitoring to optimise control strategies.

Obtaining dust samples ensures exposure is effectively controlled, provides data for reporting obligations, and helps determine dust behaviour, distribution, and properties.

Typical techniques for dust sampling and measurement around the world include sampling from still air, mass concentration measurements, continuous real-time monitoring, and personal sampling.

In New South Wales, personal gravimetric sampling is the approved method used in coal mines.

This method collects inhalable dust from the air close to a mine worker's nose and mouth during a full shift, which is then measured and weighed.

For underground coal mines, ventilation is integral to managing air quality and dust exposure, and can be improved through several methods.

These methods include installation and maintenance of a gob curtain, face ventilation, ventilated cutting drums, blowing face ventilation, and exhausting face ventilation.

> "In the case of mining, this means having operations that have a net positive contribution to the environment and society, and working with the wider metals supply chain to promote the responsible use and recovery of metals after they enter markets."

Face ventilation is the process of providing air to dilute and carry airborne dust down a longwall face and prevent it from coming into contact with mine operators.

Ventilated cutting drums reduce the amount of dust created by a longwall shearer through water-powered dust capture tubes built into the hub of the shearer drum.

Blowing face ventilation involves blowing clean air toward the longwall face and returning contaminated air back through the ventilation system, while exhausting face ventilation uses clean air across the face but then draws contaminated air behind a curtain or through exhaust tubing.

ENVIRONMENTALLY-FRIENDLY INNOVATION FOR DUST SUPPRESSION

A study published last year explained that current methods for dust suppression fell into either physical or chemical methods, with the first involving suppressing dust by covering it with cloth, dust control net, or watering, whereas chemical methods use environmentally-friendly dust suppressants.

The authors said: "Due to the suspension and hydrophobicity properties of coal dust, chemical methods are more efficient than physical ones in dealing with respirable dust.

"Chemical dust suppressants, which capture dust particles in air through the application of chemical substances, can eliminate or reduce dust pollution to environment – considering their good dust suppression effect, they have been widely used and developed."

They noted that despite availability, chemical suppressants generally faced problems such as single function and high price, as well as disadvantages such as toxicity, corrosiveness, refractory degradation, secondary pollution, and limited open-air application.

By Andrew Mack, Talis Consultants

Environmental offsets: when hope and promise fade

Environmental offsets have been utilised worldwide for over 40 years. Defined by the EPA (2011) as "an offsite action or actions to address significant residual environmental impacts of a development or activity," these initiatives typically cover issues such as biodiversity loss and greenhouse gas emissions.

There is an array of policies, guidelines and metrics available that frame the consideration of offsets at both the state and federal level. At Talis, we leverage these frameworks to quantify and evaluate offsets for various approvals.

Whilst acceptability of the use of offsets to counterbalance significant residual impacts forms part of the current approvals processes and are widely-used, their effectiveness is questionable.

The *Review of the Western Australian environmental offsets framework* released in 2019 states that "implementation of the framework has not fully counterbalanced the significant residual impacts of approvals".

Similarly, an extensive study by Guardian Australia in relation to NSW's offsets framework was critical of "offsets that had been promised and not delivered, as well as...offsets in areas that already had some form of protection and restoration activity".

Earlier this year, the federal government released an audit report on environmental offsets, revealing one in seven were non-compliant or potentially non-compliant with their approval conditions and a further one in four had not, or potentially had not, secured the necessary offsets. This is alarming given recent inclusions to the Federal list of Matters of National Environmental Significance, now numbered at 2,224.

Polly Hemming notes the inherent contradiction in treating nature as a low-risk, tradeable commodity (Dec 2022 – *The Saturday Paper*). In our view, this underscores the problem of offsets.

Proponents want approval and may opt for low-cost solutions that align with statutory requirements. However, these solutions might not always achieve the intended goal of counterbalancing environmental impacts. Whilst legally acceptable, they may not achieve the desired environmental outcomes.

Ethically, several questions remain to be answered in relation to improving the offsets framework, including:

- Potential ineffectiveness to mitigate loss and provide a net gain;
- Temporal and spatial discrepancies between impact and offset;
- Mismatches between social and ethical values lost locally and those used as offsets;
- Implementation and monitoring difficulties leading to poor delivery outcomes;
- Perception issues regarding 'buying' an approval; and
- Inability of offsets to counterbalance intrinsically lost values.

In this ESG world, such a one-dimensional approach is unlikely to remain palatable.

Offsets do not create acceptability for a project's impacts but should create a net environmental benefit. Talis suggests that offsets still have a role in the approvals framework, but their application and benefits need careful consideration.

Where used with impunity, offsets could undermine a company's social licence to operate, damage its reputation, and lead to further environmental degradation.

Assuming nothing changes for the better, Talis suggests the acceptability of offsets may diminish, forcing proponents to demonstrate the acceptability of their proposals without relying on offsets.

What is clear is that all parties involved in the approvals process - proponent, consultant and regulator, must ensure the process remains appropriate and accountability maintained.

This is what led them to investigate the use of microcapsule technology to provide an environmentally-friendly method of coal dust prevention and control.

Microcapsules are tiny particles with a 'core-shell' structure that belong to a micro-packaging technology in which natural or synthetic polymer materials are used to embed and seal solid particles, liquid droplets, and even gases.

Using peanut shell waste as the organic material, the researchers separated cellulose nanofibrils (CNF), which is an emerging nanocellulose materials that has properties such as high aspect ratio, high strength, and low thermal expansion, as well as a wide range of sources, low cost, and friendliness to the environment.

They then examined the microscopic action mechanism between dust-suppressing microcapsules and coal from a molecular perspective with the aid of molecular dynamics simulation software.

The simulation results were consistent with experimental phenomena, which verified the feasibility and accuracy of the molecular dynamics simulation.

The researchers said: "The dust-suppressing microcapsules prepared from peanut shells are advantageous for their low cost, good performance, and environmental friendliness.

"They can not only realise the recycling of waste, but also effectively control coal mine dust.

"This process ensures the clean production of coal mining enterprises, which is consistent with the requirements of coal in the new era."

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