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RECORD

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MINOTAUR
EXPLORATION

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MAJOR COMMODITIES SNAPSHOT p4

CHARGING AHEAD

The owners of the Bald Hill lithium mine in WA – Tawana Resources and Alliance Mineral Assets – have merged to elevate their status in the global battery metals market.

FEATURE p22

Image: Alliance Mineral Assets.



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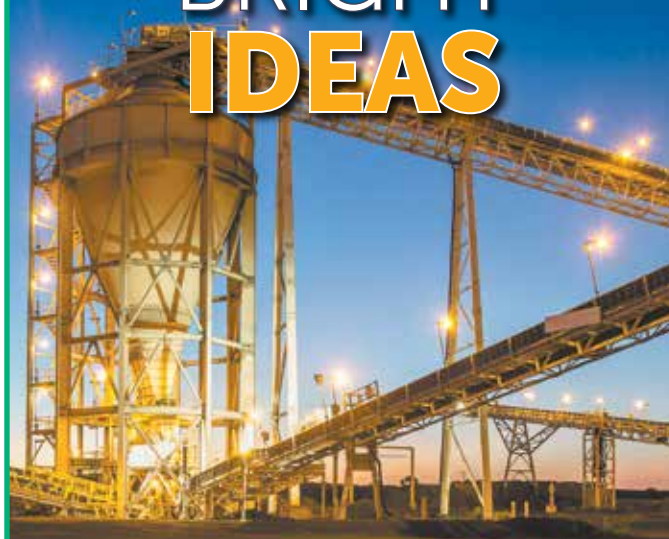
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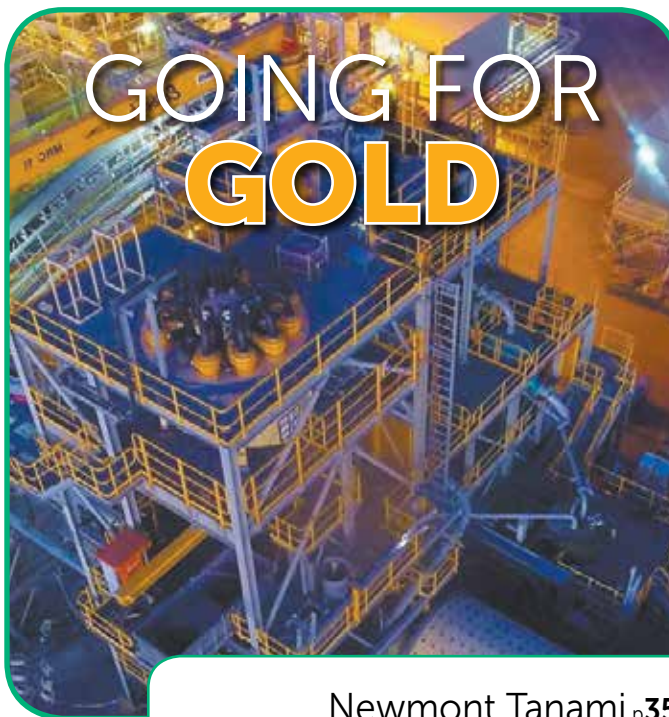
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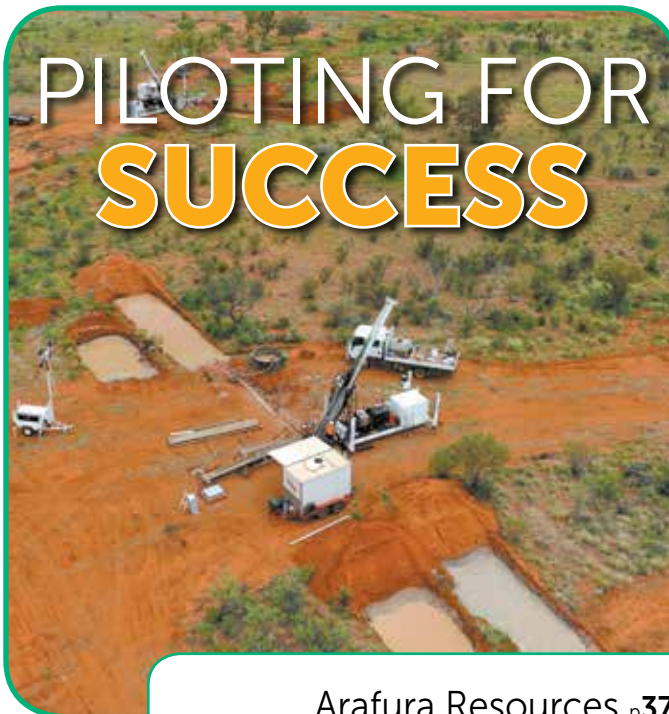
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MAJOR COMMODITIES SNAPSHOT

GOLD

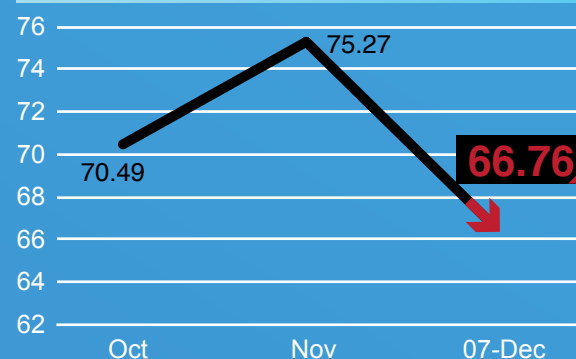
\$US/oz

Gold prices hit a five-month high of \$US1250 per ounce in early December due to a weaker US dollar, but later fell amid Brexit vote uncertainty.



IRON ORE

\$US/t
62% Fe CFR China

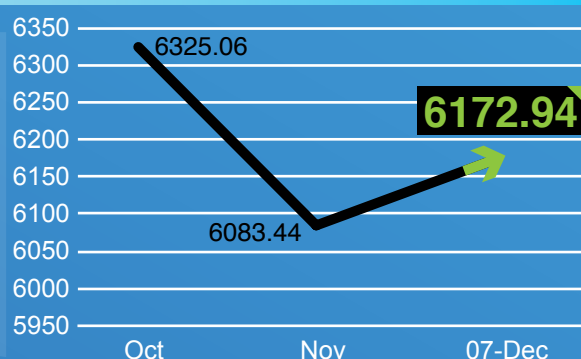


The iron ore price suffered losses during the month, sparked by further signs of a slowdown in Chinese steel production early in December.

COPPER

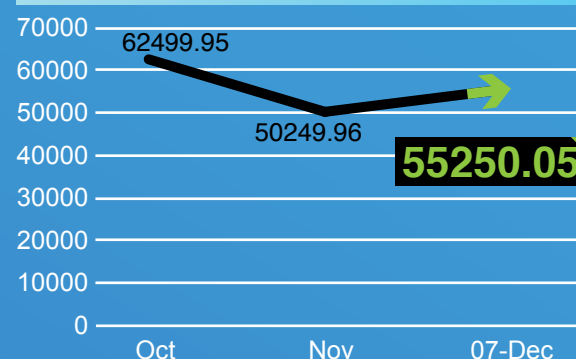
\$US/t
LME Price

Copper prices climbed above \$US6300/t in December before slipping back down to \$US6172/t as Chinese import data strengthened worries about demand growth.



COBALT

\$US/t
LME Price

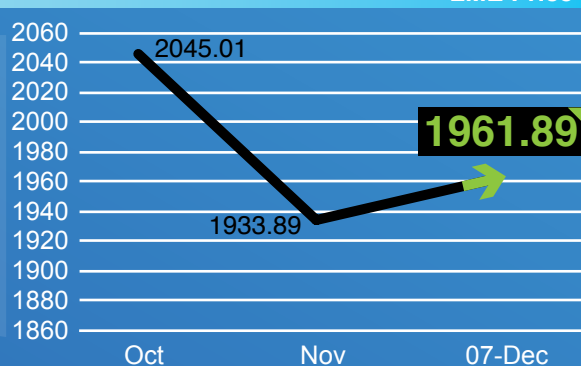


Cobalt enjoyed a modest price rebound following a month of slow trades and aggressive buyer bidding.

ALUMINIUM

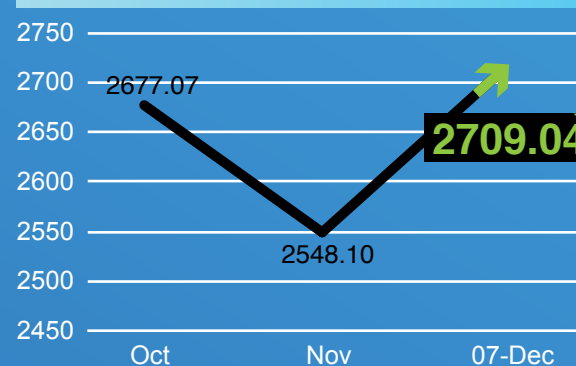
\$US/t
LME Price

Aluminium prices rallied slightly in December but analysts remain cautious, forecasting global oversupply during the first quarter of 2019.



ZINC

\$US/t
LME Price

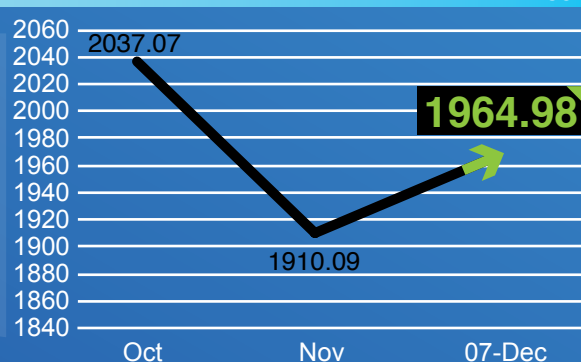


Zinc rose on persistent supply tightness and positive trade talks between the US and China, having picked up from an overall decline in metals prices in November.

LEAD

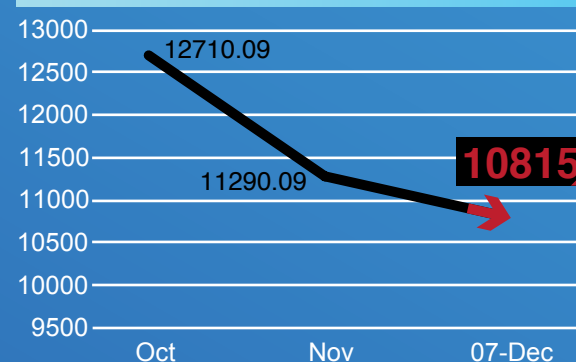
\$US/t
LME Price

The lead price saw some recovery in mid-November, reaching a three-month high of \$US2000/t before settling at the \$US1964 mark mid-December.



NICKEL

\$US/t
LME Price



Nickel prices continued to tumble in line with declining Chinese steel demand. Analysts anticipate the downward trend will continue into 2019.

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IN BRIEF

EPA approves Mt Keith project

WA

THE Environmental Protection Authority (EPA) has approved BHP Billiton Nickel West's proposed Mt Keith Satellite project near the existing Mt Keith nickel operation, 80km north of Leinster.

The proposed mine would produce about 9.6 million tonnes of nickel ore a year for potential use in lithium batteries and was expected to extend the life of the Mt Keith nickel operation by 12 years.

"Nickel West demonstrated appropriate engagement with traditional owners during the design of the mine site and developed suitable management procedures for impacts to flora and vegetation including avoidance of clearing in the Wanjarri Nature Reserve," EPA chair Dr Tom Hatton said.

Refinery expansion to boost economy

QLD

A \$300 million expansion of the Sun Metals Zinc Refinery (SMC) is set to bring hundreds of jobs to North QLD.

QLD Premier Annastacia Palaszczuk said the newly announced expansion would increase zinc production to about 220,000 to 270,000 tonnes per year, and was great news for North QLD and for Sun Metals Corporation.

"This is a huge day for Townsville and the surrounding region because the expansion is expected to support an estimated 350 jobs during construction, and there will be around 100 additional permanent refinery and logistic workers once operational," Ms Palaszczuk said.

Sun Metals' refinery expansion was expected to commence immediately, and was expected to be complete by the first half of 2021.

'Mega' steel plant on cards for Whyalla

SOUTH AUSTRALIA

GFG Alliance executive chairman Sanjeev Gupta has unveiled plans to build a 'Next-Gen' steel plant in Whyalla that will be the largest in the world.

The plant would be capable of producing 10 million tonnes per annum, with the ability and infrastructure to eventually double capacity.

"Using the most advanced technologies and our own local resources, we will aim to be one of the most competitive steel producers globally," Mr Gupta said.

"Thousands of job opportunities will be created throughout the construction phase and from the plant's ongoing operations."

Kidman settles Mt Holland dispute



Image: Kidman Resources.

Mt Holland's Earl Grey resource is one of the world's most significant hard rock lithium deposits.

ELIZABETH FABRI
WA

KIDMAN Resources and Sociedad Quimica y Minera de Chile's (SQM) Mt Holland JV project has the green light to move forward now a dispute over key tenements has been resolved.

The dispute involved 13 key tenements at the project, where insufficient capital had been invested in site exploration under Government regulations before Kidman acquired the project in 2016.

In September, Kidman announced it had received notification from the Perth Mining Warden that applications for exemption from minimum expenditure on the relevant tenements be refused.

Kidman's assessment of the previous

owner's expenditure shortfall was \$102,771, which it said "was not material in the context of the opportunity that the Mt Holland project represents for all relevant stakeholders".

On 10 December, the miner executed a deed of settlement with the objectors which "resolved the matter completely", and all forfeiture applications would be dismissed.

"With the settlement concluded, funding secured through to final investment decision and our recent lithium hydroxide offtake agreements with Tesla, Inc. and Mitsui & Co. Ltd, we will be able to wholly focus on progressing the development of the Mt Holland lithium project, secure further strategic offtake agreements with key global partners and continue our discussions in relation to the provision of debt facilities with prospective lenders," Kidman managing

director and chief executive Martin Donohoe said.

Kidman said the specific terms of the settlement were confidential and "not material" to Kidman.

In June, Kidman made headlines as the first Australian miner to sign an offtake agreement with Elon Musk's Tesla.

The binding agreement would see the miner supply lithium hydroxide to the electric vehicle maker over an initial three-year term on a fixed price, take-or-pay basis.

To date, Kidman and SQM have invested more than \$55 million in the Mt Holland project, which was expected to create about 700 jobs during construction and 300 full time positions during operations.

WA Government royalties were also expected to be in excess of \$1.7 billion.

Adani pushes ahead with Carmichael mine

AMY BLOM
QLD

A LAST minute legal bid will not prevent Adani Australia from pushing ahead with the construction of its Carmichael mine in central QLD, with the company opening expressions of interest on 4 December.

The Indian energy giant announced it would 100 per cent finance the scaled-down mine and rail project on 29 November, opening it up to begin construction before Christmas.

Adani Australia chief executive Lucas Dow said work in recent months had culminated in the miner's approval of the revised project plan that de-risked the initial stages of the mine and rail project by adopting a narrow gauge rail solution combined with a reduced ramp up volume for the mine.

"This means we've minimised our execution risk and initial capital outlay," Mr Dow said.

"The sharpening of the mine plan has kept operating costs to a minimum and ensures the project remains within the first quartile of the global cost curve."

Mr Dow said Adani would now begin developing a smaller open cut mine comparable to many other QLD coal mines, and would ramp up production over time to 27.5 million tonnes per annum.

The following week, environmental



Image: Adani.

Adani Australia chief executive Lucas Dow made the announcement at the Bowen Basin Mining Club.

activists launched a legal challenge to a Federal Government decision to bypass an impact assessment of planned water use by Adani, in a bid to prevent construction of the mine, which has become a lightning rod for environmental activists.

However an Adan spokesperson said the legal action would not stop construction, and that Adani did not need the North Galilee Water Scheme finalised to begin work on the project.

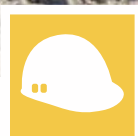
"Adani will continue to deliver the

Carmichael project, and we will do so in line with our approvals, along with the strict regulations and legislation that govern our Australian resources industry," the spokesperson said.

"Adani has been through a rigorous and strict approvals process over the last eight years and we have met all of those requirements.

"Accordingly, we now expect that we will be treated no differently to any other Australian miner."

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Albemarle to acquire 50pc of Wodgina

EMMA DAVIES
WA

MINERAL Resources (MinRes) has agreed to sell a half-share in its Wodgina lithium project to US group Ablemarle Corporation for \$US1.15 billion.

Under the deal, Albemarle would acquire a 50 per cent interest in all mineral rights within the Wodgina tenements other than iron ore (which will be retained exclusively by MinRes) and tantalum (which remain held by Global Advanced Metals Greenbushes), as well as all fixed infrastructure and utility assets, the spodumene concentrate plant and the mobile mining equipment.

The two companies would form a 50:50 Joint venture (JV), which would include a jointly funded, designed, built and operated lithium hydroxide plant.

The Wodgina project was expected to produce up to 750,000tpa of 6 per cent spodumene, which would be used as feedstock for the plant once constructed.

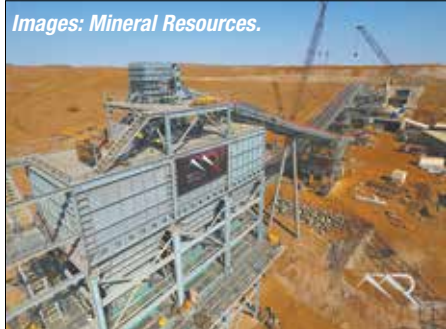
The first stage was expected to produce at least 50,000tpa of battery grade lithium hydroxide and the second stage was expected to convert the remaining volume of spodumene concentrate to battery grade lithium hydroxide — with expected production at about 100,000tpa.

MinRes managing director Chris Ellison said there was an extremely good fit between the corporate cultures and skillsets of both businesses.

“Our proven local Western Australian capability is extremely well complemented by Albemarle’s proven technical downstream processing expertise and their international marketing capabilities in lithium and other energy storage minerals,” Mr Ellison said.

“Our organisations share the same vision to develop Wodgina, a tier one asset, as a world class, 30-plus year integrated lithium operation together.

“I am confident that with MRL and Albemarle working together at Wodgina, we will produce and supply high-quality, competitively priced lithium products into the market to meet increasing global requirements for these important energy storage products.”



The project will be jointly funded, designed, built and operated by both companies.

FMG launches higher grade iron ore



FMG's West Pilbara Fines product at its Pilbara operations.

ELIZABETH FABRI
WA

FORTESCUE Metals Group (FMG) will wave off its first two shipments of higher grade 60.1 per cent West Pilbara Fines iron ore in December to customers in China.

The new product is a higher iron, low alumina ore blended from its Firetail mine and the western pits at its Cloudbreak mine in the Pilbara.

FMG said it planned to ship between 5 and 10 million tonnes of the WPF product in FY19, which will grow to 40mtpa once its Eliwana mine enters production in December 2020.

At a recent media and investor tour, FMG took visitors to its port, rail and Chichester Hub operations to view the West Pilbara Fines stockpiles.

“We’re expecting a couple of shipments

in December, both into China to established large steel mill customers,” FMG chief operating officer Greg Lilleyman said at a media briefing.

The introduction of West Pilbara Fines came at an opportune time for the company, which had experienced wider-than-normal discounts in recent years for its lower grade 58 per cent iron ore.

However, the miner remained confident the gap between prices received for lower and higher grade ore was beginning to narrow.

FMG chief executive Elizabeth Gaines said the new product would enable FMG to offer a more flexible product mix.

“Innovation in process and design is a key component of Fortescue’s strategy to efficiently and effectively deliver products from mine to market and the introduction of West Pilbara Fines will further enhance the range of ores available for our customers,”

Ms Gaines said.

“Fortescue’s wholly owned, integrated mining operations and infrastructure, together with our innovative processing and blending strategy, provides us the flexibility to deliver West Pilbara Fines before full scale production begins on completion of the Eliwana development.”

The investor and media tour also highlighted FMG’s advances in automation across its operations.

The miner was currently converting its existing fleet of haul trucks with Caterpillar’s ‘Cat Command’ autonomous haulage technology.

“The 789D is the 35th manned truck to be converted to autonomous at Christmas Creek, demonstrating our progress to becoming the only iron ore operation in the world to have a fully autonomous haulage fleet,” Ms Gaines said.

TNG to raise \$850m for Mount Peake

AMY BLOM
NT

TNG Limited has appointed a German company to raise \$850 million for the development and construction of its Mount Peake project.

KfW IPEX-Bank would start a mandate for the funds on 15 January.

TNG managing director Paul Burton said the company was one of the leading export and project banks worldwide.

“We now look forward to working closely with KfW IPEX-Bank to progress the full financing package for the Mount Peake project expeditiously, with a view to achieving financial close as soon as possible and getting on with the job of constructing this major new Australian resource project,” Mr Burton said.

According to Mr Burton the decision followed extensive reviews and meetings in Europe and Singapore.

It came less than a month after the Northern Territory Government granted the company a mineral lease for Mount Peake, 235km north of Alice Springs.

The mine, granted major project status by the NT Government, had the potential to create up to 500 jobs during construction, and between 175 and 250 ongoing roles during operation.

Following the mineral lease being granted, Mr Burton said the company was rapidly ticking off the boxes towards the Mount Peake development, with key



A rig at TNG's Mount Peake project.

announcements over the past few months, including the signing of a Native Title Agreement.

“With these important milestones now complete, and subject to finance, this will now lead to a significant project going into production in the NT with long-term employment opportunities,” Mr Burton said.

Subject to further operational approvals, TNG aimed to begin construction in 2019

over a two year period, with an estimated mine life of 17 years.

The new mine would produce a vanadium, titanium and iron concentrate that TNG intended to transport by rail to a proposed new metals processing facility being planned for the Middle Arm Industrial Precinct in Darwin.

Subject to approvals, TNG expected construction of the refinery to begin in 2020.

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IN BRIEF

New projects benefit from exploration grants

QLD

ALMOST \$2 million is up for grabs as part of the QLD Government and industry's Collaborative Exploration Initiative, which aims to encourage explorers to uncover minerals in the State's remote, resource-rich North West.

QLD Mines minister Dr Anthony Lynham said 15 new exploration projects, powered by 12 companies, would be bolstered by the latest round of collaborative exploration grants.

"Queensland is investing in exploration," Dr Lynham said.

Proponents would receive up to half of the direct activity costs of their projects to a maximum of \$200,000 and will get an additional incentive of 75 per cent, or up to \$300,000, if they can finalise projects by August 2019.

High-grade mineralisation at Southern Nights

NSW

PEEL Mining has announced high-grade zinc-lead assays at its 100 per cent owned Wagga Tank project, south of Cobar in western NSW.

The Wagga Tank project, which included the Southern Nights prospect, was emerging as one of the most significant zinc polymetallic discoveries in Australia in recent years, with results including 18.2 metres at 40.3 per cent zinc, 15.7 per cent lead, 0.97 per cent copper, 356 grams per tonne silver, and 2.77 grams per tonne of gold from 182 metres.

Intermin and MacPhersons to merge

WA

JUNIOR Goldfields-focussed explorers Intermin and MacPhersons have agreed to merge to form a new gold company, Horizon Minerals.

Under the merger, the company would have a combined mineral resource of 1.15 million ounces with a 100 per cent interest in the Boorara gold project and the Nimbus project which contained gold, silver and zinc, as well as several active joint ventures.

"Combining MacPhersons' large baseload Boorara deposit with the nearby, higher-grade Intermin projects should enable a more rapid pathway to production with sufficient scale to avoid the need for third party toll milling," Intermin managing director Jon Price said.

Vimy defines uranium corridor



Image: Vimy Resources.

Drilling at Such Wow.

AMY BLOM NT

VIMY Resources has defined a large uranium corridor at its Such Wow prospect, which is part of its Alligator River project in the Northern Territory.

According to Vimy, first pass reverse circulation (RC) drilling at the prospect intersected the uranium hosted Cahill formation in all six holes.

Key targets were identified along major fault zones with extensive alteration haloes.

Vimy managing director and chief

executive Mike Young said the sheer size of the prospect was remarkable.

"The combination of surface alteration and structural features, along with significant uranium anomalism in our last drill hole, reinforces its potential," Mr Young said.

"Our exploration team has over 20 years of combined uranium experience in Arnhem Land and they have never seen a clear-cut surface expression of potential uranium mineralisation as was mapped at the Shiba Zone about 120 metres above the unconformity.

"We're confident that future drill programs at Such Wow will prove up more

uranium mineralisation and help to build a pipeline of projects."

According to Vimy, Such Wow was a stand-out exploration target due to the overall size of the structural corridor – more than five times the size of the Angularli prospect – with thin sandstone cover and surface expressions of hydrothermal alteration associated with uranium mineralisation.

Such Wow was within the King River-Wellington Range joint venture, which Vimy had a 75 per cent stake in, and Rio Tinto Exploration had the remaining 25 per cent.

Galileo strikes more cobalt

AMY BLOM WA

MARK Creasy-backed Galileo Mining is a step closer to developing a commercial cobalt mine in WA's goldfields region, after announcing a new 4100 tonne cobalt resource within its Norseman project.

The Maiden JORC 2012 Inferred Resource for the Goblin prospect recorded 4.9 million tonnes at 0.08 per cent cobalt for 4100 tonnes of contained cobalt.

With the addition of the Goblin prospect, the global resource base of the Norseman cobalt project now stood at 25.1 million tonnes at 0.11 per cent cobalt (at a 0.06 per cent cobalt cut-off) for 26,600 tonnes of cobalt and 122,400 tonnes of nickel.

Galileo managing director Brad Underwood said the new JORC resource at the Goblin prospect validated the company's strategy of building up the project's resource base while undertaking metallurgical test work to understand the most efficient method of metal extraction from those resources.

"The Goblin resource is a great result and confirms our belief that significant zones of cobalt mineralisation occur outside of our current JORC resources," Mr Underwood said.

"We are confident that this continues to be the case and look forward to the opportunity of



Image: Galileo Mining.

Reverse circulation drilling at Galileo's Norseman cobalt project.

adding further resources with our exploration and resource extension drilling programs planned for 2019."

The Goblin prospect was 3km south of Galileo's main resource at Norseman and had an identified strike of cobalt mineralisation of more than 2km.

According to Galileo, the cobalt mineralisation occurred at shallow depths of between 12 metres and 60 metres and was consistent in style with the company's existing

JORC resources at Norseman.

In early December the explorer announced metallurgical test work results had demonstrated up to 95 per cent cobalt metal extraction and 66 per cent nickel metal extraction from Norseman project concentrate samples.

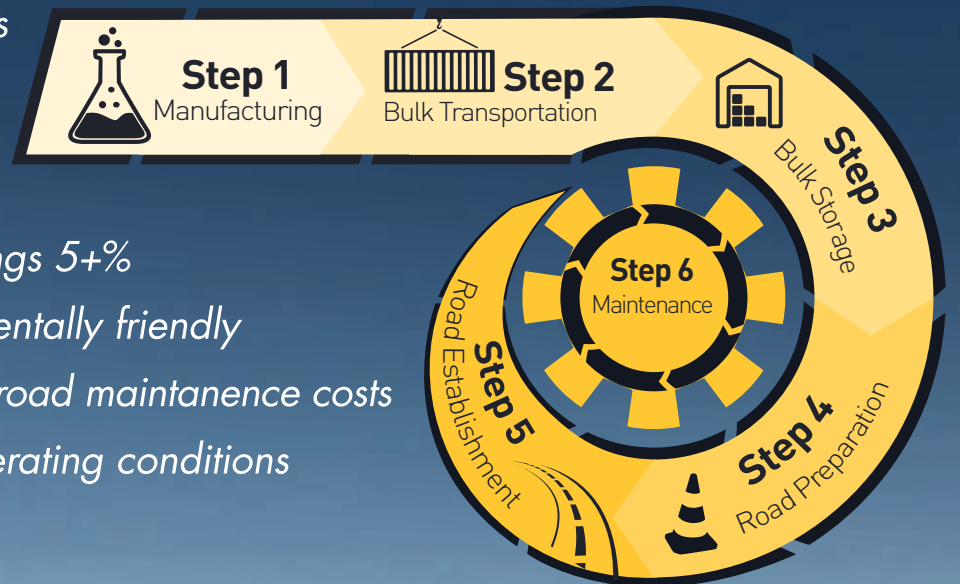
Mr Underwood said the results showed that Galileo was making substantial progress towards understanding the best way to extract cobalt and nickel from its Norseman resources.

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IN BRIEF

Isaac plains mining work extended

QLD

NRW Holdings' subsidiary Golding Contractors has reached agreement with Stanmore Coal for a five-year extension to its current contract for mining services at Isaac Plains East open cut coal mine in QLD.

The value of this award added about \$500 million to the existing contract and extended the project term to June 2024.

"The relationship which commenced in 2015, has been a productive and successful partnership and we look forward to supporting Stanmore's growth ambitions as they further develop their extensive resource base over the coming years," NRW chief executive and managing director Jules Pemberton said.

MACA secures Kirkalocka contract

WA

MACA Interquip has nabbed a \$28 million mill construction contract at Adaman Resources' Kirkalocka gold project near Mt Magnet in WA.

The work, scheduled to begin in February, included a new semi-autogenous grinding (SAG) mill installation and refurbishment of an existing mineral processing plant.

MACA operations director Geoff Baker said the contract would span about eight months and employ up to 40 personnel.

"The recent contract awards for MACA Interquip demonstrates the success of the MACA strategy to diversify its services within the resource industry," Mr Baker said.

Three year extension for Bis

NSW

MINING services company Bis has been awarded a three-year contract extension to provide haulage services for Whitehaven Coal's Tarrawonga and Rocglen coal mines in NSW.

Bis would deliver a new fleet of enhanced prime movers to support the Gunnedah operations.

The bespoke haulage solution provided greater payload capacity, while reducing the number of prime movers, delivering cost efficiencies and benefits to Whitehaven Coal.

One way trips would also be reduced by 36 per cent (about 48 000 fewer trips per annum when compared to the current fleet) which would reduce vehicle emissions, and contribute to improved local road safety.

Veterans transition to mining jobs



Image: Macmahon.

Macmahon has initiated a series of veteran assessment days this year.

EMMA DAVIES
NATIONAL

MINING services contractor Macmahon and the Working Spirit group have joined forces to improve employment opportunities available to Australian defence force veterans as they transition to civilian work.

Macmahon manager human resources Katherine Blacklock said most veterans had been extensively trained and their experience and knowledge was a "highly transferrable fit for many mining and associated industry roles".

"Typically, veterans breed integrity and hard work and have shown leadership under stressful conditions," Ms Blacklock said.

"Veterans often tell us the transition process can be quite jarring and many feel

there is a need for a new wave of consistent government policy and direct pathways to industry roles.

"In response, we have implemented targeted strategies for engagement, development and retention of ex-defence force personnel."

Ms Blacklock said high unemployment rates of veterans were often attributed to misconceptions that army, navy and air force veterans suffer from mental health issues and veterans often under-sold their skill set to potential employers.

She said through the Working Spirit program, Macmahon and other miners were improving employment opportunities available to veterans through a direct opportunities portal as well as career summits, networking, and social sundowners.

In 2018, there had been a 36 per cent increase in job demand in the mining sector, according to the latest DFP Recruitment national *Mining and Resources Job Index*.

"This [program] is a key aim for us to help fill jobs across our wide network of contract services to surface and underground mining operators, especially given we have about \$7 billion worth of project opportunities in our pipeline to come onstream," Ms Blacklock said.

"These opportunities will be in gold, base metals and coal sectors in Australia and offshore and are accompanied by significant growth in demand for skilled and unskilled labour."

To date, Macmahon has held a series of veteran assessment days and has employed 12 former Australian Defence Force personnel through Working Spirit.

Thyssenkrupp nabs \$250m South Flank contract

AMY BLOM
WA

THYSSENKRUPP Industrial Solutions will deliver the largest rail-mounted stackers and reclaimer in the world after securing a \$250 million contract at BHP's South Flank iron ore operation in WA's Pilbara region.

It would be one of the largest fabrication and construction projects the company has ever undertaken in WA, and would see it design, supply, construct and commission large-scale stockyard machines.

Thyssenkrupp Industrial Solutions mining technologies chief executive Torsten Gerlach said the company looked forward to contributing to South Flank by combining long-standing global expertise in the mining business with local experience.

"Our strong partnership with BHP extends globally, but the Pilbara region is a core area where we have provided material handling solutions for decades," Mr Gerlach said.

"With our field service teams we are supporting our customers on a daily basis."

Thyssenkrupp would supply two stackers that deposit iron ore into stockyards, and a reclaimer for loading the ore into trains for transport to Port Hedland.



Image: Thyssenkrupp.

A Thyssenkrupp stacker and reclaimer at a BHP mine.

The machines would have a capacity of 20,000 tonnes per hour, making them the largest of their kind in the world.

According to Thyssenkrupp, the design of the machines incorporated the latest Australian design standard requirements and technology improvement centred on safe construction, operation, and maintenance

activities.

Generating about 80 million tonnes of output per year, South Flank would fully replace production from the existing Yandi mine, which was reaching the end of its economic life.

BHP was targeting first ore extraction in 2021.

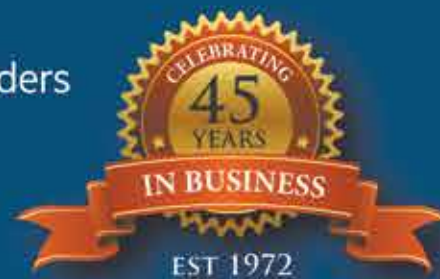
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Data scientists called for \$1m challenge

ELIZABETH FABRI
SOUTH AUSTRALIA

OZ Minerals, in partnership with open innovation platform Uearthed, has launched an Explorer Challenge that aims to crowdsourcing solutions online from the world's leading data scientists and geologists.

During the 10-week challenge, participants will have the opportunity to develop ground-breaking approaches to discovering new exploration targets at OZ Minerals' Prominent Hill copper-gold mine, with a \$1 million prize pool awarded to "winning ideas".

Uearthed founding director Justin Strharsky said the challenge sought to test how the global resources industry could leverage data science to its full potential.

"During the exploration process, the iterative process of collecting different datasets, followed by geological interpretation, can take a very long time," Mr Strharsky said.

"Vast amounts of data are collected and processed, and very often this does not result in a discovery.

"The Explorer Challenge will speed up the exploration lifecycle and allow us to analyse information at a much faster rate than before.

"This competition represents a fundamental change in approach to problem-solving.

"Data science techniques can be used for exploration and many other challenges faced by the industry."

Mr Strharsky said the business as usual

Image: OZ Minerals.



The Explorer Challenge is open to geologists and data scientists from across the world.

approach in the mining industry would no longer suffice.

"The traditional borders of our companies must be expanded virtually to include people with different skills and perspectives from around the world," he said.

"If your approach to digital skills is to hire people who happen to live near your HQ on the basis of a CV or a degree from a school

you recognise, you're doing it wrong."

OZ Minerals chief executive Andrew Cole said the challenge would give the team potential access to thousands of scientists' ideas and data, and the winning idea would have the chance to get their model tested in real life.

"The challenge is a continuation of our digital transformation journey, which we

started two years ago when we migrated all our exploration data to the Amazon Web Service (AWS) cloud," Mr Cole said.

"We want to find ways to work smarter with all the data we've got, not just geological data, and challenge existing concepts of how we are harnessing it."

Entries open in February 2019 with winners to be announced in June 2019.

Hybrid truck tech goes global

EMMA DAVIES
QLD

A NEW hybrid truck has been doing circuits around New Hope Group's New Acland mine for the past two years and is now attracting interest on the global market.

New Acland mine general manager David Vink said the innovative dual fuel trucks, led by project partners Mine Energy Solutions (MES) and Hastings Deering, were a great example of industry collaboration.

"We provided the trial site and wherewithal, MES the technology and Hastings Deering the hardware - so to speak (truck and engines)," Mr Vink said.

The revolutionary technology enabled the conversion of high horse powered diesel engines from 100 per cent diesel to dual fuel operation, using natural gas as the dominant fuel through sequential gas injection.

"When MES first looked for project partners in Queensland there was no one interested, but we could see the potential for this technology from the outset," Mr Vink said.

"Now, after nearly 24 months operating on site, clocking more than 6200 hours, we've piqued the interest of the big boys and the sceptics.

"We've taken the technology from an R&D project to ready for commercial application.

"The trial is complete, MES's technology has been proven and we are pleased to be part of this exciting project that is now going global."

Koodaideri sets technological benchmark

EMMA DAVIES
WA

RIO Tinto has approved its \$3.5 billion Koodaideri iron ore mine in WA that is set to be its most technologically advanced operation to date.

Construction was set to begin in 2019, and once complete, the mine would have an annual capacity of 43 million tonnes - underpinning production of the Pilbara Blend, Rio Tinto's flagship iron ore product.

The operation had been designed to utilise an increased level of automation and digitisation which Rio Tinto expected would significantly enhance productivity, safety and maintenance of the new mine.

"Koodaideri is a game-changer," Rio Tinto chief executive Jean-Sébastien Jacques said.

"It will be the most technologically advanced mine we have ever built and sets a new benchmark for the industry in terms of the adoption of automation and the use of data to enhance safety and productivity."

The site would feature technology already in use across Rio Tinto, such as autonomous trucks, trains and drills, and implement systems connecting all components of the mining value chain for the first time.

Innovations included a digital replica of the processing plant, accessible in real time by workers in the field; fully integrated mine automation and simulation systems; advanced automation, including an automated workshop; and numerous data analytics capabilities and control loops to optimise production and reduce downtime.

Rio Tinto Iron Ore chief executive Chris Salisbury said the project would be

Image: Rio Tinto.
Photography: Christian Sprogoe.



Rio Tinto autonomous haulage trucks, West Angelas minesite.

a significant leap forward for the global mining industry.

"We've been building mines in the Pilbara for over 50 years, and, subject to final approvals, Koodaideri will incorporate all of that knowledge to enable us to build the smartest, safest and most efficient mine we've ever constructed," Mr Salisbury said.

"The deployment of leading edge technology will deliver a step-change in both safety and productivity for our

business."

Rio Tinto expected to employ more than 2000 people throughout construction, with 600 permanent roles created once the mine was operational in 2021.

The miner had also poured \$44 million into a pre-feasibility study for Koodaideri Phase 2, which would increase annual capacity to 70 million tonnes and beyond.

Koodaideri remained subject to WA Government approval.



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Newcrest signs landmark agreements

EMMA DAVIES
PNG/CHILE

NEWCREST Mining is ramping up its activities overseas after entering non-binding agreements with exploration juniors in Chile and signing a memorandum of understanding (MOU) with its Wafi-Golpu joint venture partner Harmony Gold and the Independent State of Papua New Guinea.

The Wafi-Golpu MOU established the framework for the parties to progress the permitting of the Wafi-Golpu project as quickly as practicable and re-affirmed the intention to achieve grant of a special mining lease by 30 June 2019.

“We have been working constructively with the Government of Papua New Guinea to progress permitting of the project and recently achieved key milestones in this process with completion of our Feasibility Study Update in March 2018 and Environmental Impact Statement in June 2018,” Newcrest managing director and chief executive Sandeep Biswas said.

“Getting this work started will benefit Morobe Province, with a capital injection into the economy and improved access to remote parts of the Province.”

The company’s agreements in Chile included an option to farm-in on Mirasol Resources’ Gorbea high-sulfidation epithermal gold project; and Cornerstone Capital Resource’s epithermal gold-silver and porphyry gold-copper deposits along the interpreted northern extension of the



Image: Newcrest Mining.

The Wafi-Golpu Joint Venture in Papua New Guinea is expected to be granted a Special Mining Lease by mid-2019.

Maricunga magmatic belt.

Mirasol chief executive Stephen Nano said the company was pleased to again be partnering with Newcrest to explore its prospective Mio-Pliocene belt projects for district scale gold deposits.

“Newcrest has allocated a combined \$US7.3 million in separate agreements,

for the exploration of Mirasol’s Gorbea and Altazor projects over the next 12 to 18 months.”

Cornerstone Capital Resources chief executive Brooke Macdonald was also enthusiastic to be working with Newcrest.

“Newcrest is one of the largest gold mining companies in the world, operating

mines in Australia, Papua New Guinea, and Indonesia, and we are pleased to have entered into this agreement with them,” Ms Macdonald said.

“Newcrest is also actively exploring in Ecuador, where Cornerstone has a first mover advantage as a prospect generator in Ecuador since 2005, and several drill-ready properties available for option.”

Tribune acquires high-grade gold project

AMY BLOM
PHILIPPINES

AUSTRALIAN gold producer, Tribune Resources, has acquired Singapore-based Prometheus Developments as part of its bid to transform the company into a significant mining house.

Prometheus has rights over the high-grade Diwalwal gold exploration project on Mindanao in the Philippines.

As part of the acquisition, Tribune Resources, a partner in the East Kundana mine in WA’s eastern goldfields, would purchase 5.5 million shares at deemed issue price of \$4.50 for a total consideration of \$24.75 million.

According to Tribune, Prometheus had defined an exploration target that would be the focus of an extensive drilling program by Tribune in 2019 with the intent to establish a maiden mineral resource estimate.

Tribune director Gordon Sklenka said Diwalwal “ticked all the right boxes and represented an excellent investment opportunity for the company and its shareholders.

“Having a strong balance sheet and income from the East Kundana joint venture has allowed us to assess meaningful acquisitions where we will be able to transform the company into a significant mining house,” Mr Sklenka said.

“Diwalwal ticks all the right boxes for us in terms of adding value for shareholders.

“The project has secure tenure, excellent grades, prospective geology and the potential for the delineation of a very large gold deposit.”

South32 enters US alliance

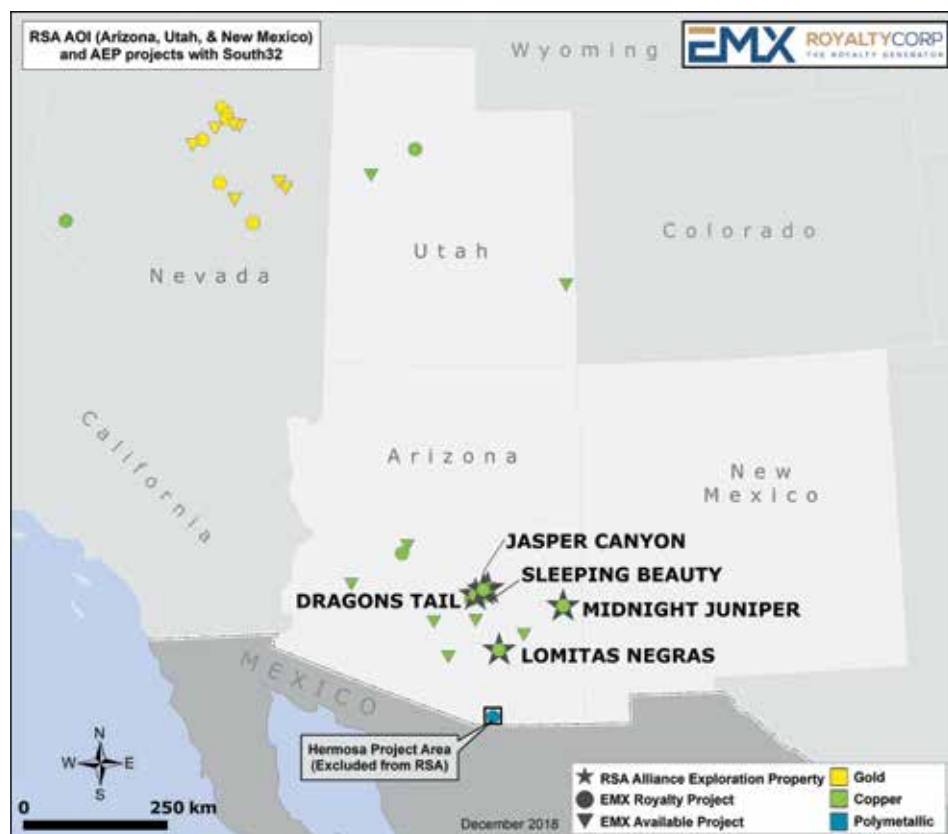


Image: South32.

EMMA DAVIES
US

SOUTH32 has executed a Regional Strategic Alliance Agreement with EMX Royalty Corporation covering exploration tenements in Arizona, New Mexico, and Utah.

Under the agreement, South32 agreed to provide \$800,000 per year over two years to cover generative work and the salaries of EMX personnel involved in the exploration of copper and other base metal projects within the Laramide and Tertiary



magmatic arcs — excluding South32’s Hermosa project in southern Arizona.

South32 would also provide a separate annual acquisition fund of \$200,000 to pay for the acquisition of new properties as approved by the technical committee, with exploration work to be funded separately through cash calls to South32.

Any projects advanced to the designated project stage would be covered under separate option agreements with each agreement providing that South32 can earn a 100 per cent interest in the project by reimbursing EMX’s holding costs upon execution of the option agreement.

During the five-year term of an option agreement, South32 would also make option payments totalling \$525,000 and completing \$5 million in exploration expenditures to EMX.

Five EMX copper projects in Arizona had been selected to begin advancing toward the drill program stage; Midnight Juniper, 1km northwest of the Morenci open pit copper mine; Jasper Canyon and Sleeping Beauty in the Globe-Miami mining district; Dragons Tail in the Superior mining district; and Lomitas Negras, about 10km southeast of the town of San Manuel.

Lynas faces licensing hurdle



Image: Lynas Corporation.

EMMA DAVIES
MALAYSIA

AUSTRALIAN rare earths miner Lynas Corporation remains positive it can reach “an appropriate outcome” after stringent environmental demands were made for its Malaysian processing operations’ license renewal.

Lynas owns the Mt Weld rare earths mine in WA, and the Lynas Advanced Materials Plant (LAMP) in Malaysia – one of the largest and most modern rare earth separation plants in the world.

In December, a statement from Malaysia’s Minister for Energy, Science, Technology, Environment and Climate Change (MESTECC) expressed concerns over Lynas’ processing plant site and set new conditions for the company to meet ahead of its license renewal in September 2019.

Conditions included the export of Water Leach Purification (WLP) residue and the submission of an action plan on the disposal of Neutralization Underflow Residue (NUF), as current approval was only valid until February.

In a statement, Lynas said the preconditions were inconsistent with the Review Committee’s recommendation released the same day, that Lynas Malaysia should determine the location of and build a permanent disposal facility (PDF) for the WLP residue.

“The potential construction of a PDF for WLP residue has always been part of our planning,” the company stated.

“It is provided for in our financial statements and by way of the PDF bond in excess of \$US34 million that is held by the Malaysian regulator.

“Lynas’ license conditions explicitly state that residues should be recycled, and if that

fails, then they should be stored in a PDF. Export should only be considered if a PDF is not possible.”

Lynas said it was one of a number of industries in Malaysia with feedstock that produces residues with low level radioactivity, and there should not be one rule for other industries and one rule for Lynas.

“We will consider all options available to us to achieve an appropriate outcome prior to 2 September 2019, including legal options,” it stated.

Lynas’ share price dropped by about 26 per cent after the conditions were set.

The Review Committee report on Lynas’ operations was also released on 4 December, which was drafted after an extensive tour of Lynas’ operations, reviewed data from Lynas’ monitoring, relevant regulators and peer-reviewed research, and meetings with regulators, independent experts and local community members.

The report concluded Lynas Malaysia’s operations were low risk and compliant with applicable laws.

“We thank the Review Committee for its diligent and thorough approach,” Lynas chief executive and managing director Amanda Lacaze said.

She added the company was surprised with the Ministry’s decision to impose the pre-conditions, and they were inconsistent with the science, international best practice as well as with the expert Review Committee’s recommendations.

“This appears to be policy based on politics, not policy based on science. It is very disappointing to receive this on the same day that the Review Committee report was released,” she said.

“However, we are confident we are well placed to manage potential changes and our long term investment thesis remains strong.”



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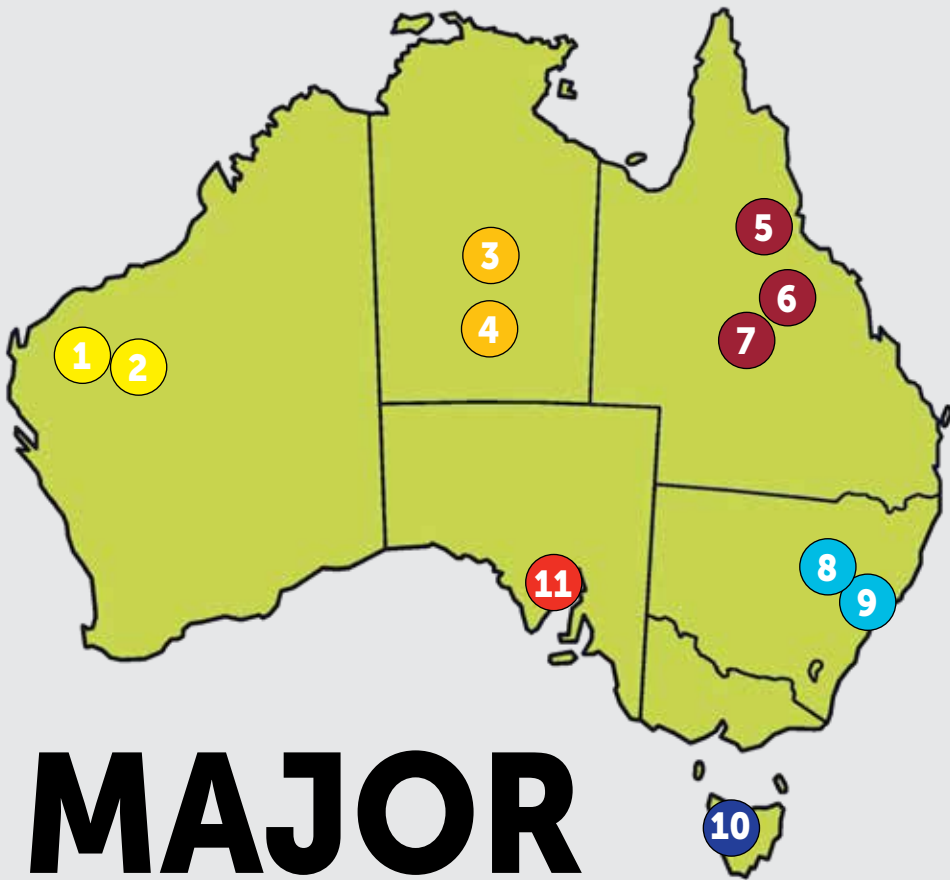


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MAJOR PROJECTS SNAPSHOT 2019

5 SCONI

Australian Mines (100%) www.australianmines.com.au

A cobalt-nickel-scandium project with a 2 million tonne per annum processing plant.

- Capital cost: \$1.35 billion
- Jobs: 500 during construction and 300 in operations
- Development start date: 2019
- First production: 2021
- Mine life: 18 years

6 OLIVE DOWNS

Pembroke (100%) www.pembrokeresources.com.au

Greenfield metallurgical coal mine with a yield of up to 15 million tonnes of product coal per annum for steel production.

- Capital cost: \$1 billion
- Jobs: 3500 in construction and 1000 in operations
- Development start date: 2019
- First production: 2020
- Mine life: More than 50 years

7 CARMICHAEL

Adani (100%) www.adaniaustralia.com

A 10 million tonne per annum thermal coal mine, with plans to ramp up to 27.5mtpa.

- Capital cost: \$2 billion
- Jobs: 1500 jobs during construction
- Development start date: 2019 (pending approvals)
- First production: 2021
- Mine life: 30+ years

9 CLEAN TEQ SUNRISE

Clean TeQ (100%) www.cleanteq.com

Sunrise is one of the highest grade and largest nickel and cobalt deposits outside of Africa and one of the largest scandium deposits in the world.

- Capital cost: \$1.7 billion
- Jobs: 1000 in construction and 300 in operations
- Development start date: Mid 2019
- First production: 2019
- Mine life: More than 40 years

8 BYLONG COAL

KEPCO Bylong Australia (100%) www.bylongproject.com.au

Open cut and underground mine expected to produce up to 6.5 million tonnes of run of mine coal per annum for supply to the thermal coal export market.

- Capital cost: \$1.3 billion
- Jobs: 650 in construction and 450 in operations
- Development start date: 2019 (subject to approvals)
- First production: [unknown]
- Mine life: 25 years

10 ROGETTA

Forward Mining (100%) www.forwardmining.com

The biggest iron ore mine in Tasmania, Rogetta is forecast to produce 1mtpa over its initial mine life, and could fetch export revenues of up to \$100 million a year.

- Capital cost: \$100 million
- Jobs: 200 jobs during construction and 100 jobs in operations
- Development start date: 2019
- First production: 2020
- Mine life: 30 years (initial 8 years)

11 SIVIOUR

Renascor Resources (100%) www.renascor.com.au

Sivour the largest graphite deposit in Australia, and the fifth largest graphite deposit in the world with annual production of 123,000 tonnes.

- Capital cost: (Stage 1) \$US29 million, (Stage 2) \$US91 million
- Jobs: About 150 during construction and 100 during operations
- Development start date: Q4 2019 (pending approvals)
- First production: 2020
- Mine life: 60+ years

1 ELIWANA

Fortescue Metals Group (100%) www.fmg.com.au

Eliwana is set to replace production at the 30mtpa Firetail mine, and will further contribute to FMG's new 60.1 per cent West Pilbara Fines iron ore product.

- Capital cost: \$US1.275 billion
- Jobs: 1900 during construction, 500 in operations
- Development start date: 2019
- First production: December 2020
- Mine life: 18 years

2 KOODAIDERI

Rio Tinto (100%) www.riotinto.com

Koodaideri will deliver a new 43 million tonne iron ore production hub for Rio Tinto, and will be its most technologically advanced mine to date.

- Capital cost: \$3.5 billion
- Jobs: 2000 during construction, 600 in operations
- Development start date: 2019
- First production: Late 2021
- Mine life: 30 years

3 MOUNT PEAKE

TNG Limited (100%) www.tngltd.com.au

Open pit mining and onsite processing to produce a magnetite concentrate

- Capital cost: \$853 million for stage 1 and \$969 million for stage 2
- Jobs: Up to 500 in construction and 175-250 in operations
- Development start date: 2019 (subject to further approvals)
- First production: 2021
- Mine life: 17 years

4 NOLANS

Arafura Resources (100%) www.arultd.com

An open cut rare earths mine with a targeted annual output of 3600 tonnes of neodymium and praseodymium (NdPr) and other by-products.

- Capital cost: \$US680 million
- Jobs: 400-500 in construction and 250-300 in operations
- Development start date: late 2019 (subject to Final Investment Decision)
- First production: 2021/2022
- Mine life: 40 years based on identified resources



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AUSTRALIAN DEVELOPERS

• **Renascor Resources (ASX: RNU)** is developing the Siviour graphite project in South Australia with construction planned to begin in 2019, and production in 2020.

• **Hexagon Resources (ASX: HXG)** and **Mineral Resources (ASX: MIN)** signed a joint venture agreement over the McIntosh graphite project in WA East Kimberley in 2018 and are aiming for first production before April 2021.

• **Mineral Commodities (ASX: MRC)** is planning to mine graphite from six open pits at its Munglinup project near Esperance in WA. Production was targeted for Q4 2019.

• **Novonix (ASX: NVX)** has a mining lease application underway for the Mount Dromedary graphite deposit in QLD. However the company's priority was currently on downstream processing.

• **Lincoln Minerals (ASX: LML)** is currently undertaking a Definitive Feasibility Study into its \$44 million Kookaburra Gully mine in South Australia.

• **Anson Resources (ASX: ASN)** owns the Ajana graphite deposit in Northampton, WA, with exploration activities underway.

• **Comet Resources (ASX: CRL)** is advancing its Springdale graphite project in WA. In late November it raised \$825,000 to put towards drilling programs and pursue offtake agreements.

• **Oakdale Resources (ASX: OAR)** is continuing to review the short term commercialisation of its Oakdale graphite project in South Australia and is in offtake discussions.

• **Archer Exploration (ASX: AXE)** has entered collaborations with a number of universities that are testing graphite from its Campoona deposit in South Australia and its use in various technologies.

• **Strike Resources (ASX: SRK)** is developing the Burke graphite project in QLD, and is undertaking test work to determine its suitability for use in EV batteries.

• **Quantum Graphite (ASX: QGL)** owns the Mikkira graphite deposit in South Australia.

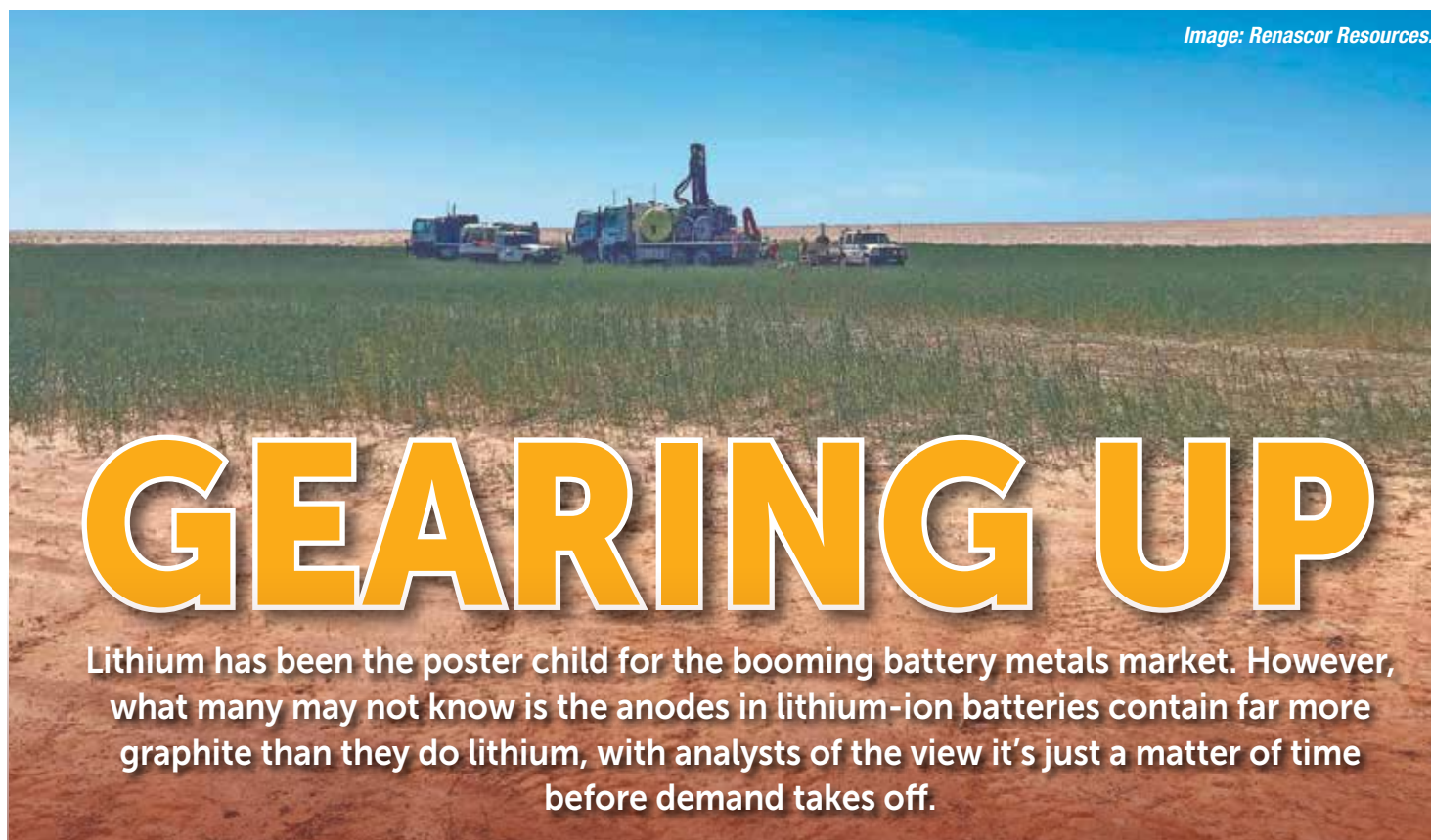


Image: Renascor Resources.

ELIZABETH FABRI

GRAPHITE demand and prices are about to skyrocket.

According to Roskill, the market will soon see a rapid period of growth driven by – you guessed it – the rising lithium-ion battery industry.

Graphite itself can come in two forms; natural graphite which is mined and processed, and synthetic graphite which is made from petroleum coke.

Then there's graphene; an allotrope form of carbon comprising one atomic layer of graphite arranged in a hexagonal lattice, which is the strongest material recorded.

In its 2018 *Global Industry, Markets & Outlook* report, Roskill forecasts consumption of graphite in battery applications to be five to 10 times higher by 2027 than the current level, pending the uptake of lithium-ion battery electric vehicles.

"Roskill forecasts electric and hybrid vehicles could account for 69 per cent of all motor vehicle sales by 2027," Roskill stated.

"With battery demand from these electric vehicles as well as an unprecedented surge in stationary storage, the future for battery graphite is exciting."

Australia is fortunate to have a large number of graphite focussed ASX-listed companies with projects at various stages of development, particularly overseas in Europe, Mozambique and Tanzania.

Industrial minerals consultant Andrew Scogings said Tanzania, Mozambique and other nearby countries such as Malawi and Madagascar had numerous graphite deposits that were characterised by a wide range of flake sizes that could supply a variety of markets.

"In fact, the term 'Jumbo Flake' was coined for an East African deposit, given that several of the East African deposits often have a higher proportion of large flakes than other locations," Dr Scogings said.

"It is believed that Chinese deposits (China is the global leader in flake graphite production) don't have as many of the large flakes, which are in demand for expandable graphite used in fire retardants and in making graphite foils for electrical and computer applications."

On the other side of the size distribution, Dr Scogings said small flakes less than 150 micron were in demand for spheroidal graphite.

"It is reported that some East African explorers/producers can achieve higher purity (e.g. >96 per cent carbon) for small

flakes (minus 150 micron) which is higher than the current 94 per cent purity graphite being used to make spherical graphite in China," he said.

"The use of higher purity feedstock to make spherical graphite reduces the cost of chemical and or heat treatment to raise the purity to above 99.9 per cent, which is needed for batteries."

ASX companies currently making moves overseas included Talga Resources which had established a vertically integrated business that starts with its large European graphite deposits; and Syrah Resources, which was now the largest global producer of natural flake graphite after commencing mining at its Balama project in Mozambique in 2018.

Closer to home there was also an emerging group of Australian-focussed explorers hitting ground.

Renascor Resources was a leader of the pack, along with peers Lincoln Minerals, Hexagon Resources and Mineral Resources, with plans to begin construction on its Siviour graphite project in 2019 and production in 2020.

Renascor's South Australian deposit was considered the largest graphite deposit in Australia, and the fifth largest graphite deposit in the world.



Image: Syrah Resources.

ASX-listed Syrah Resources' Balama graphite mine in Mozambique was opened in 2018.



Image: Renascor Resources.

“But it’s more than just large,” Renascor managing director David Christensen said.

“We’ve been able to produce a high-grade, high-quality graphite product from Siviour, and our recently completed PFS suggests Siviour can be among the lowest cost producers in the world.

“Our goal is to give Australia a world class graphite mine that can compete in any price environment with any development in the world.”

Mr Christensen said the price of flake graphite (the kind most mines like Siviour would produce) was currently hovering between \$US800 per tonne and \$US1800/t depending on the size and purity.

“The prices have been gradually rising over the last six-months and are projected to continue this trend, subject to potential disruption,” he said.

“On the demand side, the biggest potential disruption is probably the use of flake graphite in lithium ion batteries.

“Graphite for lithium ion batteries currently accounts for around one-fifth of flake graphite demand, but is projected to account for significantly more in the very near future.”

Challenges

While market fundamentals looked strong, a common hurdle experienced among emerging producers was locking in finance.

“Graphite is easy to find and relatively easy to mine,” Mr Christensen said.

“The hard part is producing a product at a low enough cost to be able to finance the mine’s development and stay in business.

Mr Christensen said a point of difference of its Siviour project was its location in a modern, established part of Australia.

“We can start our development without having to pay large sums of capital for infrastructure,” he said.



Industrial minerals consultant Dr Andrew Scogings.

“I may be biased, but it’s hard to think why any other place would be better than Australia – provided you can find a high-quality deposit.

“We think we’ve really ticked this box with Siviour, as the project economics and quality of the graphite product stacks up with any development in the world, including those in Tanzania and Mozambique.”

Dr Scogings said investors were also still treading with caution as they hadn’t seen the dramatic price increases in graphite as for lithium.

“However, the word in the market is that

graphite prices are rising, that the Chinese are importing graphite and apparently are prepared to pay more for higher purity products especially in the batteries market,” Dr Scogings said.

“The graphite market is also relatively diverse with a wide range of specifications (e.g. flake size distribution and purity) in addition to moisture, bulk density, trace element impurities and also performance requirements such as expandability and oxidation temperature.”

Dr Scogings said another key requirement of miners was to produce consistent quality graphite over extended periods of time.

“Industrial customers such as refractories manufacturers and spheroidal graphite processors need to have consistent sizing, purity and moisture contents for example,” he said.

“Producing consistent graphite quality is difficult if the deposit (the orebody) hasn’t been explored/defined in sufficient detail to enable selective mining if required, blending and consistent feed to the flotation plant to enable consistent product stream.”

Mr Christensen agreed, citing consistency as a challenge that often “gets overlooked” by industry.

“High-quality and low cost are essential, but the project must demonstrate the ability to be consistently high-quality and low cost,” Mr Christensen said.

“We think this is where we have another real advantage with Siviour.

“We have one massive deposit (rather than a series of deposits), so we will always be offering from the same source and delivering the same high-quality.

“To date, we’ve tested our material at labs all over the world (Australia, North America, Europe and China), and we’ve consistently demonstrated the ability to deliver.”

Dr Scogings said other important factors were determining what products can consistently be extracted from the ore, and whether the proposed products perform in targeted markets and offer competitive advantage.

“Further important factors are location, logistics and sovereign risk with cost of logistics often a game changer,” Dr Scogings said.

“A well-known saying for industrial minerals such as graphite is that ‘without a market, an industrial minerals deposit is merely a geological curiosity’.



December was a big month for the owners of the Bald Hill lithium Joint Venture –Tawana Resources and Alliance Mineral Assets Limited – with a merger finalised between the two companies that is set to take the mine into its next phase of growth.

All Images: Alliance Mineral Assets.

EMMA DAVIES

BALD Hill – 50km south east of Kambalda in the Eastern Goldfields region WA – entered commercial lithium concentrate production in mid-2018.

To date, the mine has been operated under a 50:50 Joint Venture between Tawana Resources and Singapore-based Alliance.

However a merger has been in the works since April that will simplify the mine's ownership and management, as well as place the merged group on the radar of a greater number of domestic and global institutional investors.

On 27 November, Tawana shareholders approved a scheme of arrangement with Alliance under which Alliance would acquire 100 per cent of the issued capital of Tawana.

Days later, the JV partners obtained approval from the Federal Court of Australia to merge, with Tawana shares suspended from trading on the ASX and Johannesburg Stock Exchange on 4 December.

From mid-December Tawana started trading on a normal settlement basis as part of Alliance under the ASX code A40, with Tawana shareholders receiving 1.1 Alliance shares for every Tawana share held.

In the days leading up to the merger, Tawana Resources managing director Mark Calderwood (now Alliance Mineral Assets managing director) said the companies had been working together at the site since 2016 – so merging to create a pure-play mid-tier lithium producer was the next natural step.

"The merger will elevate our status in the market, giving the company a pro-forma market cap of about \$400 million, as well as simplifying the ownership and management structure," Mr Calderwood



"With the proposed fines circuit, we are targeting increased combined throughput to 300tph and recovery of 72-80 per cent"

The mine achieved commercial production in July 2018.

told *The Australian Mining Review*.

"The merger process has taken a little longer than we expected, due to the need to secure funding to allow the ASX listing of Alliance following the merger as well as strengthen the company's balance sheet going forward."

"Now that we have a \$40 million package from a consortium of lenders led by Tribeca Investment Partners, we are aiming for the merger to be finalised in December 2018."

Tawana has also demerged a number of non-core assets this year to form Cowan

Lithium.

"We spun out our non-core assets into a new company called Cowan Lithium to allow shareholders to realise value from these assets and for Tawana to focus on operations at Bald Hill," Mr Calderwood said.

"The demerger was approved by our shareholders in July, with Tawana continuing to hold a 15 per cent stake in the company - given the current market climate the proposed ASX listing of Cowan Lithium Limited has been postponed and we will revisit this in the New Year."

Bald Hill

Mr Calderwood said the company was extremely pleased to bring the Bald Hill project into production in less than 16 months.

"Having completed our first shipment in May 2018 and achieved commercial production in July 2018, we are now ramping up operations and we have estimated production of 55,000 to 60,000 tonnes of spodumene in the second half of the 2018 calendar year," Mr Calderwood said.

“We achieved production of 28,500 wet metric tonnes of lithium concentrate in the September 2018 quarter, up 63 per cent on the previous quarter, and we expect to produce a similar quantity this quarter.”

Bald Hill is one of the lowest cost lithium mines to come online in Australia with a prepaid offtake agreement helping to fund construction and leaving Tawana virtually debt free once production started.

100 per cent of Stage 1 concentrate produced over a five-year term (from 2018-2019) was agreed to be sold to Burwill Commodity at \$US880 per tonne (t) with shipment prices to be settled annually for the remaining three years of the contract.

In October, first tantalum concentrate was produced with 20-30 dry metric tonnes (dmt) (50 per cent each) of high-grade tantalum concentrate (approximately 30 per cent contained Ta₂O₅) sold to H.C. Starck Tantalum and Niobium GmbH (HC Starck).

As part of Stage 2 production at Bald Hill, the owners are proposing to treat otherwise stockpiled material that is <1mm fines.

“We have recently completed a fines optimisation study to examine the options to increase throughput and recovery,” Mr Calderwood said.

“With the proposed fines circuit, we are targeting increased combined throughput to 300tph and recovery of 72-80 per cent.

“We are undertaking an upgrade of our fines circuit at Bald Hill which aims to increase our throughput to 300 tonnes per hour as well as improve recoveries, therefore boosting our production and reducing costs.”

The team also recently conducted a study, which found the best option was to transition from a two-stream circuit processing a feed range of 1-18mm, to a three-stream circuit that can process a feed range of 0.5-18mm (such as the fines and middlings) through the addition of cyclones, screens and pumps.

“A three-stream circuit would provide maximum operational flexibility for the feed coming from Bald Hill,” Mr Calderwood said.

Primero Group, which has extensive knowledge of DMS circuits and the Bald Hill circuit in particular, has estimated the cost of adding this third stream at between \$10 million and \$15 million.

“Work is continuing on the Front-End Engineering Design (FEED) works to undertake this upgrade, and we expect to commence ordering equipment during the December 2018 quarter,” Mr Calderwood said.

Exploration Potential

The focus in 2018 was getting Bald Hill into production as rapidly and cost effectively as possible, meaning exploration programs had been restricted until now.

“The ground covered by the Bald Hill joint venture comprises nearly 770sqkm, and at this stage, we have explored only 8sqkm, or about 1 per cent of this ground, for lithium,” Mr Calderwood said.

“Our current lithium resource totals 26.5mt but given the limited exploration of our tenements, we believe we can add significantly to this.

“The resource remains open in all directions, and there are pegmatites widespread across sub-crop areas of the project that are worthy of future exploration.

“In addition, our understanding of mineralisation and structural controls has continued to improve as our exploration campaigns rolled out.”

Mr Calderwood said that limited exploration had intersected significant mineralisation outside the current resource area - which further added to the belief that



“The merger will elevate our status in the market, giving the company a pro-forma market cap of about \$400 million, as well as simplifying the ownership and management structure”

Photography: Carla Gottgens.

The new fines circuit is expected to increase throughput to 300tph.

the Bald Hill resource can increase.

“There are several opportunities for increasing mine life through exploration and infill reserve drilling which we will further examine during 2019, which include the northern and eastern extensions of the resource, as well as several areas outside the resource,” he said.

A Strong Future

Analysts predict demand for lithium to triple over the next five to 10 years as the use of metals needed to produce lithium-ion battery cathodes continues to increase.

“There are several converter plants in construction to produce lithium carbonate and many of these are yet to source a supply of feedstock, so we see the immediate outlook for lithium to be quite strong, however we expect supply to gradually increase over the next five or so years as more companies bring mines online,” Mr Calderwood said.

“At Tawana, we are working to ramp up our production to capitalise on this demand and interest.

“The original PFS study estimated production of 155,000tpa however a plant upgrade will allow potential to double production and should we increase our resources we will work towards further increases to production.”

The Chamber of Commerce and Industry of Western Australia November 2018 report *WA’s Future in the Lithium Battery Value Chain* stated that global demand megatrends are driving the opportunities for WA in the lithium-ion battery supply chain with forecasts suggesting the demand will quadruple out to 2025.

“Demand for personal and portable electronic devices, energy storage systems and particularly electric vehicles is expected to result in orders of magnitude increases in

demand for minerals used in the manufacture of lithium-ion batteries,” the report stated.

“As an established and expanding producer of some of these minerals for the global lithium-ion battery supply chain, WA stands to benefit from these megatrends.”

However the report cautions the lack of domestic demand to drive local industry development and that will most likely have a small market due to population and industry limitations.

“Western Australia currently accounts for approximately 11 per cent of global lithium reserves, and as a result of recent project developments, around half of global production and the vast majority of hard-rock lithium production,” the report stated.

While Bald Hill is primarily producing lithium, Mr Calderwood said Tawana is also negotiating an offtake agreement for the tantalum concentrate produced at the mine.

“We have recently made non-contracted sales of high-grade tantalum concentrate to two of the largest suppliers of tantalum products in the world,” he said.

“Tantalum pricing has been relatively strong in 2018 and we are encouraged by the level of interest in high quality tantalum concentrates with low levels of deleterious elements.

“At Bald Hill, we are able to produce a premium +30 per cent Ta₂O₅ concentrate, and we have been able to secure prices well above what we previously budgeted.

“Sales of tantalum concentrate will provide us with an important additional revenue stream and help us to fund future growth at Bald Hill.”

Moving forward, Mr Calderwood said the fines circuit upgrade will further boost production and recoveries and the company intends to follow up on several exciting exploration targets across its tenements and build additional resources for its inventory.



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All images: St Barbara.

STAR PERFORMER

A refusal to accept the status quo and a willingness to adopt innovative techniques will see the life of the historic Gwalia mine extended to 2031 and beyond, according to St Barbara managing director and chief executive Bob Vassie.

AMY BLOM

AS part of its bid to extend mine life at Gwalia, in the WA Goldfields, St Barbara will complete a \$100 million expansion (GEP) over the next 12 months, while also investigating a change to mining and haulage methods, called the Gwalia Mass Extraction (GMX).

According to St Barbara's Bob Vassie, the GEP was about 50 per cent complete, on schedule, and on budget, with planned completion expected at the end of 2019.

He said the GEP would improve production by addressing existing ventilation constraints.

"We are currently ventilation constrained at Gwalia, which limits how many activities we can do at one time, including trucking," Mr Vassie told *The Australian Mining Review*.

"Further, much of the waste rock we generate must be trucked to the surface, which displaces ore capacity.

"The GEP solves this by upgrading the ventilation capacity and installing paste aggregate fill (PAF) equipment underground."

Mr Vassie said PAF would enable St Barbara to combine crushed waste rock from underground development with cemented paste from the surface to use for stope fill.

"Having this set up underground will allow us to fill stopes faster and increase productivity and trucking efficiency," Mr Vassie said.

"Increasing the ventilation, along with upgrading power and cooling, will enable Gwalia to be mined to 2000 metres below surface."

Mr Vassie said St Barbara had also identified further chilling and fan upgrades to mine down to 2200 metres below surface.

"This, along with the GMX results in a life of mine plan out to FY31," he said.

The PAF component was the faster of the two areas and was due to be finished in the March quarter of 2019.

When turned on it would not only be able to dispose of the waste rock underground,



The team at St Barbara's Leonora operations have been investigating innovative solutions to increase production.

but also be able to deal with the waste rock chippings generated by the ventilation raise-boring.

Mr Vassie said this would immediately improve ore trucking capacity.

"When we commission the new ventilation and chilling at the end of 2019, that is when we can well and truly liberate the mine," he said.

Exploring New Methods

While implementation of the GMX was still a while away, the feasibility study was progressing well, having been expanded to consider alternative designs for hydraulic hoisting.

The feasibility study was due in March 2019.

"GMX is an innovative solution we've been studying that allows us to maintain gold production, in a deepening mine with lower

grades, by changing mining and hauling methods to double ore tonnage production," Mr Vassie said.

St Barbara announced the results of the pre-feasibility study in February 2018, highlighting the use of either continued truck haulage or hydraulic hoisting.

Hydraulic hoisting involves crushing and potentially grinding ore underground and pumping it to surface, then to the plant.

According to Mr Vassie, St Barbara would also change mining methods in some areas for economic extraction of thinner lodes.

GMX scenarios have 280,000 to 300,000 ounces per annum (ozpa) produced in the initial years, which were expected to be FY21 and FY22.

Production would then be maintained above 200,000ozpa until FY29.

Despite being an innovative solution, Mr Vassie said the crushing and pumping technologies St Barbara was exploring had

been proven within other applications.

"It's a little bit of horses for courses," he said.

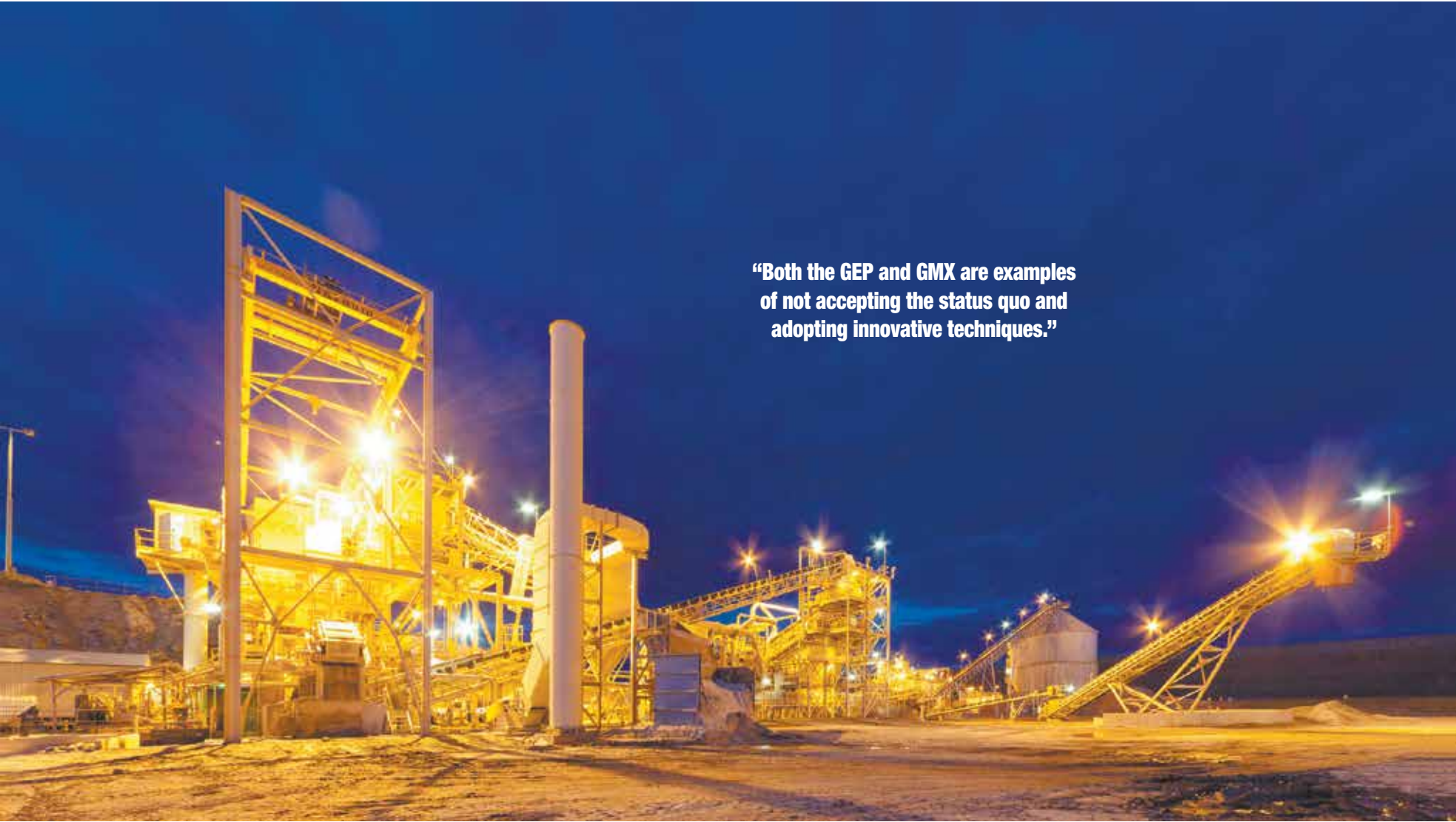
"Other deep mines would generally have a haulage shaft, so they would not need to consider pumping; that is why there are not many examples of vertical pumping of ore.

"In St Barbara's case we seek to innovate to maintain margins as Gwalia gets deeper.

"Both the GEP and GMX are examples of not accepting the status quo and adopting innovative techniques."

Drilling Further

Beyond the GEP and GMX, St Barbara also hoped to extend mine life through exploration success according to Mr Vassie, who said the miner had already had good results from the Gwalia Deeps drilling during the September quarter, with high expectations for the future.



“Both the GEP and GMX are examples of not accepting the status quo and adopting innovative techniques.”

St Barbara will complete a \$100 million expansion of its Leonora operations.

Drilling at Gwalia Deeps returned significant intersections including 18.6 metre grading at 10.3 grams per tonne (g/t) of gold and 6 metre grading at 12.2g/t of gold.

Both results were from two daughter holes, which tested the southern extension of the ore body.

Mr Vassie said the most pleasing thing about the results was the grades and thickness of the lodes, which were both similar to what St Barbara was currently mining 250 metres above.

He said St Barbara had increased the Leonora region’s exploration budget for FY19 by \$3 million, largely based on the results of that drilling.

“We have drilled a further two daughter holes since the September quarter was released and we’re waiting on assays,” Mr Vassie said.

“Other greater Gwalia exploration includes a drill hole to test a third seismic target located further south of the previous two.

“In the Leonora region we’ve also

completed a reverse circulation program at Horse-Paddock as well and are waiting on results.”

Mr Vassie said St Barbara would be doing a lot more on the large regional tenement package it held north of Leonora.

“This ground is along trend from Gwalia for about 60km and has not been explored by modern techniques,” he said.

“Previous exploration was shallow drilling decades ago.

“The long-term outlook for Gwalia looks very promising, with the work we’ve completed to date on the GMX indicating a mine life to FY31; if we factor in exploration success both at Gwalia and within trucking distance, the mine could operate for many years beyond FY31.”

In addition to its drilling around Gwalia, St Barbara has also entered into a joint venture agreement with Australian Potash at the Lake Wells gold project, 180km north east of Laverton.

Under the \$7 million agreement, St Barbara will pay Australian Potash \$1.25 million in cash and a minimum exploration

spend of \$1.75 million during the initial 12-month earn-in period.

After the first-year earn-in period, St Barbara could elect to earn a 70 per cent interest in the tenements by spending a further \$3.5 million on exploration over a 24-month period and reimburse Australian Potash \$500,000 in costs previously spent on exploration.

Mr Vassie said St Barbara viewed these types of investments as another form of exploration and part of its growth pipeline.

“The investments are targeted on areas and regions we view as highly prospective, but also have teams who are genuinely putting the money into the ground,” Mr Vassie said.

“The size of our investment allows for accelerated exploration and also gives us options should they have success.”

Performing Strongly

Exploration and extensions aside, Gwalia has already proven itself to be a strong performer for St Barbara, pouring its 2

millionth ounce of gold in October.

“It is a high-grade underground mine, but also the deepest trucking mine in the world and getting deeper each year,” Mr Vassie said.

“When the mine restarted in 2008, the initial target was producing around 185,000ozpa, which the company achieved in FY12 and FY13.

“Since then, new records for annual production have been set almost every year, with FY18 producing a new record of 268,000ozpa.”

Mr Vassie said while St Barbara was benefitting from production moving through a very-high grade portion of the orebody, much of the success since FY12 was due to increased tonnage productivity.

“The success has been driven through a focus on business improvement by our team on site,” he said.

“Reducing waste haulage, introducing ore passes and adoption of remote bogging have all contributed to productivity and efficiency.”



St Barbara managing director Bob Vassie.



St Barbara has increased production at the Gwalia mine.

All images: Fitzroy Australia Resources.



Fitzroy Australia Resources has managed to turn around the troubled Carborough Downs mine and has received approval to develop its Ironbark No.1 project – just in time to meet forecast growth in demand for Australian metallurgical coal.

EMMA DAVIES

SINCE Fitzroy Australia Resources (Fitzroy) acquired the Carborough Downs mine in 2016, more than 2 million tonnes of coking coal has been produced and a 10-year mine life has been achieved by opening up northern reserves.

The mine, formerly owned by Brazilian mining giant Vale, had encountered a number of issues since it began production – with various geological problems, rock faulting, and dangerous levels of carbon monoxide causing a force majeure in 2012.

Before the acquisition, Vale intended to put Carborough Downs into care and maintenance, but Fitzroy had other plans for the project, as well as the nearby Broadlea open cut mine, which was already mothballed.

Fitzroy Australia Resources chief executive Grant Polwarth said that turning the Broadlea and Carborough mines around and increasing production by 33 per cent was due to “thinking outside the box”.

“Upon acquisition of Carborough Downs, there was a major fault structure prohibiting access to the mine’s northern resources, which would have resulted in a longwall discontinuity of over 12 months,” Mr Polwarth said.

“We challenged the mine plan and industry norms to optimise the plan and unlock several smaller remnant longwall panels and diversified the mining mix by implementing bord and pillar mining.

“The fault traverse was approached differently and was conquered within 10 months of acquisition – this unlocked a 10-year mine life in the northern reserves and delivered longwall continuity.”

Ironbark No.1

The lessons learned through the revival of Carborough Downs can only add to Fitzroy’s recently approved Ironbark No.1 project, also in the Bowen Basin, 35km north-east of Moranbah.

The new project will share existing infrastructure at Carborough including the coal handling preparation plant (CHPP) and rail load out facilities – making it both low impact and capital efficient.

“Ironbark No. 1 will be a new, modern, underground longwall and bord and pillar operation,” Mr Polwarth said.



The location of the recently approved Ironbark No.1 project.

“It will mine the same seam and utilise the same mining methodologies as Carborough Downs,” he said.

Mr Polwarth said the right culture helped in the Carborough Downs revival and that the team’s experience will be vital to the new project.

“We were fortunate to have great people – we needed to get the culture right: back to basics coal mining where we are proud of what we do and have conviction in ourselves and each other,” he said.

“We will take over 10 years of learnings, the experience and expertise of our team, and continue to challenge industry norms at Ironbark No.1.”

Economic Benefits

Queensland Resources Council (QRC) chief executive Ian Macfarlane said he was thrilled the Palaszczuk Government issued a mining lease for the Ironbark No.1 project.

“Around 160 jobs will be needed for construction to build the greenfield mine, which will produce metallurgical coal for export in early 2020,” Mr Macfarlane said.

“It’s more good news for the coal industry and is another example of the Queensland Government’s commitment to responsibly develop the State’s rich mineral deposits to the benefit of all Queenslanders.

“Resources are a major contributor to Queensland’s economy creating a job every 40 minutes, investing \$1 million every hour and exporting \$1 billion each week.”

The project provided the opportunity for up to 6 million tonnes of coking coal production annually, and the possibility of 350 jobs on site from the first quarter of 2020.

“The economic benefits extend beyond the significant royalties to the State – this development will further strengthen our already strong presence in the local community and region more broadly,” Mr

Polwarth said.

“At Fitzroy, we pride ourselves on being a people business that mines coal, and the construction of Ironbark No.1 will see that vision continued.

Queensland Mines minister Dr Anthony Lynham was equally enthusiastic about the economic potential of the project.

“Ironbark No.1 comes on top of the 13 committed resources projects in Queensland with a combined capital value of more than \$9.4 billion across multiple commodities,” Dr Lynham said.

“Another 42 projects are at feasibility stage, with a combined capital value of more than \$65 billion, again, across multiple commodities.

“Queensland remains a global resources investment magnet, as our \$56 billion resources sector generates thousands of jobs and business opportunities and royalties to pay for our teachers, doctors and nurses.”

The Queensland resources sector now provides one in every six dollars in the Queensland economy, sustains one in eight Queensland jobs, and supports more than 16,400 businesses across the State all from 0.1 per cent of Queensland’s land mass – so the project will be a shot in the arm for the local economy.

“This is great news for Mackay and coalfields families, and businesses, especially those affected by the recent job losses at Hail Creek,” Member for Mackay and Assistant State Development minister Julieanne Gilbert said.

“It shows that the resources sector continues to offer bright prospects for our region well into the future.”

Skilled Workers

The Ironbark No.1 project will also focus on training and upskilling new workers for a long and rewarding career in coal.

“We are excited to be providing the opportunity to employ in excess of 50 per cent of the workforce as new industry entrants – training and engagement will be a primary focus as we bring the team together,” Mr Polwarth said.

“This will be a once in a career opportunity to be part of building a new mine, new team and the broader Fitzroy journey.”

(CONTINUED ON PAGE 28)



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(CONTINUED FROM PAGE 26)

“Ironbark No.1 will be a new, modern, underground longwall and bord and pillar operation”

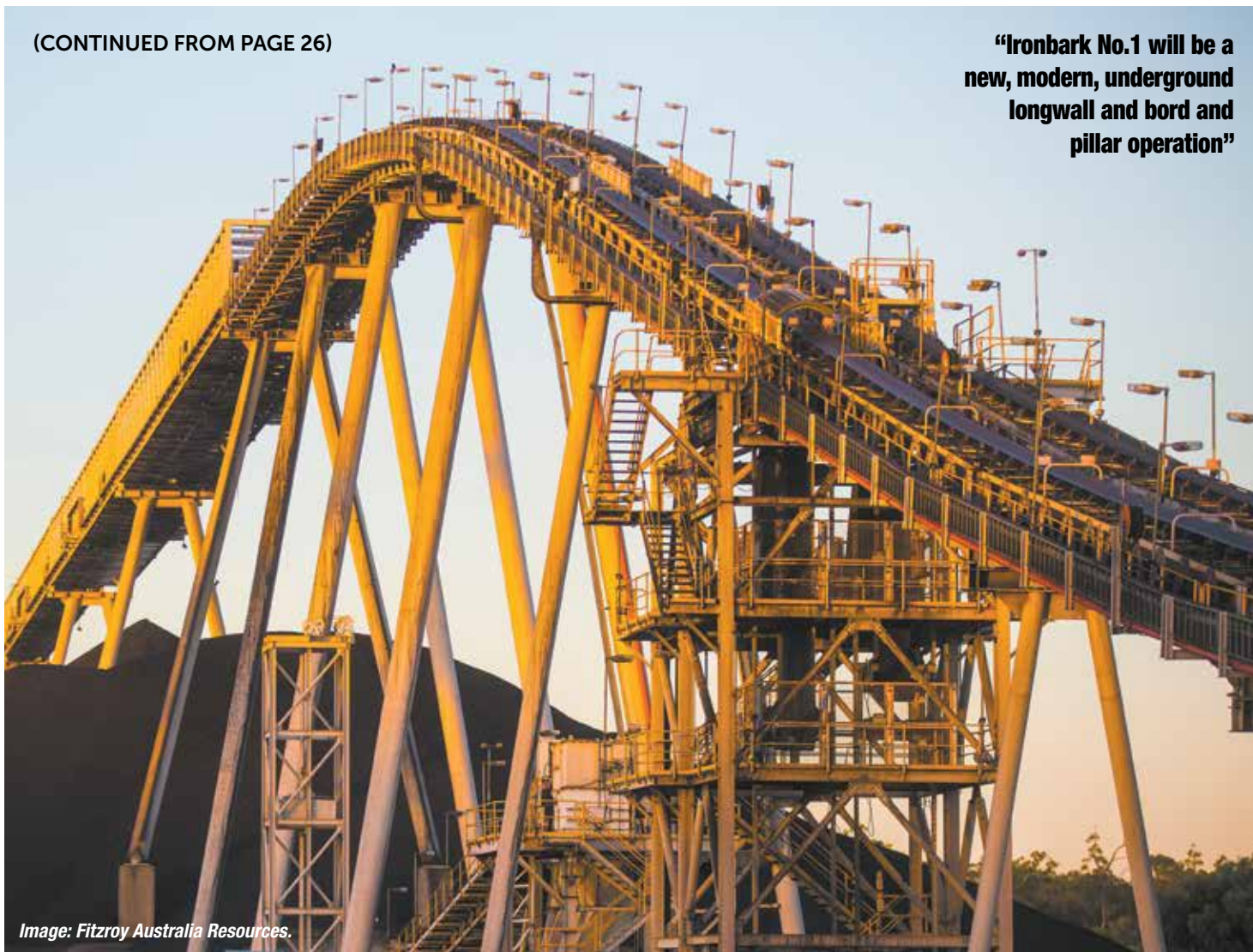


Image: Fitzroy Australia Resources.

Carborough Downs mine.

Digital skills will be vital to the future workforce and Fitzroy was committed to trialing new technologies and ensuring that digitizing operations will improve both safety and productivity of the new employees.

“We believe connectivity to the coal face will have immense benefits to safety and efficiency, and we’re working to try and deliver the coal mine of the future,” Mr Polwarth said.

“Our lives have been transformed by the

power of digital communications and technology – imagine being able to video-conference the longwall deputy on the face from thousands of kilometres away and see what they are seeing, as an example.”

“We trialled, and will be deploying this technology at Carborough Downs in early 2019 – the possibilities are endless.”

Global Outlook

In a recent report commissioned by the Minerals Council of Australia, *Market Demand Study: Australian Metallurgical Coal*, data showed rapid growth in Australian metallurgical coal exports from the Bowen Basin – generally considered to be the best metallurgical coal in the world.

“Metallurgical coal import demand is expected to grow more than 95mt over the period [2018-2030], from 275mt in 2017 to 372mt in 2030. This is equivalent to 2.3 per cent growth per annum, or around 7.5mt,” the report stated.

“The forecast growth in metallurgical coal import demand from 2018-30 is approximately 56 per cent of current Australian metallurgical coal exports, therefore representing a large potential growth opportunity for the sector.”

Mr Polwarth said the company was well on its way to becoming a key player in Australia’s coal industry.

“We aspire to build the next great Australian mining house,” he said.

“With over 98,000ha of tenement in the central Bowen Basin, the imminent Ironbark No.1 coal mine project and a centralised hub of world class infrastructure, we are well-placed to realise that vision.”

Construction was planned to commence at Ironbark No.1 in 2019, with first coal from the underground operation in Q1 2020 and first longwall coal in Q3/Q4 of 2021.

Key partnership at Ironbark No.1

NATIONAL

NEPEAN has announced its partnership with Fitzroy Australia Resources (Fitzroy) for the design and delivery of key equipment and infrastructure for the Ironbark No. 1 coal mine.

NEPEAN and Fitzroy will execute the project as an integrated project team in two phases; firstly, the accelerated design and development, and secondly, the acquisition, installation and commissioning.

The project will leverage NEPEAN’s leading stream specialist businesses; NEPEAN Conveyors, NEPEAN Power and NEPEAN Longwall.

The scope includes conveyors (surface and underground), electrical systems, electrical reticulation, the mine ventilation system and the longwall system.

“We are delighted to be forming a partnership with Fitzroy,” NEPEAN chief executive Miles Fuller said.

“This partnership will achieve a superior outcome for Fitzroy, by significantly reducing project cost, accelerating delivery time, and ensuring superior equipment lifecycle performance.

“This model will redefine how successful projects can and should be delivered.”

NEPEAN is renowned for its innovative solutions, inhouse design capabilities, world-class manufacturing operations, on time project delivery, specialist commissioning and optimisation services, and life cycle support capabilities.



Since founding in 1974, NEPEAN has grown to become a global organisation with 25 businesses across five continents.

Fitzroy Australia Resources chief executive Grant Polwarth highlighted the cultural alignment between Fitzroy and NEPEAN, and said the mutual focus on value-adding decision making and execution, were key factors in establishing

the partnership.

“We are excited about working with NEPEAN in a true partnership sense to deliver a result which has the potential to be company building for both groups as

well as change the industry landscape and expectations on major project delivery,” Mr Polwarth said.

More information can be found at: www.nepean.com.

All images: Aeris Resources.

PATH TO GROWTH

Copper miner Aeris Resources has shown no signs of slowing down as it sets its sights on continued growth at Tritton, exploration at its Torrens project, and opportunities presented by mergers and acquisitions.

AMY BLOM

AERIS Resources is in its best position in six years and looking to expand in 2019 following a strong year, according to its executive chairman André Labuschagne.

It was a far cry from when Mr Labuschagne took the helm at Aeris in 2013, at a time when the company had a \$US136 million debt and two operating mines, Mt Muro gold mine in Indonesia and Tritton copper mine in NSW, which were both making significant losses.

Mr Labuschagne said Aeris had focussed on restructuring the balance sheet over the last five years with great success.

It divested itself of Mt Muro, began paying down the debt and restructured the company, leading to increased production at the Tritton mine, which eventually became profitable again.

First discovered in the mid-1990s, the Tritton copper deposit is more than 20 million tonnes in size and now spans across multiple mines and an ore processing plant, which has a capacity of up to 1.8 million tonnes per annum depending on the hardness of the ore.

In November 2018, Aeris reported that its five year average annual copper production at Tritton had increased 19 per cent on the previous five years to 27,400 tonnes.

Total copper production in FY18 was 26,686 tonnes, up 14 per cent from 23,404 tonnes in FY17.

FY19 production guidance was 24,500 tonnes, with Q1 FY19 copper production of 6753 tonnes.

Mill throughput had also increased from 1.27 million tonnes per annum (mtpa) in FY13 to 1.6 mtpa in FY18.



Aeris Resources executive chairman André Labuschagne.

“We’ve moved the focus from survival into future growth, specifically around Tritton.”

Murrawombie underground mine was now in full production, the ventilation plant had been successfully commissioned, and a new crusher was installed in October.

A floatation circuit upgrade was also near completion.

In October 2018, Aeris completed a fully underwritten \$35.1 million equity raise, and reduced debt to \$US29 million from its original \$US136 million in 2013.

Exploration

Speaking with *The Australian Mining Review*, Mr Labuschagne said capital constraints had limited exploration over the last five years, but the recent debt reduction had allowed Aeris to refocus its attention to extending the Tritton copper mine beyond the current reserves.

Aeris had also been freed up to focus

on its strategic greenfields exploration program with the aim to find other Tritton-sized orebodies of more than 10mt.

The miner has a number of prospective exploration tenements in NSW surrounding the Tritton copper operations, collectively called the Tritton tenement package.

Six major geological complexes have already been identified within the package to date – Tritton, Girilambone, Budgery, Kurrajong, Miandetta and Exley.

An initial six drill hole campaign was completed at the Kurrajong prospect, 20km east of Tritton processing infrastructure, in 2018.

High-grade mineralisation has now been traced over 800m down-plunge and downhole EM surveys have inferred an extension of the strike.

A second phase drilling program of up to 12 holes had begun at Kurrajong, with drill results expected to be announced periodically.

“We have started to spend more money on exploration, we came up with new exploration strategies, and we started drilling at Kurrajong,” Mr Labuschagne said.

“We’ve moved the focus from survival into future growth, specifically around Tritton.

“We are very positive about the future; we’ve got a five year reserve life, which will produce an average of about 24,000 tonnes of copper.”

Mr Labuschagne said there was also significant potential for extensions to the current ore body.

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“There’s a great opportunity for a mid-tier copper player in the market and that’s what our focus will be.”



The AERIS team at Tritton.

“The Tritton mine does extend at depth, which we will draw out over the next six to 12 months, and those north and south wing deposits will each extend the mine life by about five years,” he said.

“Then you’ve got Budgerygar heading to the north of Tritton; there’s already 1.6mt at 1.5 per cent resource.

“Just through that one area you can see significant opportunities for extensions.”

Strong down-dip continuity was a feature common across all known deposits within the tenement package.

There was also a prospective corridor between the Tritton mine and Budgerygar, though little drilling had been conducted yet.

Mr Labuschagne said mineralisation at Murrawombie also extended at depth, though like Budgerygar, little drilling had previously been conducted.

“We’re very positive that once we’re at the right level, we’ll draw that out and we’ll continue,” Mr Labuschagne said.

“From that perspective, we see a significant upside on the reserve, with potential for the Tritton operations.”

However, Mr Labuschagne said exploration had largely been focussed on the southern package, where 750,000 tonnes of copper had been discovered to date along a geological trend of 50km of strike.

While the northern half has been historically underexplored, recent mapping extended the prospective geological corridor by 65km.

Mr Labuschagne said AERIS had therefore begun airborne EM surveys over the northern package in late November, as well as a new tenement the company had applied for further north.

“That will really be our focus for exploration to the northern part of that package, and at the same time we will continue exploring Kurrajong towards that southern area,” Mr Labuschagne said.

“I think Tritton is well set for where we want it to be; there’s a huge opportunity



Production increased by 14 per cent from FY17 to FY18.

and we are now focussed on creating that future mine.”

Breaking New Ground

Beyond the Tritton operations, AERIS was gearing up to begin a drilling program at its Torrens project after three native titles claims were quashed in the High Court on 19 October.

The Torrens anomaly is a coincident magnetic and gravity anomaly in the Eastern Gawler Craton Iron Oxide Copper Gold (IOCG) corridor in South Australia, which also hosts several large-scale deposits and world-class copper-gold operations such as Olympic Dam, Carrapateena, and Prominent Hill.

AERIS holds a 70 per cent interest and manages the project through a joint venture with Argonaut Resources, which holds a 30

per cent interest.

Mr Labuschagne believed Torrens had huge potential, with a footprint seven times bigger than Olympic Dam, however native title claims over Lake Torrens had previously held up the project.

The Federal Court dismissed the three claims in August 2016 and upheld the initial decision in March 2017.

On 19 October 2018, the High Court refused the three group’s application to appeal.

Mr Labuschagne welcomed the decision, and said it would have otherwise been a challenging way forward.

“Torrens has been a long drawn out court process and we’re very nearly out of that process,” he said.

“That was a key milestone for the company and the joint venture.”

Mr Labuschagne said with the legal

challenge resolved and approval to drill 74 holes, AERIS was looking to begin its drilling program in the first half of FY19, and was confident of positive results.

“To the north-west you’ve got Olympic Dam and towards the south you’ve got Carrapateena; those are two of the biggest copper names in Australia, so it’s in the right address; it’s in the IOCG district in that corridor,” Mr Labuschagne said.

“It’s a pure exploration play – you never know what you’re going to find, but if you look at what’s there, it seen as a tier 1 potential.”

Beyond Organic Growth

Mr Labuschagne said with the Tritton operations and Torrens project on track, AERIS was now looking to continue growing its business.

“The company is now set, the operation at the Tritton mine is doing really well, we’re focussing on the future there, and Torrens is getting a bit of extra leverage in terms of the opportunity for exploration,” Mr Labuschagne said.

“But really sitting back and saying ‘where do we see ourselves in the next 12 to 14 months,’ we’ve always said that we are focussed on growing this business beyond Tritton.

“We always said we want to be a multi-mine, mid-tier company, focussing on operational excellence, because that’s our strength, so we’re now more focussed on, mergers and acquisitions.”

Mr Labuschagne said AERIS was already in the process of pursuing ‘a few opportunities’ and would look both onshore and offshore.

“There’s a great opportunity for a mid-tier copper player in the market and that’s what our focus will be,” he said.

AERIS was currently Australia’s fifth largest, independent copper miner by volume produced.

Image: Talison Lithium.

GREEN SHOOTS

Talison Lithium’s mammoth Greenbushes mine in south-west WA is entering its next phase of growth with a \$320 million expansion to double production nearing completion, a \$516 million second expansion greenlit to begin in 2019, and a further \$1 billion commitment made towards downstream processing.

ELIZABETH FABRI

TALISON Lithium’s owners Tianqi Lithium and US group Albemarle are pouring some serious capital into their long-running Greenbushes mine in WA’s south-west as the State begins its transition into a global hub for battery metals and value-added processing.

In early 2018 the State Government established a Lithium and Energy Materials Taskforce aimed at understanding opportunities from the emerging industry and creating a strategy going forward.

The Greenbushes mine – 250km south of Perth and about 90km south east of the Port of Bunbury – was at the centre of the discussions as a supplier of a significant portion of the world’s lithium.

“The Greenbushes mine is the largest lithium mine in the world and is an important component for Western Australia to advance further into the lithium-ion battery value-chain,” WA Mines minister Bill Johnston told *The Australian Mining Review*.

Over the course of the year, the State Government engaged with key stakeholders from industry, research organisations and the community to ensure they were given the opportunity to play an active role.

In July it held an Industry Consortium for stakeholders from local and international companies to discuss ideas, with results due to be released early 2019.

Mr Johnston said it was “very important” that WA reaps the full potential of the battery minerals value chain from processing and manufacturing capacity, technical expertise and research capability.

He said the State currently had seven operating lithium mines in its ranks, and the Government had committed \$6 million to the establishment of a Future Battery



The Greenbushes mine was 250km south of Perth.

Industries Co-operative Research Centre bid, which would enhance Australia’s capabilities in the increasingly important battery and energy storage industry.

“By expanding further into the battery minerals value chain the State will further diversify the Western Australian economy and maximise benefits to the local community,” Mr Johnston said.

Expansions

The Greenbushes mine was already on a growth path of its own, with a \$320 million expansion to double production from 80,000tpa to more than 160,000tpa in its final stages, with commissioning expected to begin in the second quarter of 2019.

Another \$516 million second stage expansion was approved in July, and

earmarked to begin construction in the first quarter of 2019, which would increase the processing rate to between 2.3 and 2.7 million tonnes per annum of lithium bearing mineral concentrate from late 2020/early 2021.

The second expansion included the construction of a new 520,000tpa concentrator plant, a new crushing plant and associated infrastructure.

However, it hasn’t been smooth sailing for Talison, with expansion plans muddled by a legal dispute between Talison and Global Advanced Metals, which claimed the upgrade would waste the mine’s tantalum resource, over which it has rights.

Greenbushes Shire president Tony Pratico said the dispute between both parties had since been resolved.

“I’m not aware of any details,” Mr Pratico said.

“But I think the good part about that is they dealt with it around the table and it was good news when we heard it was resolved.

“I think moving forward for all those involved, they didn’t need something like this hanging over their head at a time when their resources and expertise were in high demand during these expansions.”

Mr Pratico said the whole community was getting behind the Greenbushes expansion projects and the investments made by the company were “enormous”.

“Talison’s Greenbushes mine has been the largest employer for many years here in Greenbushes and it’s been important to the Shire because the best thing is to have local employment for residents rather than fly-in, fly-out, which leaves not only families divided but also communities divided,” Mr Pratico said.

Downstream Processing

But it wasn’t just mining upgrades that had sparked national (and global) interest.

Investments in high-quality value-adding plants linked to the mine were also building momentum, and shaping WA’s profile as a hub for downstream processing.

Tianqi Lithium was one of the first to jump on the downstream processing wagon.

In 2016, the company announced it would invest \$400 million into a largescale Kwinana Lithium Plant that would become Australia’s first lithium hydroxide processing facility.

The Kwinana Lithium Plant’s first stage would produce lithium hydroxide from spodumene mined at the Greenbushes operation, with commissioning set for late 2018.

(CONTINUED ON PAGE 33)

Supporting the industrial metals sector

NATIONAL

WAVE International's beginnings in the lithium and industrial metals sector date back more than 15 years, starting with general engineering services to Talison Lithium's Greenbushes mine.

The early years at Greenbushes provided a solid operational grounding for Wave's core team and allowed the company to grow its capability to support the development of the lithium chemical supply chain from mine to chemical, both within Australia and internationally.

Wave International director Ryan Hanrahan said that the company has supported the sector both in upstream mining and beneficiation, to downstream processing.

"We have delivered upstream projects from resource definition through study, delivery and operations," Mr Hanrahan said.

"In the downstream sector we have delivered projects from study, design, and construction with a team of specialists who have experience in actual operating facilities.

"Wave is active in connecting investment, projects, and customers to enable effective new supply into the market."

The company's contribution to the expansion of the supply chain is unique and extends beyond just technical services to developing relationships with lenders, equity partners, contractors, technology



More information can be found at: www.waveinternational.com.

providers, trading houses and end users.

"It is this knowledge that allows Wave to provide a strategic view of the industry to its clients and tailor project solutions," Mr Hanrahan said.

Wave's expertise allowed the team to assess the best economic value from a spodumene project between DSO, low-grade and high-grade concentrate products, as well as a cost benefit trade-off

between processing technologies.

The company also assessed the best economic value from an integrated mine and chemical facility between lithium carbonate and lithium hydroxide, considering geographical, technical and demand trends.

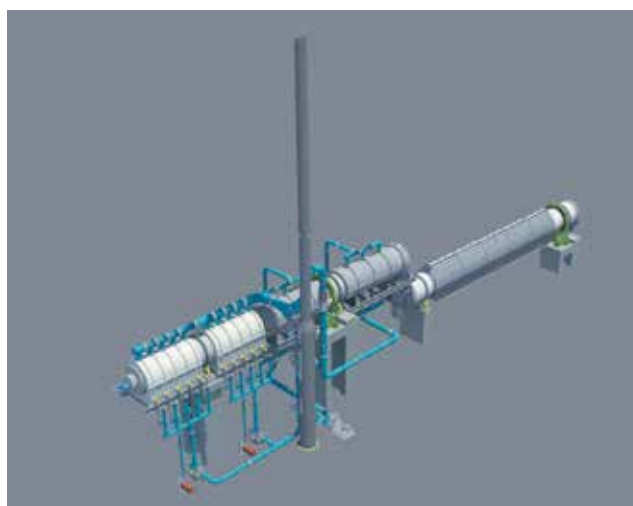
Mr Hanrahan said that in the present market one of Wave's most valuable assets was its downstream processing capability.

"With a global trend towards integrated refinery models, Wave's combined upstream and downstream capability provides clients a unique opportunity to access all required expertise to produce a value added chemical material under one roof," he said.

"This expertise is supporting the development of lithium chemical supply across the geographies of Australia, Canada, Korea and Europe."



PROUDLY SUPPORTING THE DEVELOPMENT OF AUSTRALIA'S LITHIUM SUPPLY CHAIN.



Wave is one of the few companies globally to have delivered upstream and downstream lithium projects from concept to reality.

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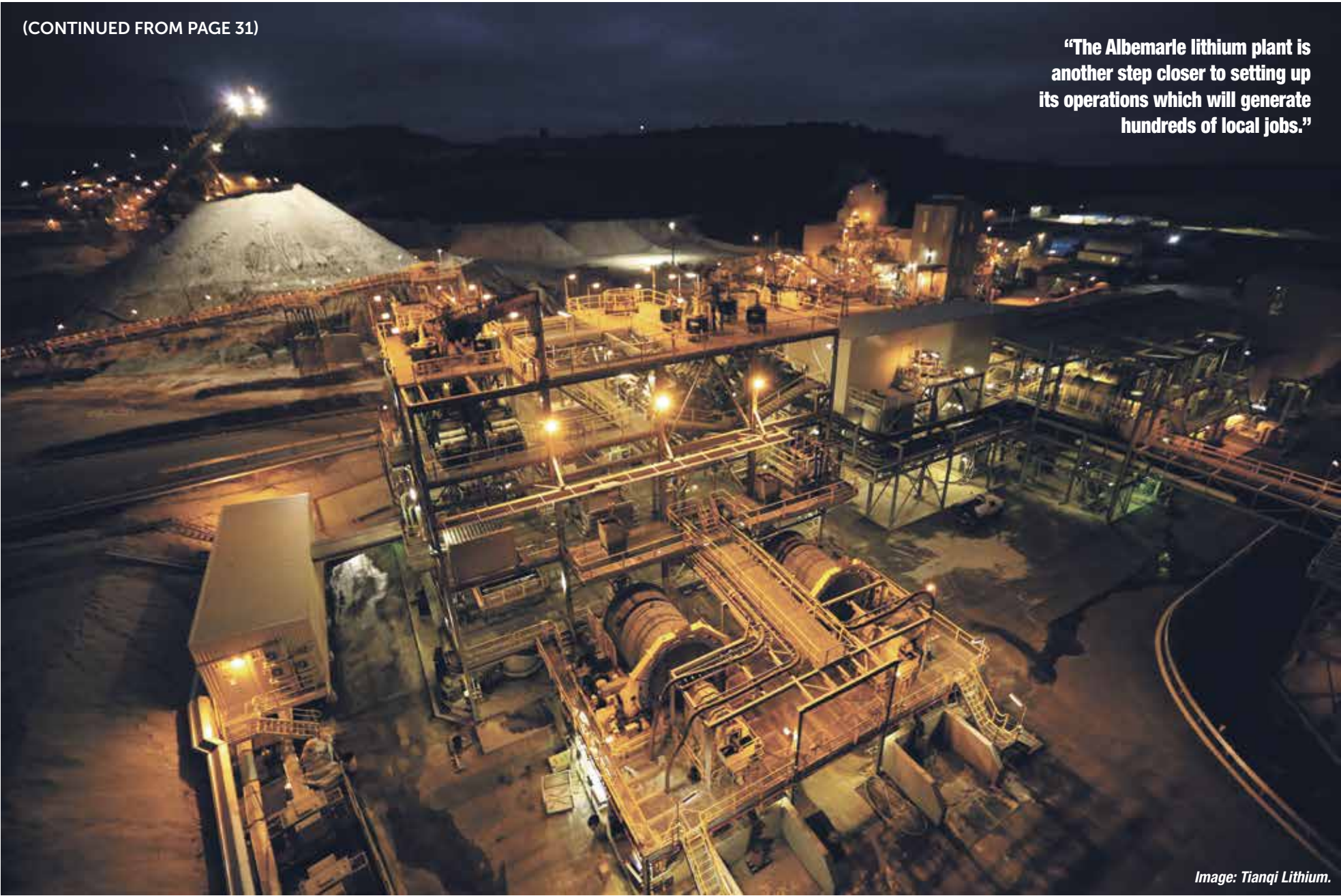


Image: Tianqi Lithium.

The Greenbushes mine plant at night.

In October 2017, a \$300 million second stage also received board approval and would double plant capacity to 48,000 tonnes of lithium hydroxide per annum.

Then, on 9 November 2018, Talison's other owner Albemarle obtained environmental approval from the WA Government to develop a \$1 billion lithium manufacturing plant in the Kemerton Strategic Industrial Area near Bunbury.

The plant itself would process spodumene ore concentrate from Greenbushes through five trains to produce 100,000 tonnes of lithium hydroxide, and up to 1.1 million tonnes of tailings.

The Albemarle news caused a wave of excitement in the region with the promise of more than 500 jobs during construction, and 500 operational positions.

WA Premier Mark McGowan said the State Government's number one priority was "diversifying the economy" and creating jobs.

"The Albemarle lithium plant is another step closer to setting up its operations which will generate hundreds of local jobs," Mr McGowan said.

"I'm pleased to see this project progressing, following my positive discussions with Albemarle's directors during my visit to Washington earlier this year."

Mr Pratico said some members of the community raised concerns why the plants were not built in and around the Greenbushes region, however this option would not have been as practical.

"Number one – there was not enough power, and number two- [there was not] a [large enough] workforce to draw from," Mr Pratico said.

"The buildings that are going to be in Kemerton and Kwinana will be where they have a bigger employment base to draw on.



Image: Talison Lithium.

The proposed route of the new Greenbushes mine access road.

"At Greenbushes we also don't have gas, which is another handicap, so I think that was the reason Kwinana and Kemerton were selected for those value-adding plants to be able to draw on the infrastructure that is already there on those industrial sites."

"The Greenbushes mine is the largest lithium mine in the world and is an important component for Western Australia to advance further into the lithium-ion battery value-chain."

Talison Lithium also recently began construction on a new bulk storage facility at the Port of Bunbury to store lithium

concentrate prior to export by October 2019.

Community Engagement

Mr Pratico said the Shire was fortunate to have regular briefings from the mine at council, and Talison regularly held public meetings in the surrounding towns to inform residents of project timelines and community issues.

One of the issues up for public discussion currently was the establishment of a mine access road to "define the best option to deal with increased truck movements" resulting from the expansion.

On 29 November, Talison announced the Shire of Bridgetown-Greenbushes was

seeking public comment on Talison's Mine Access Road proposal.

"Talison Lithium takes very seriously its role as a responsible and responsive member of the communities in which we operate, which is why we are being fully transparent with our Mine Access Road proposal and welcome public comments," Talison general manager operations Craig Dawson said at the time.

"We are committed to delivering a win-win for all by removing traffic from residential areas and roads frequented by the public, at the same time as upgrading an existing gravel road with minimum impact on the environment.

"From the outset we have acknowledged that the mine's expansion, while delivering hundreds of new jobs into the local area and injecting millions of dollars into local businesses, will involve an increase in mining activity and truck movements."

The miner was also assessing the feasibility of reopening the Greenbushes railway line, which was awaiting approval by the State Government.

Mr Pratico said Talison had been consistent "all the way through" with its cooperation with the community.

He said the company, together with the Shire, were currently assessing options on how they can open up more undeveloped crown land for residential properties so that it's available when the need arises.

Mr Pratico said the miner also enriched events within the local community.

"Only recently they sponsored Under 12 year old kids to our local show for them to attend for free, and in Greenbushes we have a pink fun run in May of every year and the company is a major sponsor and it's appreciated by everybody," he said.

Trusted engineering and construction partners

NATIONAL

DWYER Engineering and Construction is proud to be part of the Talison Lithium chemical grade plant 2 project at the Greenbushes mine in WA.

Through MSP Resource Development Consultants, Dwyer Engineering and Construction was awarded more than 1500 tonnes of off-site fabricated items including a supply of 28 rubber lined tanks; structural steel package; chute package; conveyors; and miscellaneous mechanical items.

Since 1999, Dwyer Engineering and Construction has successfully assisted its clients in the mining, power, oil and gas, water, and infrastructure industries.

The company is a proudly 100 per cent WA-owned and operated multi-discipline engineering company based in Harvey.

It is certified to AS/NZS ISO9001:2015 and is pre-qualified to many of the larger resource company's quality systems.

Its in-house services consist of shop detailing; fabrication; surface treatment; pre-assembly and modularisation; transport; site installation; and site maintenance, including shut down and labour hire.

Dwyer Engineering and Construction managing director Joe Dwyer said the company is committed to providing total satisfaction to its clients, delivering projects safely, on time, and within budget, while respecting the environment in which it works.



Dwyer Engineering and Construction was awarded multiple contracts at Greenbushes Lithium chemical grade plant 2 project through MSP Engineering, resource development consultants.

"Our strength is our people and our people are our ambassadors," Mr Dwyer said.

"We aim to lead, guide and direct

our team by developing project implementation and monitoring policies, processes and systems for the high company standards of quality and safety

in delivering a product in a timely and environmentally sound manner."

More information can be found at www.dwyereng.com.au.

MORE THAN JUST FABRICATION



Dwyer Engineering and Construction is a 100% WA owned multidiscipline engineering company, specialising in providing "turnkey" packages and ongoing maintenance support in the civil, structural, mechanical and piping disciplines across the mining, oil and gas sectors.



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All images: Newmont Mining.

Newmont's Tanami gold mine in the Northern Territory has commenced a second phase expansion, is constructing two power stations on site and is on track to reach tier 1 status in the not too distant future.

EMMA DAVIES

NEWMONT Mining is focussed on long-term growth with Australian production remaining between 1.4 and 1.6 million ounces in 2018.

Newmont Mining regional project director Francois Hardy told *The Australian Mining Review* that Tanami's second phase expansion will leverage the mine for future growth and will maximise value from the deeper orebody, from between 1200m and 2600m below surface.

"Tanami Expansion 2 secures the future of Tanami as a long-life, low-cost producer, adding approximately 100,000oz per year (2023 – 2027) and reducing operating costs," Mr Hardy said.

"The expansion will provide a platform for future growth, with the potential to extend the mine life to 2040."

Increasing profitable production and extending Tanami's mine life will have a positive impact on Newmont's other operations; the improved grade and productivity at Tanami has already helped to offset geotechnical challenges at the Kalgoorlie Consolidated Gold Mine (KCGM) Joint Venture.

Pre-feasibility studies were underway to improve orebody knowledge and optimise the approach to material handling, ventilation, and refrigeration.

Stage 2 will include the construction of a vertical shaft and associated ventilation to optimise processing plant capacity and was expected to take about three years to complete.

Currently costs are estimated between \$650 million and \$750 million but Mr Hardy said funding decisions have yet to be

finalised.

"We will be reaching a full funding decision in 2H of 2019 with the construction phase still being finalised as we progress through definitive feasibility," he said.

"We will be able to update more detail once we have reached a full funding decision."

Fuel Shift

The Tanami site is due to transition from diesel fuel to natural gas, with two power stations and a 450km natural gas pipeline currently under construction connecting the Tanami site to the Amadeus Gas Pipeline.

Following issues with power generation after severe weather in early 2017, the power stations will mitigate fuel supply risks as well as lowering CO2 emissions and reducing power costs.

"The unit cost of power will reduce over a five-year period as site power requirements increase," Mr Hardy said.

"Carbon emissions will be significantly reduced with an estimated average reduction of 55,000 tonnes of carbon reduced per year over the first five years.

"It's also expected to reduce power costs by approximately 20 per cent, equating to cash cost savings of approximately \$34/oz."

Capital costs are estimated at between \$225 million and \$275 million, with annual cash lease payments over a 10-year term beginning in 2019 with approximately \$10 million of owner's costs paid in 2018.

The project Internal Return Rate is expected to be greater than 50 percent at \$0.75 AUD.

"Once the new power stations are

commissioned, the old power stations will be decommissioned," Mr Hardy said.

"The new power stations have hybrid generators, that can run on either gas or diesel if required and the risk of site shutdown due to road closures from rain is all but eliminated with a secure all weather gas supply to the site power stations."

The Tanami Gas Pipeline will be built, owned and operated by Australian Gas Infrastructure Group (AGIG) and has created about 400 jobs during construction.

Mr Hardy said that there was sufficient capacity in the pipeline to provide local communities along the pipeline corridor with the option to connect to natural gas for future power generation or domestic use.

AGIG commercial general manager Jon Cleary said the development of the Tanami Gas Pipeline could also lead to other infrastructure projects in the region.

"This investment in infrastructure in a remote part of the Territory could be the catalyst for further investment which will lead to better opportunities and living standards for the local communities that are nearby," Mr Cleary said.

Mr Hardy also flagged the potential for solar power at the mine in future.

As the cost for solar generation continues to decrease, solar power may present a competitive and viable alternative compared to remote diesel generation.

"The site is looking at a number of options to expand the life and capacity of the mine into the future," he said.

"Solar and other renewable options are being considered to provide some of the energy required to power these expansions.

"Newmont has commenced working with all parties to develop the right mix of

gas, power and renewables to provide the optimum solution for the site and wider environment."

Tier 1

Tier 1 status could also be on the horizon.

The Dow Jones Sustainability World Index (DJSWI) recently named Newmont the 'Metals and Mining' sector leader for the fourth consecutive year.

Newmont president and chief executive Gary Goldberg said the recognition was an important reflection of how well the company is doing to create value and improve lives for all of their stakeholders.

"Employees at our sites around the globe know that leading in profitability and responsibility go hand-in-hand, and that their day-to-day work can have positive and lasting impacts on local communities," Mr Goldberg said.

"Our focus is on the long-term success of our company and doing that requires integrating sustainability into all aspects of our business."

Mr Hardy said that the focus of the Tanami operation is to grow margins and reserves which translates into a low cost, long-life operation.

"Tanami continues to focus on growing margins and reserves; Tanami Expansion 1 (delivered in Q3 2017) was a big first step in the transformation and has provided a strong foundation for the next phase of growth," Mr Hardy said.

"Tanami Expansion 2 (TE2) has the potential to extend life to 2040 and reduce operating costs by up to 10 per cent which would help secure Tanami's position as a tier 1 asset."



GVR is a logistical specialist for heavy haulage and oversized loads to the mining industry.

Remote transportation specialists

NATIONAL

FAMILY-owned WA business GVR Transport has provided logistics and transport services to the mining industry for more than 22 years.

GVR is a remote freight specialist for general transport, heavy haulage, sensitive cargo, project construction

support and plant relocations.

It carries more than 50 years' combined experience working with road trains, single trailers and oversized loads, both locally and interstate.

It has proudly carried freight between WA and the Northern Territory for mining operations such as Newmont's Tanami gold project.

"At GVR we are committed to providing

innovative and creative solutions to the transport and logistics services for industry and mining," GVR manager John Pearsall said.

"Being a smaller business you can be assured of individual attention and the ability to meet your needs on a load by load basis.

"No job is too big, and we have experienced drivers and pilots who are

able to safely transport oversized loads."

GVR is proud of its community footprint across the Northern Territory and Western Australia, with support to a variety of organisations such as the Royal Flying Doctor Service, Fitzroy Crossing Rodeo Club and Heartkids WA.

More information on GVR's transportation services can be found at: www.gvrtransport.com.au.

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PILOTING FOR SUCCESS

Arafura Resources is going above and beyond many juniors on the path to production, with a seven phase pilot project for its Nolans rare earths mine nearing completion, downstream processing plans confirmed for the Northern Territory, and a DFS and Final Investment Decision imminent.

All images: Arafura Resources.

ELIZABETH FABRI

ARAFURA Resources has made some innovative decisions on its \$US680 million Nolans neodymium-praseodymium (NdPr) project over the last few years.

Instead of taking what would be considered a faster route straight to production, the explorer has had a dedicated team focussed on a detailed pilot program addressing key engineering and operational considerations prior to commissioning.

Arafura's Nolans project is one of the world's largest undeveloped deposits, with a JORC compliant resource of 56 million tonnes at 2.6 per cent total rare earth oxide (TREO) with 26.4 per cent NdPr enrichment that could provide 5-10 per cent of global demand of NdPr oxide (about 3600 tonnes of NdPr oxide production per annum) for use in permanent magnets.

Nolans was positioned in a tier 1 jurisdiction, 10km from Stuart Highway, and adjacent to the Amadeus natural gas pipeline.

And unlike many of its rare earth peers, which were in earlier stages of development, Arafura's Nolans project was fast advancing with major project status granted, environment and Federal approvals locked in, and results from a Definitive Feasibility Study (DFS) expected before the end of the 2018 calendar year.

Arafura Resources Nolans project manager Stewart Watkins said the completion of the DFS will be a major milestone that will set the team up for project financing.

"It isn't, however, the only work we have on-going in the company at the moment in relation to the project," Mr Watkins told *The Australian Mining Review*.

"Currently we are working with the NT EPA to assess the impacts of the various changes to the project to that contemplated in the EIS."



The acid bake (Phase 4) pilot plant.

The main change Mr Watkins was referring to was the company's recent decision to build the rare earth separation plant on site in the Northern Territory as opposed to an overseas option in South Korea, originally floated by the board.

The separation plant, which hosts the final stages of rare earth processing, takes a mixed rare earth intermediate (chloride) product and refines it into high-value NdPr oxide and other rare earth products.

The decision to build locally would mean more jobs for the Northern Territory, as well as assurance for the management team with all operations undertaken on home soil.

Arafura was also significantly advanced in preparing the Mining Management Plan (MMP), which draws together the environmental approval conditions,

commitments made in the EIS as well as the designs developed in the DFS.

"This MMP will then be assessed by the Department of Primary Industry and Resources in the NT and once approved will provide Arafura with our approval to mine (obviously once we have a granted mining lease) which is a pre-requisite to commencing any site works," Mr Watkins said.

"Finally, in order to be granted a mining lease, we need to reach an agreement with the traditional owners recognising the impact of our operation on their Native Title rights."

Mr Watkins said the company hoped to reach an agreement in the first half of 2019, and have the mining leases granted soon after.

"Once all these things are completed,

and we have the financing advanced sufficiently, then we will be in position for the board to make a final investment decision and the project team can then commence Front End Engineering and Design (FEED) with our selected execution partners," he said.

Piloting Program

In parallel to final approvals, the pilot plant program, undertaken at ALS Metallurgical Services (ALS) facilities in Perth, was also in its final stages.

In Arafura's Annual Report the company's chairman Ian Kowalick said the program – designed to reduce execution risk – went "above and beyond the work typically undertaken by a junior resource company developing a mining project".

Mr Watkins agreed.

"Many typical mining projects executed by junior companies actually include no piloting at all, or simple bench scale piloting such as locked cycle testing or the like," Mr Watkins said.

"In the case of a complex rare earths project such as Nolans we have definitely had to go above and beyond the normal level of metallurgical testing carried out by juniors."

Mr Watkins said the piloting program – which comprised seven phases covering beneficiation, phosphate extraction, bulk pre-leach, acid bake, rare earth processing, and the soon to be completed rare earth separation phase – had been important in a couple of key ways.

"Firstly it provides confidence that process is not just viable but suitably robust to be workable in the real world," he said.

"Many things that work in a batch on a bench scale with continuous operator attention become unworkable when running continuously at a larger scale.

(CONTINUED OVER)

(CONTINUED FROM PAGE 37)



Nolans project manager Stewart Watkins.

“Secondly there are aspects, such as materials handling or materials of construction that just can’t be tested in a batch setting.

“And finally, in order to test some aspects, such as solid/liquid separation, a reasonable quantity of material is needed and that just isn’t possible unless the processing is done at a reasonable scale.”

Mr Watkins said the most important aspect of the piloting process by far was the acid bake pilot phase completed in early August, following a thorough period of commissioning of all unit operations.

“Because of the characteristics of the



Bulk sampling of Nolans ore.

“In the case of a complex rare earths project such as Nolans we have definitely had to go above and beyond the normal level of metallurgical testing carried out by juniors.”

Nolans ore, Arafura is able to carry this out at a much lower temperature than traditional processing,” Mr Watkins said.

“Additionally we are carrying it out using paddle dyer technology as opposed to large rotary kilns.

“On that basis it was extremely valuable to carry this out continuously at scale and to allow us to prove up the equipment and also provide detailed scale up information for the vendors.

“We now have a lot of confidence in this aspect of the process which is really at the heart of the whole plant.”

On 28 November, Arafura announced the fifth phase of the piloting – the rare earth purification and precipitation – was completed successfully.

This phase, took the NdPr sulphate materials from Arafura’s acid bake pilot plant through purification and precipitation processes to produce rare earth hydroxide.

Arafura’s process engineers closely monitored several important operational performance parameters over the duration of the five-day pilot, including solid-liquid separation, reagent dosing, temperature profiles and residence time across each unit

operation of the process.

The rare earth hydroxide produced would feed into phase six – rare earth dissolution and evaporation – with phase seven expected to be completed in early 2019.

Overcoming Challenges

Like all of its rare earth peers, Arafura also faced the challenge of bringing costs down.

Mr Watkins said the rare earth elements (REE) industry was “very different to traditional mining projects in Australia”.



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“The execution of the project is anticipated at this stage to consist of a six month FEED process followed by a roughly two year construction.”

Drill sample splitting.

“You are dealing with a project that is not so much a mining project but a small mine with a large chemical processing plant attached,” he said.

“As such the capital costs are very much higher than a traditional project, however, on the flip side the operating margins are also much higher.”

Mr Watkins – who has a chemical engineering background spanning 25 plus years – said he had worked on a lot of different projects throughout his career, and Nolans was “by far the most complex and challenging” and the processing was “some of the most technical going around”.

“However, it has been very rewarding to come into the team and try and instil some of the pragmatic design guidelines that work on every project – knowing what needs to be gold plated and done just right and what can be done more cost effectively,” he said.

“This type of project, especially with our very long mine life (which is typical of the quality REE projects around), means that the investment decision is more about developing something that is more akin to a financial annuity, which will deliver shareholder returns year after year for 20 to 40 years.”

In studies to date, Nolans will have operating costs of about \$US6.23/kg TREO or \$US24.38/kg NdPr oxide, which will be the lowest amongst peers.

Mr Watkins said the costs were influenced by the ore being mined.

“The development in house of the phosphoric acid pre-leach (PAPL) process means that our processing really works with the ore.

“The added benefit of that is that we produce a merchant grade phosphoric acid by product, which offsets a significant part of our operating costs (the by-product credit essentially pays for the incoming and outgoing transport and logistics effectively relocating the mine to Darwin).

“There are also some other aspects of the



Nolan’s drill core.

flowsheet that also act to keep the costs lower where we utilise alternate chemistry rather than further consumption of reagents.”

Mr Watkins said the biggest part of the operating cost picture was the cost of reagents, and as Arafura finalised the costs for the DFS, any movement in projected reagent pricing would impact on these costs.

However, he said the team remained “pretty confident of having comparable or lower costs” to its peers.

The decision to build the rare earth separation plant locally would also be more expensive in areas.

“While there were some negatives on the cost side (higher reagent costs on site) the benefits of less overall labour and consolidation of expertise largely outweighed these factors,” he said.

“The key driver for considering Nolans for the separation plant was really the ability to take full control of our environmental impact.

“Provenance of raw materials is becoming a larger and larger factor in the REE industry (and other industrial supply chains) and as such by locating everything at Nolans it

means we have 100 per cent control over all the wastes from the project and can assure that they are managed in an appropriate manner.”

Rising Demand

Once Nolans enters production, Arafura will be well positioned to tap into growing demand for NdPr out of China.

“The NdPr market is a matter of when, not if,” Mr Watkins said.

“There is massive demand side pressure with the electrification of transport, which is also the current drive that is fuelling the lithium market.

“At the same time, China’s environmental commitment to cleaning up ‘black market’ and polluting producers also adds a degree of supply side pressure.”

Analysts have forecast that China will move from being a net exporter of NdPr to being a net importer by 2021/22 to meet its own domestic demand.

“On that basis, the prospects for a company with a non-China linked NdPr project capable

of producing roughly 5-10 per cent of current global production, ready to develop and come on-line in 2021/22 look pretty good,” he said.

In October, Arafura locked in its first offtake agreement with JingCi Material Science Co for the supply of NdPr oxide.

JingCi is a tier 1 Chinese manufacturer of neodymium iron boron (NdFeB) permanent magnets and produces about 6500 tonnes per annum.

The agreement entered would see Arafura supply up to 900 tonnes of NdPr per annum to JingCi – a quarter of Nolans forecasted annual output.

Mr Watkins said the company was “relatively happy with the way things are going in the offtake space”.

“I think completion of the DFS may be a catalyst for potential offtake partners to get a better feel for the project and that will certainly help with the discussion,” he said.

Outlook

Post ramp up, Mr Watkins said Nolans had the life of mine (the EIS contemplated 55 years) to support an expansion in production.

“It certainly could become a much larger project in the REE space, but let’s get the first phase up and running before we get ahead of ourselves,” he said.

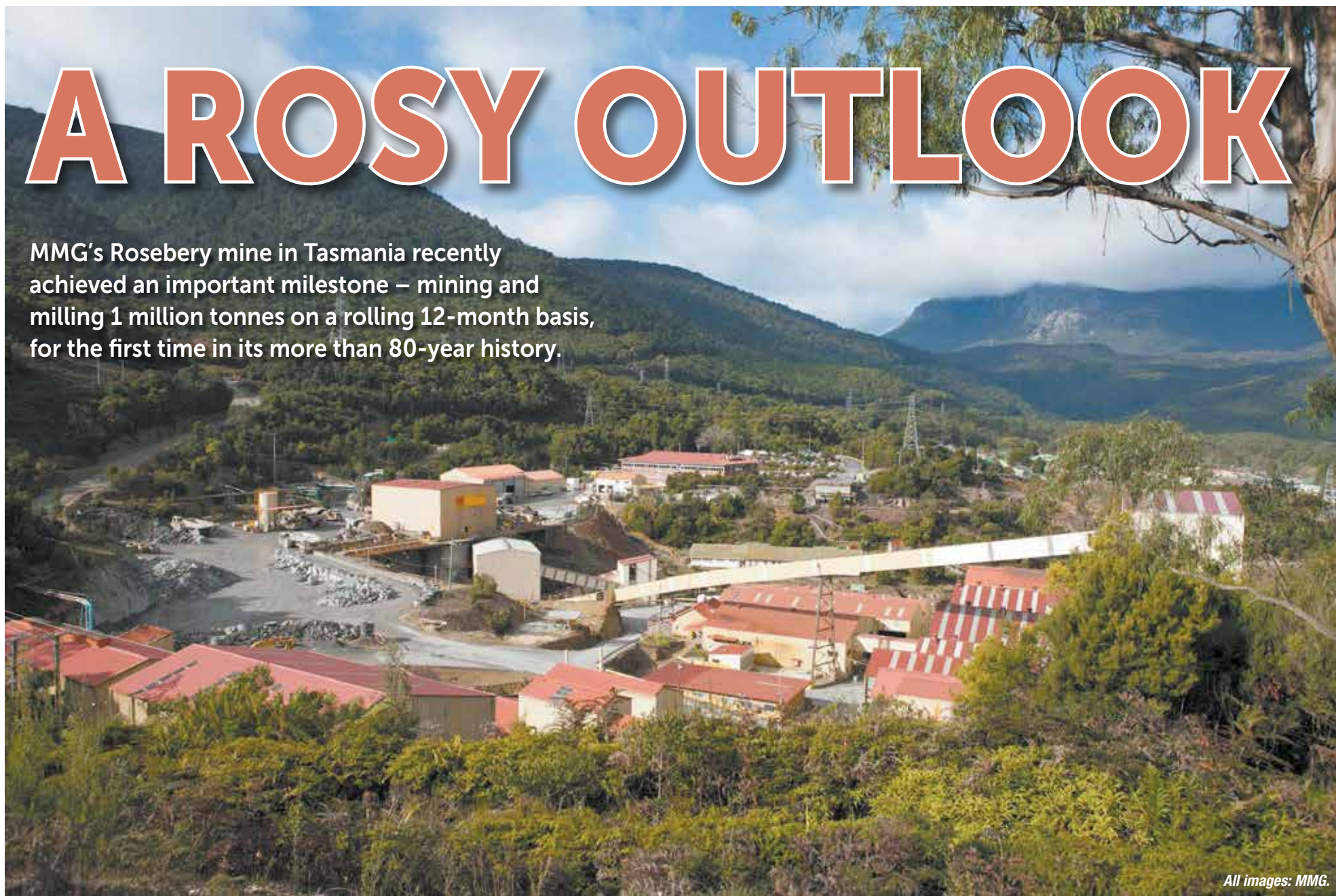
“The execution of the project is anticipated at this stage to consist of a six month FEED process followed by a roughly two year construction (just reviewing project implementation schedules at the moment).”

At peak Arafura anticipated about 500 people on site at one time.

“Commencement of construction obviously depends on financing but I would be hopeful that we would be getting into things before the end of 2019,” Mr Watkins said.

A ROSY OUTLOOK

MMG's Rosebery mine in Tasmania recently achieved an important milestone – mining and milling 1 million tonnes on a rolling 12-month basis, for the first time in its more than 80-year history.



All images: MMG.

EMMA DAVIES

ROSEBERY'S record result was achieved following improvements to the mine's tailings dam, insourcing of the mine development work, and an upgraded fleet.

MMG Rosebery general manager Jenkins Kroon said he was pleased with the site's production rates.

"In the third quarter of 2018 Rosebery produced 19,218 tonnes of zinc in zinc concentrate, broadly flat when compared to the second quarter of 2018 and up 12 per cent on the prior corresponding period," Mr Kroon said.

"The strong production was driven largely by another record quarter for both mining and milling rates, which continues to offset the trend of lower grades."

"We are currently doing exploration drilling from surface and from underground to find more ore and we are confident that we will be able to extend to current mine life."

Mr Kroon said it was a considerable achievement considering that in the past five years mining at the Rosebery site had become more difficult.

"Fortunately for Rosebery, our team was ready for this and able to pivot, with improvements happening because we have great people, working together, doing great work in many different areas of the business," he said.

"The team focussed on key constraints (bottlenecks) throughout the business and applied their skills to resolve them.

"We're now enjoying the fruits of that labour."

Since taking over mine development from Barmenco, Rosebery had not only increased



Implementing technological improvements are set to improve safety and productivity on site.

savings but increased ore mined, achieved record mill throughput, and completed a \$52 million tailings dam.

Mr Kroon said bringing the development team into the MMG team had also benefitted existing employees.

"Bringing the Barmenco development team in house has strengthened the Rosebery team," Mr Kroon said.

"It allows us to operate as one united mining team with an aligned goal, to safely produce as much metal as possible."

Operational Improvements

The current focus was to drive operational improvements on site, with MICROMINE's Pitram team recently visiting to train Rosebery employees in the fleet management

and mine control software.

Training was provided for Rosebery's Pitram operators, production engineers, drill and blast engineers and geologists, and covered technical issues, faults and problems, workflows, best practice procedures, and how to use the data and reporting more effectively.

Mr Kroon said the company would continue to manage its constraints as



MMG Rosebery mine production engineer Caroline Dunning (second from left) recently won the 2018 Exceptional Young Woman in Tasmanian Resources Award.



The processing plant has been operating continuously for 83 years.

smartly as possible.

“At the moment our focus is on setting ourselves up with an underground network that will allow us to use a number of technological solutions to improve safety and productivity,” he said.

“This follows the recent investment in new mobile fleet, the successful completion of the insourcing of mine development work and the completion of the new 2/5 tailings

dam this year.

“Combined these actions are setting us up for a bright future.

“Watch this space.”

Looking Ahead

Over the next 12 to 18 months, MMG will invest significantly in resource extension

drilling at Rosebery with the aim of extending the current five years of remaining life.

“Our mine is an integral part of the local community and most of our employees and suppliers at Rosebery are local to the area,” he said.

“Our contributions – beyond local employment and economic opportunities – include running stand-alone programs, infrastructure development, and

sponsorships.

“Rosebery also runs a fruit program with the local schools and is in the process of commissioning a walking trail so that the local community and tourists can more easily enjoy the amazing flora and fauna in the local area.”

The company regularly hosts public groups like universities, families of employees, community members and other interested people, able to tour the concentrator, various environmental areas and surface operations.

“This hopefully lets everyone learn and understand the way we work in Rosebery and will hopefully inspire the next generation of mining professionals,” Mr Kroon said.

Rosebery also recently celebrated another milestone of long service awards for six staff members who had worked on site for between 30 and 45 years — a big feat considering the average life of the Rosebery mine had always been about five years.

“It is amazing to see the commitment and care that our people have for the Rosebery business,” Mr Kroon said.

“While the mine has been around for more than 100 years, and the processing plant has been operating continuously for 83 years, Rosebery has always had an average mine life of approximately five years.”

Mr Kroon said that while extending the mine life was an ongoing challenge, it was one that had been overcome many times before.

“We are currently doing exploration drilling from surface and from underground to find more ore, and we are confident that we will be able to extend the current mine life,” he said.

“Together we will continue to make progress for our people, host community and shareholders for many more years.”



RECORD AFTER RECORD

The world's largest and lowest-cost manganese ore producer, South32, is set to produce even more, as it launches a three-year drilling program at GEMCO.

All images: South32.

AMY BLOM

SOUTH32 has continued to surge on the back of its Groote Eylandt Mining Company operation (GEMCO), with exploration plans underway designed to leverage even more value from the manganese mine.

GEMCO is an open-cut mining operation in the Gulf of Carpentaria, 50km from the Northern Territory mainland, producing high-grade manganese ore that is then shipped to South32's Tasmanian manganese alloy plant (TEMCO) and around the world.

According to South32, GEMCO is one of the largest and lowest-cost manganese ore producers in the world.

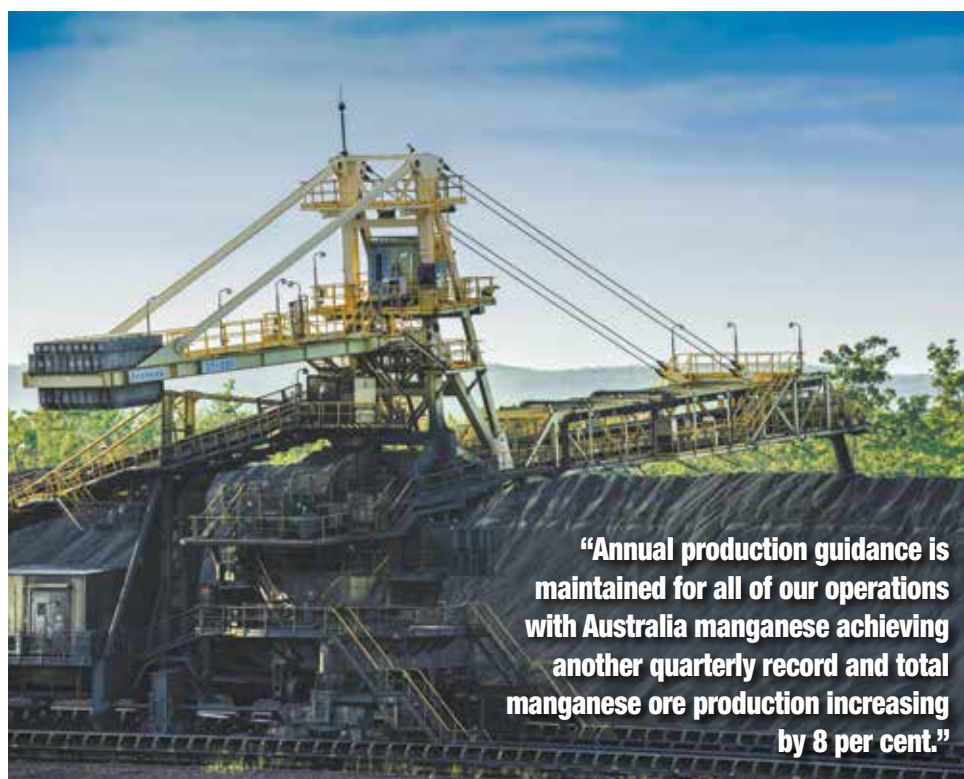
Together, GEMCO and TEMCO form South32's Australian manganese operations.

South32 holds a 60 per cent share in the operation, with Anglo American holding the remaining 40 per cent.

At its annual general meeting on 25 October, South32 chief executive Graham Kerr said the mining giant had delivered record production at its Australia manganese operations for FY18 and a 10 per cent increase in total manganese ore production, as the company responded to favourable market conditions.

South32 followed it up in Q1 FY19 with yet another quarterly record at GEMCO, producing 932,000 wet metric tonnes (wmt) of manganese ore – a 15 per cent increase year-on-year.

"Annual production guidance is maintained for all of our operations with



GEMCO has continued to increase production, and has further expansion plans.

Australia manganese achieving another quarterly record and total manganese ore production increasing by 8 per cent," Mr Kerr said.

"We finished the period with a net cash balance of \$US679 million and additional funds in our manganese joint venture as our key commodity markets benefitted from robust demand and pricing."

During Q1 FY19, South32 reported it received net distributions of \$US24 million from its manganese equity accounted

investments.

The combination of strong operating performance and pricing saw additional cash build in its manganese joint venture, despite Australian manganese paying \$US13 million in royalties in respect of the prior six month period.

According to South32, the primary circuit continued to achieve high utilisation rates while the Premium Concentrate Ore (PCO2) circuit operated at about 120 per cent of its design capacity,

contributing 9 per cent of total production for the quarter.

The \$US139 million PCO2 was completed at the end of FY16 and ramp up to full production of 0.5 million tonnes per annum (mtpa) was achieved in FY17, thereby increasing GEMCO's capacity from 4.8mtpa to 5.3mtpa.

Manganese alloy saleable production decreased by 2 per cent or 1000 tonnes, to 42,000 tonnes in the September quarter.

FY19 production guidance remained unchanged at 3.35 million wet metric tonnes.

Exploration

Despite record production already being achieved, South32 had even higher hopes for GEMCO, with aims to continue developing the mine further.

The miner has plans to drill 4800 holes over about 115,200 metres over the next three years, targeting an increase in reserves, as well as looking to reduce costs through improvements to the mine supply chain.

South32 awarded the three-year drilling contract to Utah-based company in October, which would provide 16 employees, including fitters and full-time drilling supervisors to operate two reverse circulation rigs.

Further mining was planned to begin within the eastern leases of GEMCO in about 2022 to 2023.

The lease areas are 2km east of the existing mine at their closest point.

Although drilling has previously been conducted at the eastern leases, according to South32, additional drilling was required before mining began to improve GEMCO's understanding of the mineralisation on the leases, including ore quality and geological conditions.

The drilling would also support the further definition of the geological block model and the development of the mine plan.

The Bigger Picture

Plans to develop the mine came amid increased market volatility, however Mr Kerr remained confident that South32's operations, including GEMCO, would continue producing strong results.

"Looking ahead, we are well-positioned for the future," Mr Kerr said.

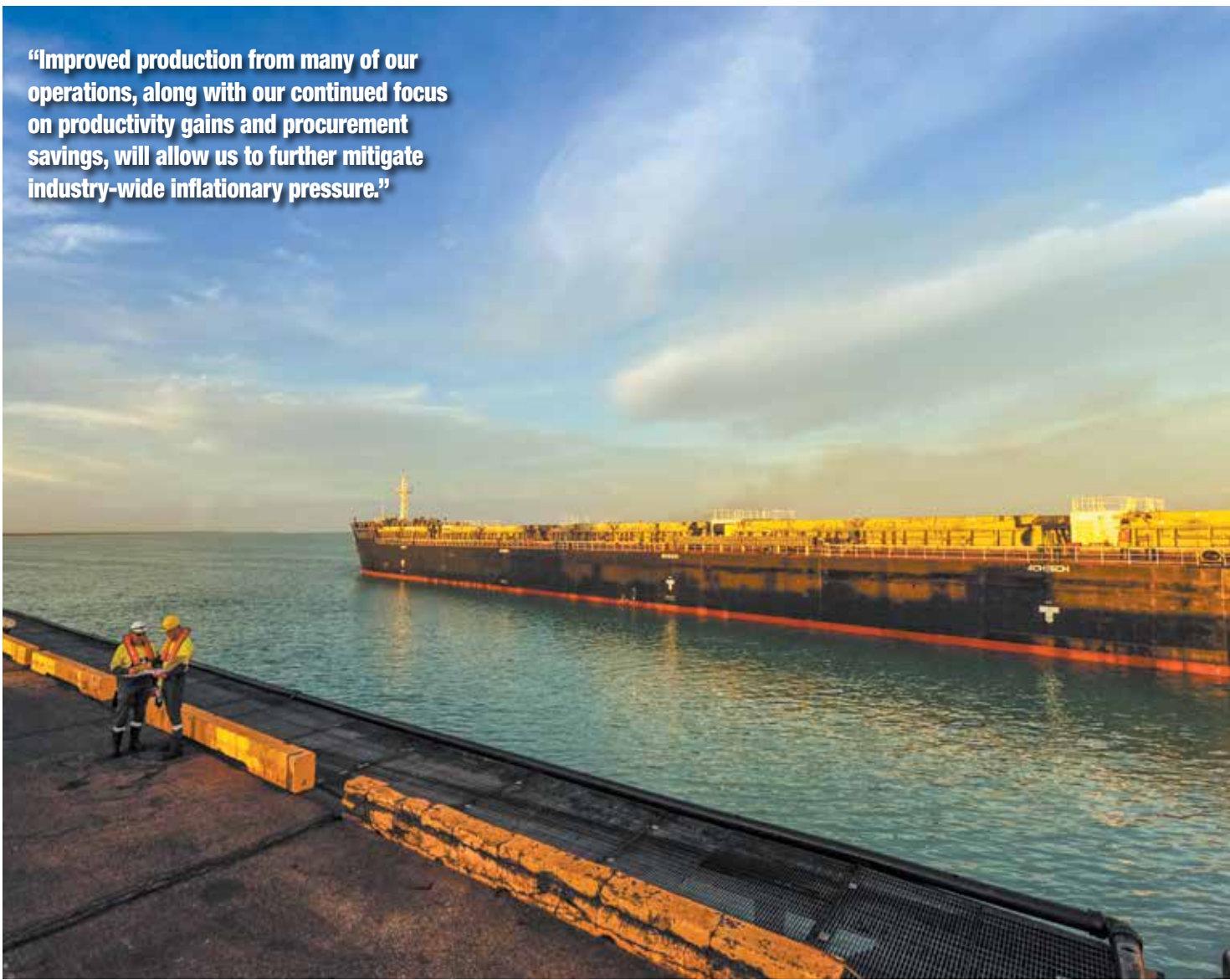
"We anticipate some price volatility in global commodity markets, driven by rising trade tensions and a strengthening US dollar.

"However, strong demand for higher quality raw materials is expected to continue as China implements policy initiatives to meet environmental reforms.

"Improved production from many of our operations, along with our continued focus on productivity gains and procurement savings, will allow us to further mitigate industry-wide inflationary pressure."

Mr Kerr's outlook was supported by the most recent *Resources and Energy Quarterly Report*, released by the Department of Industry, Innovation and Science.

According to the report, world steel consumption was forecast to rise to 1.8 billion tonnes in 2020, led by growth in emerging markets, while China – the world's largest steel consumer – was forecast to reduce consumption by 0.5



Manganese is shipped from GEMCO to be smelted at TEMCO, forming South32's Australian manganese operations.

per cent annually, driven by an expected slow-down in infrastructure projects and construction.

About 90 per cent of manganese goes into steel-making as it improves the

strength of the building material.

Manganese can be added to aluminium for the same reason, however it was increasingly being used in next-generation battery and power

storage applications.

The increasing demand for these technologies would also likely serve as an important driver in the demand for manganese.



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GROOTE Eylandt lies 650 kilometres off the coast of Darwin and is the third largest island in Australia.

A unique environment with pristine beaches, spring water swimming holes, rainforest and sand dunes, the area is a haven for anglers to experience some of the best fishing in the world.

Groote is also home to GEMCO, a manganese ore mine, which means there are multiple daily flights and luxury accommodation at Groote Eylandt Lodge available to fishers travelling to the island.

"On a typical three-day safari, you can experience reef, bluewater and estuary

fishing and tangle with hard-hitting tropical species," fishing guide Jonathon Eddy said.


"You could fish for three or four days out here and catch a marlin on the first day and a barramundi on the last day and every other species the tropics has to offer in between."

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INDUSTRY SPOTLIGHT

COMPANIES GEARING UP

KBR delivers proven solutions

INTERNATIONAL

RENOWNED engineering, procurement and construction (EPC) company KBR has built a strong reputation for delivering proven solutions across a range of sectors including resources, infrastructure, marine engineering, environment, and transport.

One of KBR's core strengths has been its ability to deliver some of the world's most complex projects and programs using its proven program management office (PMO).

As a major EPC contractor, KBR has consistently brought the skills to manage and deliver projects in remote and harsh environmental conditions against time critical project completion dates, while helping ensure the transfer of knowledge to deliver outstanding outcomes.

These strong outcomes have been achieved by KBR's ability to develop a flexible solution, which recognised that no single execution model would suit every customer and their goals, issues, needs, and risks.

KBR has continued to offer solutions to clients that combined some of the world's best program management personnel, who have been trained and developed to work collaboratively, along with procedure, systems and tools that could be adapted and rapidly deployed anywhere in the world.

The company's approach to providing



KBR Carrapateena project director David Gallery with KBR Carrapateena deputy project director Robert Gerrard.

PMO was client goal focussed, with an emphasis on integrity and accountability, collaborative working, risk awareness, and zero harm.

It also brought a number of core skills to PMO ensuring the best possible outcomes for clients.

KBR's contracting strategy delivered the most advantageous commercial execution model to ensure delivery, while its collaborative behaviour delivered integrated teams to work with customers to deliver the best solution for the project.

This collaborative and flexible approach

to project delivery was reflected in the company's long-term relationships and contracting arrangements with clients, with KBR supporting many of its clients for several decades.

The company's skills in risk management meant clients could expect a full and open discussion on all threats and opportunities to help ensure the certainty of the outcome.

KBR's interface management guaranteed early acting to de-risk the main issues in a project and its data centric management helped ensure real time information, which could be entered once, trusted, and re-used

many times.

This was supported by KBR's appropriate skills and resources in project management; project controls; quality; HSE; information management; business transformation and training; technical and engineering teams; construction and commissioning; and logistics management.

Among its recent projects was the Carrapateena copper-gold project, which KBR has been supporting OZ Minerals to deliver since 2017.

KBR's role has been providing professional project management services for the execution phase of the project as part of an integrated project team office.

Previous to the project starting, KBR had been supporting OZ Minerals to finalise its early contractor involvement strategy and associated feasibility study activities.

In total 60 employees were working on the project, with 70 per cent coming from KBR and 30 per cent coming from OZ Minerals.

As an integrated team, KBR and OZ Minerals were delivering more than 30 separate work packages, including a minerals processing plant, 550-bed accommodation and a 1.6km aerodrome designed to accommodate a 100-seat jet aircraft.

More information about KBR can be found at www.kbr.com.

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Heralding new projects in switchboards

NATIONAL

WITH the iron ore markets looking up, mining companies have embarked on augmentation of exports and are gearing up to facelift harbour facilities.

Given the right conditions, BHP has begun its onshore and offshore outer harbour development project with the sole aim to bolster its export capacities.

From the stockyards to the jetty, new facilities were being added at Finucane Island and Nelson Point, propelling the demand for power infrastructure for its expansion projects.

DaRa Switchboards, an ISO9001-2015 company known for its reputation as a preferred manufacturer in mining boards, is the vendor for major mining companies in Australia.

The IP66 switchboards supplied were made to withstand the onshore and harsh marine weather conditions in stainless steel to last for the full project life cycle.

DaRa Switchboards has achieved remarkable acceptance and experience from a diverse range of industries, specialising in mining switchboards complying with the latest switchboard and safety standards.

Those looking for a purpose-made mining duty electrical switchboard should give DaRa Switchboards a go.

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More information about DaRa Switchboards can be found at: www.electricalswitchboards.com.au.

Aussie fire chief goes mining



Aussie's Mr T fire pump ensures mine sites are prepared for fire emergencies.

INTERNATIONAL

A RECENT incident of a big Cat dozer that caught fire on a mine site in South Africa is a timely reminder that fires can be catastrophic and can shut a complete site down.

Aussie Pumps, major manufacturers of high pressure firefighting pumps, has developed a 'Mine Boss' version of its popular diesel drive fire pumps.

The "Mr T" twin impeller high pressure pump will deliver heads of up to 90 metres (140psi) and will prime from 7.6 metres (vertical lift), producing flows of up to 500 litres per minute.

As part of Aussie Pumps' 'Quik Prime' pump range, the Mr T was claimed to be the best light weight portable high pressure fire pump in the world.

Powered by Yanmar L100 10hp, an electric stat air cooled diesel engine, the pump was built into a 38mm hot dipped galvanised frame with centre mounted lifting bar.

Aussie Pumps' product manager Brad Farrugia said the company had seen what happens to light weight pumps and other equipment on construction and mining sites when picked up by an excavator, trundled over to the new location and dropped.

"Conventional commercial frames get bent out of shape fast," Mr Farrugia said.

"Our Mine Boss frames are built like a Cat D10."

The pumps are fitted with e-stop and battery isolation as standard, while bunded trays and trolley mounts are also available as an option.

"We even supply fire extinguishers as

part of the kit," Mr Farrugia said.

Fire pumps can be teamed with a rapid poly tank on a fast attack vehicle or coupled to a larger tanker, depending on site and application.

Aussie Pumps believe every mine should have a portable mine spec fire pump on hand, as big pumps take time to mobilise, whereas the Aussie pumps are compact, relatively light weight, and highly efficient.

The Aussie Mine Boss Range of pumps are built at Australian Pump's 2.5 acre site at Castle Hill in Sydney, and are now operating not just in Australia, but on mine sites in Africa, South-East Asia and throughout the South Pacific.

More information about Aussie's Mine Boss fire pumps are available from Australian Pump Industries or authorised distributors throughout Australia.

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Tank walls and headers are 30% thicker than OE

Heavy-wall welded seam tubes

IMPROVED DESIGN

The baffle plays an integral role in a two pass system. The OE rubber gasket (pictured below) is prone to degrading over time leading to rising operating temperatures & ultimately begins to overheat equipment.

Procore's split-tank design is a major improvement over OE.

This improved development guarantees ZERO coolant bypass for the lifetime of the radiator by eliminating the OE gasket, which can fail.

OIL-RESISTANT SEAL MATERIAL

ADRAD has added new folded and AMOC radiators to its extensive industrial cooling products range.

NATIONAL

OVER the past three decades, ADRAD has established itself as Australia's leader in aftermarket heavy duty radiator design, manufacture and supply.

The company's engineering and manufacturing teams have implemented a number of advanced construction techniques that extend the performance of ADRAD cooling products far ahead of the original factory fitted units they replace.

It should come as no surprise then to learn that ADRAD applies this same quality principle when selecting parts

from carefully chosen partner suppliers around the world.

The latest new additions to ADRAD's heavy industrial cooling range are folded and AMOC radiators from PROCORE to suit many Caterpillar heavy vehicle applications.

These aftermarket radiators are built with heavier construction and feature significant design improvements, such as deep-drawn header slots and split-tanks. The changes dramatically increase strength and durability which delivers much longer service life.

Seals and grommets have also been sourced from MICON INDUSTRIES which feature oil-resistant material.

A high number of radiator leaks occur due to seal degradation and failure.

The rubber compound specially developed by MICON is completely resistant to hydraulic oil, motor oil and diesel fuel and tolerates a high temperature range.

MICON grommets are also available for water or glycol applications with Mesabi type radiators.

ADRAD supplies an extensive network of radiator specialist workshops across Australia.

Information about ADRAD's extensive industrial cooling products range can be found at: www.adradradiators.com.au/offhighway.php.

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EUREKA GROUP 1	RIIVH305E Operate and maintain a 4WD vehicle	SISODRV302A Drive and recover a 4WD vehicle	TLIC2025 Operate 4WD vehicle
EUREKA GROUP 2	RIIVH201D Operate light vehicle	TLIC1051 Operate commercial vehicle	TLIF2010 Apply fatigue management strategies
EUREKA GROUP 3	SISODRV404A Drive a 4WD in difficult terrain	SISODRV405A Coordinate recovery of a 4WD vehicle	
EUREKA GROUP 4	PMASUP236 Operate vehicles in the field	RIIVH305E Operate and maintain a 4WD vehicle	TLIC2025 Operate 4WD vehicle
EUREKA GROUP 5	AHCMOM211 Operate side by side utility vehicles		
EUREKA GROUP 6	AHCMOM212 Operate quad bikes		
EUREKA GROUP 7	TLIA1001 Secure Cargo	TLID2004 Load and unload Cargo	
EUREKA GROUP 8	FWPCOT3259 Operate a four wheel drive on unsealed roads	FWPFGM3215 Perform Complex Operations	
EUREKA GROUP 9	SISODRV302A Drive and recover a 4WD vehicle	SISODRV405A Coordinate recovery of a 4WD vehicle	



Over many years Simoco Wireless Solution have supplied radio equipment and communications systems to mine sites all over Australia.

The Mining industry cannot move a machine on site if it does not have a radio solution. Simoco Wireless Solutions have been ensuring that every vehicle and person that enters a mine has a professionally installed radio that ensures critical communications with site communications for decades. Future-proofing the Mining industry is a key focus for Simoco Wireless Solutions, through a series of digital upgrades and adoption of automation to ultimately ensure safety and productivity is paramount. Simoco Wireless Solutions supply to all types of mine sites including some of the largest Iron Ore mines, bauxite, gold, copper and salt mines in the world.



We design, build and deliver a broad range of the latest in digital technology, giving mining professionals more functionality to protect workers including features to assist OH&S teams like Man down and Lone worker, and an ability to provide bespoke solutions for our customers.

These solutions include:

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- Call Boxes complete with Radio Intercom
- Remotely triggered Voice Announcements
- Live weather warnings – Lightning imminent
- Environmental monitoring – Dust alerts
- Audio Interface Units
- Modularised Repeater Stations
- Containerised Communications Stations'
- Customised heavy haul locomotive communications systems
- Remote pole mounted solar powered radio kits
- Auto channel change based on GPS location
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Smart communication systems

NATIONAL

SIMOCO Wireless Solutions know that communications are the heart of safe and productive operations in remote underground mining environments.

Systems architecture and the nature of operations are complex and highly specialised and operators need systems and technologies that can withstand harsh conditions and provide reliable and safe links for their workforces.

With more than 60 years' experience and expertise, Simoco Wireless Solutions is an established expert in unifying divergent, complex and highly specialised technologies, which enable mining companies to take advantage of new communications functionality.

Private and secure unified communications networks also mean that mining companies can monitor and manage their operations across broad areas, including highly constricted and challenging environments.

Being able to react quickly to emergencies and identify potential problems is critical, not just to maintain operations but to safeguard workers in the event of an emergency.

Remote monitoring services, alarm and broadcast capabilities limit the threat of shutdown and save lives in emergency scenarios, while new digital solutions, such as Simoco DMR, bring new functionality to increase capacity and integrate a broad range of communication, such as SCADA and telemetry services.



Image: BHP.

By enabling customers to monitor and control critical infrastructure in the mining process, Simoco can reduce outages, accidents, down-time and overall operating costs.

Simoco Wireless Solutions works on

all stages of the unified communications journey, from system design and planning, through implementation and delivery of infrastructure projects on a massive scale, to ongoing maintenance and support.

The company combines manufacturing,

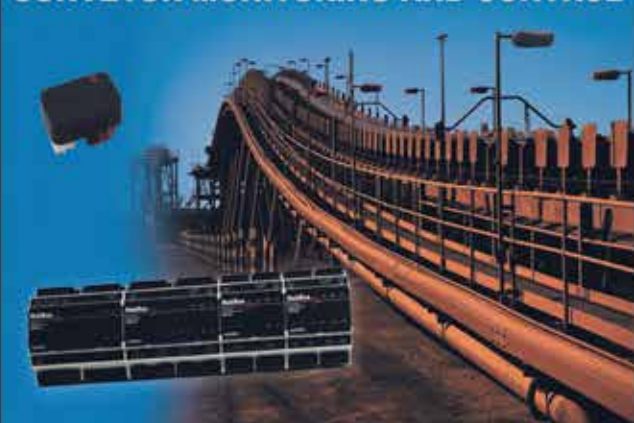
systems development and consultancy expertise to offer bespoke voice and data technologies that meet the gruelling needs of mining operators around the world.

More information can be found at: www.simocowirelessolutions.com.

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MINING LIFTING SOLUTIONS

SARENS Australia specialises in engineered lifting and transportation solutions for the resources industry. The company has a highly diverse range of equipment which can assist with all aspects of load in/load out operations, site moves of draglines and shovels, skidding and jacking, stacker and reclaimers/ shiploader installations, as well as crane and customised lifting equipment for general shutdown works.

Sarens is an experienced partner with strategically positioned operational yards throughout Australia from which equipment can be mobilised for maintenance contracts.

Its engineers work closely with their client's project

teams during the FEED, pre-design and engineering execution phase of each project to ensure the most efficient approach possible and to safeguard all project requirements.

The company is also proud to own the youngest crane fleet in Australia equipped with black boxes, which enable the team to monitor individual crane history within the fleet and a variety of operational activities.

Sarens' dedicated, well trained and disciplined team are committed to achieving the highest levels of safety, quality service and environmental awareness.

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Top market talent from across the world

NATIONAL

ASIDE from being the owners of the largest crane in the world, Sarens is the point of reference in crane rental services, heavy lifting, and engineered transport for its clients.

With state-of-the-art equipment and value engineering, Sarens offers clients creative and intelligent solutions to today's heavy lifting and engineered transport challenges.

Sarens has more than 100 entities in 65 countries operating without borders and it is the ideal partner for small-scale to mega-scale projects.

It currently employs more than 4500 professionals and diligently man's its clients' projects with top market talent from across the world.

Safety and excellence in all it does is paramount to Sarens.

The company strives daily to establish a safe space for its own team, its clients' teams, and the equipment involved.

Sarens has been the market leader for more than 60 years, and more than four Sarens family generations are intimately involved in the business.



Sarens provides crane rental services, heavy lifting, and engineered transport solutions.

Its success lies in its entrepreneurial spirit and its continued dedication to the job at hand.

However, taking heavy lifting and

engineered transport seriously is not just a matter of DNA and a family tradition at Sarens, but most importantly, a vocation.

Its proud craftsmen have built a legacy

by deploying Sarens' five unwavering values: brilliant solutions; dedication to safety; zeal for excellence; love for traditions; and a global spirit.



Capel Crane Hire has been servicing WA's South West for 40 years.

Proud service providers to WA mines

NATIONAL

CAPEL Crane Hire has been building and strengthening its business capabilities as it looks to the future in the dynamic South West.

"Going forward we desire to be at the forefront of our industry and a market leader in our region, which will allow us to build stronger professional and community relationships, expand employment and deliver revenue back into our local economy," Capel Crane Hire business manager David Payne said.

Capel Crane Hire values its local business relationships and has been servicing the South West for the last 40 years, specialising in cranes, transport,

fabrication and construction.

Recently, the company has been working with Talison Lithium, AGC and Kerman Contracting at Talison's Greenbushes mine, about 250km south of Perth.

It has also provided services at Gruyere gold project and Iluka Resources' Cataby mineral sands mine.

The company offers a full service that is both efficient and safe, while its local knowledge and qualified staff are dedicated to finding the right solution.

"Our experienced staff and the scope of what we can deliver sets us apart," Capel Crane Hire company director Ray Payne said.

More information about Capel Crane Hire can be found at www.cranehire.com.au.

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CAPEL CRANE HIRE

Going the extra mile

NATIONAL

APEX Envirocare is an innovative environmental company with a focus on water related issues.

Established more than 20 years ago, it has grown into a very successful organisation by embracing new technologies and applying these new ideas in Australia.

The dredging business uses the latest unmanned remote controlled equipment, which can be fully automated to ensure regular solids feed into a mining process or thickener.

It can also advise on and supply low energy solutions for dewatering slurries utilising the latest polymer dosing systems and desludging tubes to ensure quick drying sediments.

Apex Envirocare has recently been appointed the exclusive distributor for Mudcat and IMS dredges in Australia and the Pacific.

As a contractor using Mudcat's equipment, the company can pass on its expertise and offer professional support to its many mining and municipal clients.

Another product it offers is the clever Aqua Barrier system, which is a temporary water inflated cofferdam – Apex Envirocare has been leasing them around the country for more than 15 years.

Aqua Barrier offers a practical and



The Aqua Barrier system was recently used for a project at Rio Tinto Dampier.

environmentally preferred alternative to sandbags, earth bunds and sheet piling.

Aqua Barriers has been used by all the

large contractors and mining companies, including a recent project in WA's Pilbara region which allowed a mining company to

repair culvert structures.

More information can be found at: www.apexenvirocare.com.au.



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Pumping to please

NATIONAL

MAXITool Australia is a mining-focussed dredging and water management enterprise specialising in dredging tailings dams; process water ponds, including plastic-lined ponds; and other enclosed waterways.

With extensive coal and metalliferous experience, Maxitool delivers services to many of the world's leading mining companies.

The company operates with a clear understanding of mining compliance

standards and has the appropriate systems and processes in place.

Maxitool personnel hold dredging specific competencies and equipment has been assessed against MGD15 standards.

Its fleet of equipment includes single load, portable, cutter suction dredges, slurry booster pumps and associated kit.

The company also designs and manufactures dredges and associated equipment.

The Maxitool mission is to deliver "Certainty in Safety, Certainty in Quality, and Certainty in Value."

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Innovative solutions FITT to order

NATIONAL

FITT Resources has built a strong reputation as an innovative and services-based company offering premium products and services across a range of industries.

Specialising in dewatering, pumps, seals, wastewater pumping systems, turbomachinery and Rotating Equipment servicing, the company provided whole tank to tank solutions with premium, specialty and custom-made products and services.

FITT Resources business unit manager for dewatering Chris Molloy said its Dragflow product had proven to be not just a simple alternative for handling solids with conventional products and systems, but provided solutions for those clients operating in specialised sectors who must face extreme conditions and solve very

difficult applications.

Dragflow product range included electric and hydraulic driven submersible slurry pumps as well as full dredge packages.

Dragflow products were made with an exceptional structural quality to achieve low maintenance and service costs as well as long life of components and wear parts.

Mr Molloy said FITT Resources, founded 10 years ago, had become the preferred supplier for a number of major companies.

“Our highly trained team of 35, ensure customers receive the highest level of service, with solutions designed specifically for them,” Mr Molloy said.

FITT Resources had its headquarters in NSW, but operates nationally.

More information about FITT Resources can be found at: www.fittresources.com.au.



FITT Resources WA business development manager Josh Lipscombe was one of the company's highly trained team members.

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Aussie's mine pump solution

NATIONAL

AUSTRALIAN Pump Industries is working closely with industry leaders to provide pump solutions in mines.

Submersible pumps are ideal for pumping high volumes of water around mine sites for wash-down dewatering, processing and recycling.

While the biggest issue with any pump is reliability, an example of a solution to keep water moving in mines is Tsurumi's large capacity KTZ411 submersible pump.

The KTZ is an 11kw submersible capable of delivering in excess of 1000 litres of water per minute at a head height of 35 metres.

With this performance, the pump is able to combat pipe silting – a common issue that occurs over time as sediment build up inside pipes, reducing the internal diameter.

This restricts flow, accelerating the silting issue and reducing the transfer rate.

Australian Pumps product manager Neil Bennett said the company proved that a high capacity pump like the KTZ411 was able to push water through with a larger flow rate.

"High velocity flows mean less silting, therefore less maintenance and a less noticeable drop in performance of the pump over time," Mr Bennett said.

Tsurumi's KTZ series were purposely

built to withstand abrasive conditions, having been manufactured from heavy duty cast iron with high chrome internal wear components.

The KTZ series is widely used in mining, tunnelling, quarries, or concrete batch plant applications and piling duties.

The pumps come fitted with three-phase heavy duty two-pole motors with thermal protection, while the side flow design ensures the motor is cooled, enabling the pumps to operate at low water levels or be installed on an incline.

Also featured in the series are anti-wicking cables and silicon carbide seals that function to maximise performance longevity in extremely challenging conditions.

Mr Bennett said Tsurumi submersibles were uniquely built to withstand dry running conditions.

"The dual silicone carbide seals are lubricated and cooled continuously in a protective oil chamber," Mr Bennett said.

A 1000 volt option is also available for underground applications.

Australian Pumps have also set up a national Mining Partner network to provide local assistance to operators, because the company knows that when a pump fails it's paramount to get back in action as fast as possible.

More information about the network and Tsurumi's KTZ series can be found at: www.aussiepumps.com.au.



The KTZ411 has proven itself to be an ideal investment for the corrosive environments in mine sites.

THE AUSTRALIAN
MINING REVIEW

PROFILES FOR FEBRUARY 2019

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The road to total dust control

NATIONAL

ACHIEVING an effective dust management solution for mining roads is an ongoing challenge for mine operators.

It's been readily established that wheel generated dust is the largest single contributor to total dust emissions on any open cut mine site.

Independent studies have concluded that best practice is the application of dust suppressant solutions.

Yet using a dust suppressant is one thing – selecting the right type of product, implementing an effective application strategy, and putting an on-going management program in place are all critical to ensuring long-term success both from a dust control and economical perspective.

As Australia's leading provider of dust control solutions for the mining industry, Dust-A-Side provides tailored dust management solutions for any type and size of mine.

Dust-A-Side Australia general manager Neil Hoskin, believes that a



Dust-A-Side offers customised dust control solutions for haul roads.

combination of different measures needs to be employed to achieve total dust control across different roads and other dust generation sources.

“A typical mine site is made up of both permanent and short term roads which will need to cope with varying volumes of traffic. No single product or process can be used to achieve total dust control,” Mr Hoskin said.

“Roads need to be looked at holistically in terms of factors influencing their lifetime costings. A dust control program that works for a temporary road won't necessarily be effective or cost-efficient on a permanent haul road.”

Mr Hoskin said that mine operators need to be aware that there really is no one-size-fits-all approach that can be applied to dust management.

“Ultimately, an all-encompassing dust control management solution will provide economic benefits, productivity improvements as well as health and safety benefits to any mining operation,” he said.

“All of these factors need to be taken into consideration when developing a dust control strategy.”



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Rainstorm signs distribution deal for DustEx

NATIONAL

DUST control specialist company, Rainstorm, has included DustEx to its range of specialty dust control products.

Rainstorm is arguably Australia's leading specialist dust control company, having operated for 28 years at the forefront of technologies solving dust issues within a range of industries, including mining, civil construction, waste management, materials handling, land rehabilitation, servicing with contractor and spray systems for roads and plants areas.

With an in-house team of scientists, Rainstorm has retained its market-leading position through the development of innovative technologies that were consistently deployed hand-in-hand with best practice to ensure the optimal result on the ground.

Rainstorm sales and technical manager Mason Trouchet said the company had always sought to cover the full range in base chemistry of dust control and soil stabilisation products, seeking the best quality in each category.

"The combined power of Rainstorm and Borregaard brings to the market high-quality lignins, with experience and service at competitive pricing," Mr Trouchet said.

"We have been blending lignins and now Dustex with other products in our range to add binding power.

"We now have the history and experience of DustEx, a market leader in



Rainstorm offers efficient dust control solutions across a range of industries.

lignin technology.

"Our unique market position enables us to open up the technology base groups to the miners so they build data sets based on a type of chemical group that works for them, and then head to market to buy, comparing apples for apples in price, quality and performance."

Mr Trouchet said Rainstorm intended to offer DustEx at competitive pricing against similar lignins used in haul roads.

"If you're using a lignin now, make sure you speak with us to compare as pricing will be on the table," Mr Trouchet said.

Mr Trouchet said Rainstorm offered significant advantage to dust control solutions, scoping the best product base chemistry groups that cover the main heavy lifting when it comes to dust control.

"Using data from mobile dust monitors

attached to mine fleet vehicles provide real time dust data and events in traffic light simplicity – red, orange, and green," he said.

"Response from water carts is not wasted on road sections that are in green, instead being targeted to apply on road sections requiring an application."

It also enables targeted blend to manage the changing and variable landscape and conditions on haul roads.

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Liebherr to launch new excavators

INTERNATIONAL

LIEBHERR Mining Equipment Colmar SAS announced it will launch the new B-versions of the R 9100 and R 9150 excavators in January 2019.

Both machines have proven to be reliable and productive partners in the mining industry over the years.

With the newest upgrades, these hydraulic excavators would take a step forward to clearly exceed the performance and reliability compared to any other player in this class, while lowering the cost per tonne.

The R 9100 B and R 9150 B are equipped with the long-lasting and proven Liebherr V12 diesel engine specifically designed to withstand extreme outside temperatures and high altitudes with low atmospheric pressure.

Integrating the latest engine management system, the machines were built for extreme conditions.

The Liebherr D9512 diesel engine is the latest generation of Liebherr diesel engines and is now USA/EPA Tier 4f compliant.

It has been upgraded on many levels with an increased engine lifetime and new features that facilitate and improve the engine maintenance.

Furthermore, the new B-versions come with exclusive EVO Bucket Solution with patented Liebherr design to maximise the loading capacity and ensure optimal penetration efficiency.

The new buckets also make both excavators the perfect working partners in



The Liebherr R 9100 B was premiered at Bauma in China at the end of November.

terms of shovel match for the Liebherr T 236 truck and all other articulated and rigid trucks in the 50 tonne to 100 tonne class.

Both the new B-versions' upper structure is accessible via a robust fixed ladder of 45 degree access stair in option and integrates one large central platform equipped with slip resistant surfaces.

The new arrangement with wide catwalks facilitates maintenance and ensures comfort during all the operations.

These excavators are fitted with ergonomic access for fast and safe

maintenance.

All service points are within reach from one side and at machine level.

The modern and large cab provides ideal working conditions and optimal operator's comfort.

Mounted on silent blocks, the optimised cab design reduces vibrations.

The new headliner limits noise pollution to provide a quiet working environment – a decrease of 2 decibels in the cab compared to the previous version.

Both new B-versions are also serially

equipped with GSM data transmission functionalities to collect operating parameters, error codes and machine faults.

The data is accessible through the Liebherr-Mining Data platform (LMD) on which the user can generate customised reports to track and analyse machine data.

The accurate information collected through the connectivity kit is recorded in a worldwide database and enters a systematic assessment and resolution process to continuously improve existing and new products and components.

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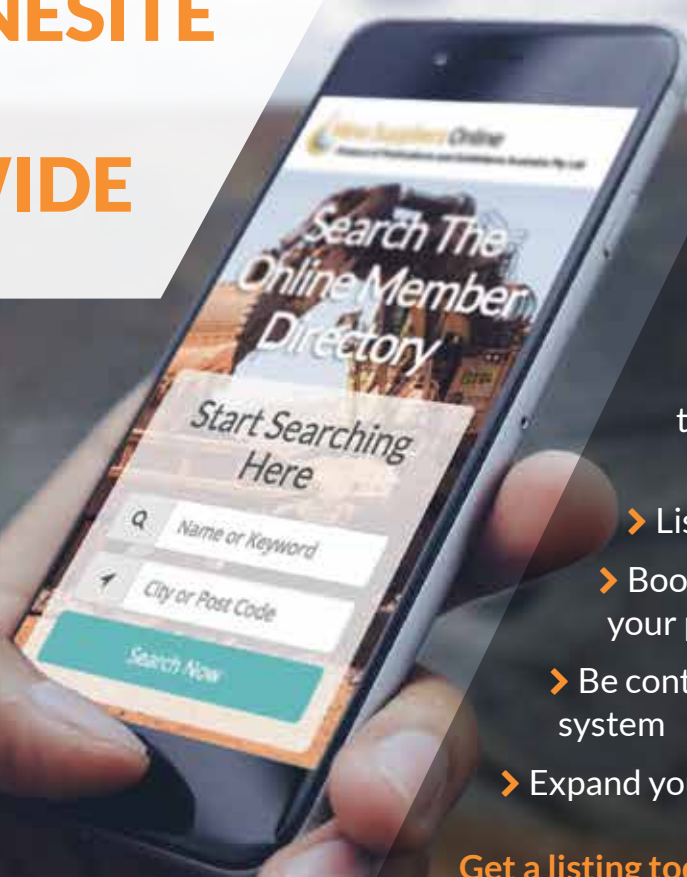
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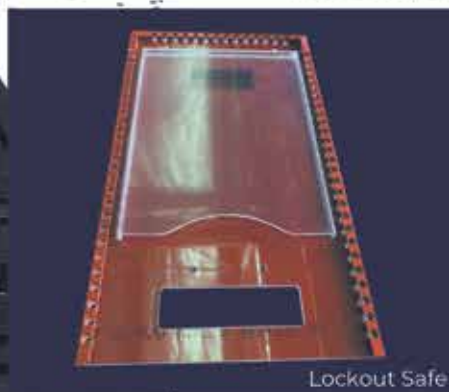
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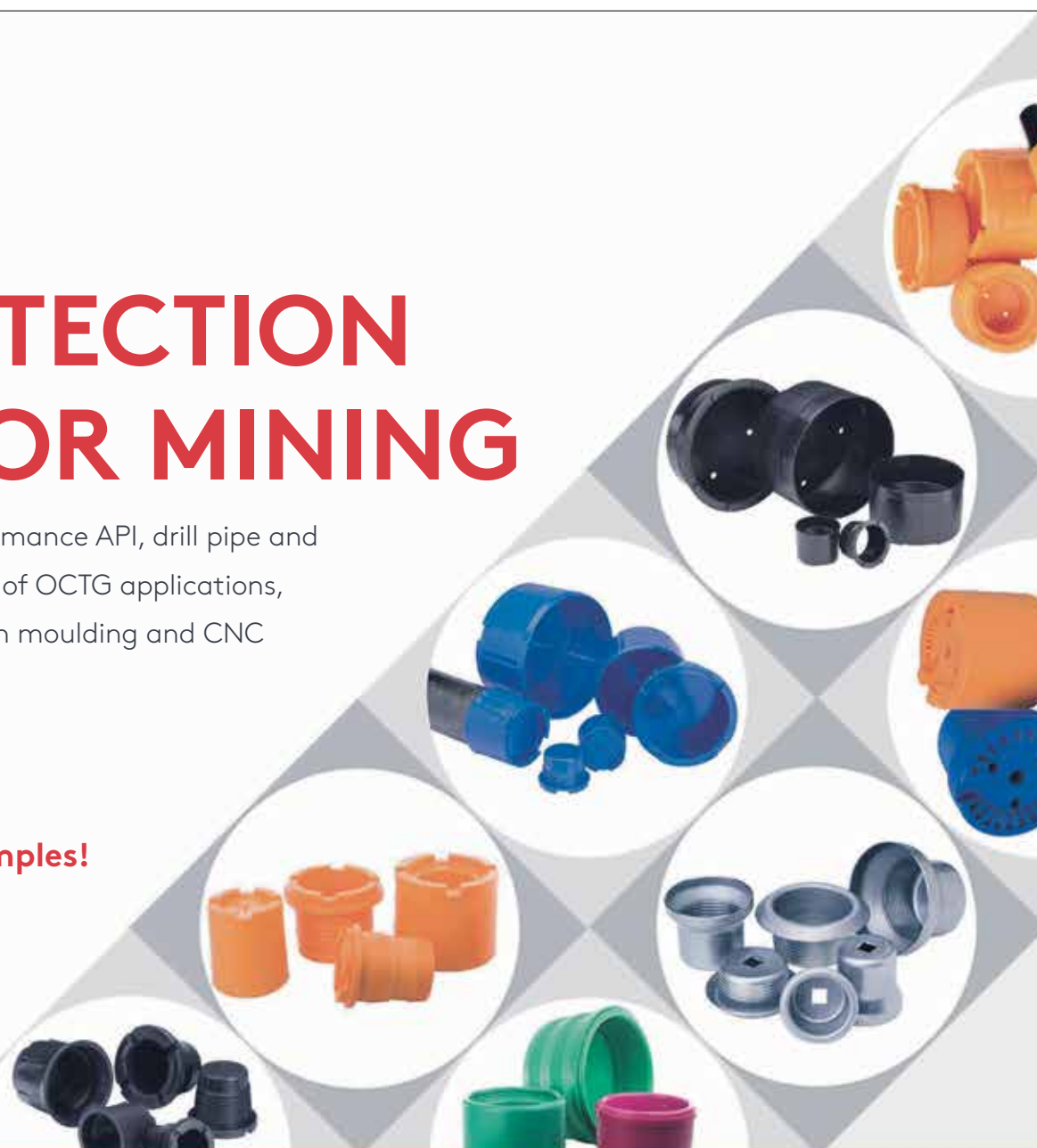
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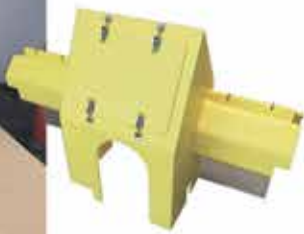
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THE AUSTRALIAN
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FEATURES FOR FEBRUARY 2019

- Alcoa's Pinjarra Alumina Refinery
- Aurelia Metals
- Boonanarring Project
- Cadia Valley Mine
- Curragh Coal Mine
- FMG
- Galaxy Resources
- Grange Resources
- KCGM Super Pit
- Lynas Corporation
- Mineral Resources
- Mining in Bendigo and Ballarat
- Pilbara-based Mining Services
- Rail in Mining
- Shark Bay Resources
- TasPorts
- Tomago Aluminium
- Yancoal's Moolarben Coal Mine



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Image: Minotaur Exploration.

MINOTAUR EXPLORATION EXECUTIVE DIRECTOR BUSINESS DEVELOPMENT

TONY BELPERIO

Minotaur Exploration has already had significant success at its Eloise joint-venture with OZ Minerals 60km southeast of Cloncurry in QLD thanks to its targeting of a relatively unknown style of deposit called Iron Sulphide Copper Gold (ISCG). As drilling continued into the Jericho copper-gold system at the end of 2018, Amy Blom spoke with Minotaur executive director business development **Tony Belperio** about the benefits of targeting ISCG deposits, recent results from Jericho, and plans to roll out the exploration model elsewhere.

Q. Minotaur Exploration has achieved a breakthrough based on a new deposit style called ISCG. What led to Minotaur's decision to target this particular style of deposit?

Historically, Minotaur has been exploring for Iron Oxide Copper-Gold (IOCG) deposits, as exemplified by Prominent Hill in South Australia and Ernest Henry in the Cloncurry district, for more than 20 years.

IOCG is a copper-gold deposit style in which the dominant host gangue is iron in the oxide form – magnetite and/or haematite.

About 10 years ago, as part of our exploration effort north of Ernest Henry, our geologists began encountering high iron sulphide (pyrite-pyrrhotite) versions in and around its IOCG targets.

Trialling of various electrical geophysical methodologies allowed us to track this iron sulphide – bearing variant (named Cormorant) for many kilometres – more than 10km – under cover.

It was the realisation that this ISCG system could be as large as, and contain as much iron as, a typical IOCG system, albeit stretched over many kilometres and responding differently to the exploration tools being utilised, that led to the decision to further target this style directly.

Q. What are the processes involved in targeting ISCG and how do they differ from the processes used to target the more commonly known IOCG style of deposit?

The key accepted tools for IOCG exploration under cover are gravity and magnetics.

These respond to the density contrast caused by a large mass of haematite and/or magnetite to its magnetic properties.

The ISCG style is characterised by similarly large quantities of iron, but with the iron in a reduced sulphide form, principally as pyrrhotite.

A key characteristic of pyrrhotite is that it is one of the most electrically conductive of minerals, so that electrical geophysics becomes a key targeting methodology.

In addition, the ISCG style of mineralisation appears to be less magnetic – even non-magnetic – and more tabular, following linear structural weaknesses in the crust compared to diatreme, like breccia bodies of IOCG deposits.

This makes ISCG deposits less likely to be detectable by regional gravity and magnetic methods.

Conversely, the high conductivity of the massive pyrrhotite host makes electrical methods a preferred tool.

In this regard, recent technological advances in electrical geophysical methods, including airborne EM, VTEM, B field EM and Squid EM are an added incentive, particularly where exploring under conductive cover.

Q. What were the results of adopting the ISCG model?

Minotaur made the conscious decision in 2013 to target the Eloise area, surrounding the privately-owned Eloise copper-gold mine as this was the best known commercial example of an ISCG deposit at that time.

The Eloise underground mining operation has extracted more than 10 million tonnes (mt) to date at a grade of 2.2 per cent copper

and 0.9 per cent gold.

The greater Eloise area, being under almost complete cover, allowed for both regional screening using airborne EM technologies, where cover was less than 50m, and direct targeting of regional structural conduits using deep penetrating ground EM, where cover thickness was greater.

Each of these technologies proved successful in their own right with successive copper-gold discoveries at Artemis in 2014, Iris in 2016 and Jericho in 2017.

Q. Can you outline the recent results of drilling at Jericho and what they mean for Minotaur?

Jericho was discovered 12 months ago under 50m of cover and just 3km to 5km from the Eloise mine.

With almost no magnetic expression to stimulate interest, the area had been ignored by previous explorers despite its proximity to a well-endowed mining operation.

With 30 broadly separated drill holes now completed into the geophysically-defined target, copper-gold mineralisation has been outlined along some 3.5km, J1, and 2km, JT, of strike extent in two sub parallel tabular bodies about 150km apart.

Of significance is that every drill hole to date into the conductive plate targets making up J1 and J2 at Jericho has intersected copper mineralisation.

An accelerated and more systematic drill out is anticipated in the new year, subject to discussion with joint venture partner OZ Minerals, to more formally define scale, grade, continuity, and extent of mineralisation.

Closer spaced tracking of high grade intervals in each of J1 – for example 8.4m at

2.78 copper and 0.66 grams per tonne (g/t) gold, and J2 – 27m at 2.42 per cent copper and 0.7g/t gold – is anticipated.

Q. How will Minotaur use its model to unlock the potential of other project areas?

Jericho, Iris, Artemis and Cormorant are emphatic proof of concept for the ISCG exploration model.

They demonstrate that the ISCG style of mineralisation can be both large and high-grade, and the ISCG model should be considered in parallel with IOCG models in exploration/complementary exploration tools need to be considered and utilised.

Minotaur has been and continues to evaluate areas with potential for both styles, the Highlands project area recently acquired being one such region worthy of critical investigation.

Like the Eloise area, Highlands consists of a known pyrrhotite copper-gold deposit, Barbara, and widespread structurally controlled copper-gold occurrences.

Systematic exploration with an appropriate exploration tool box is required.

Q. Any final thoughts?

It has been suggested that Jericho may be the most significant copper-gold discovery in the Cloncurry region since Ernest Henry in 1991.

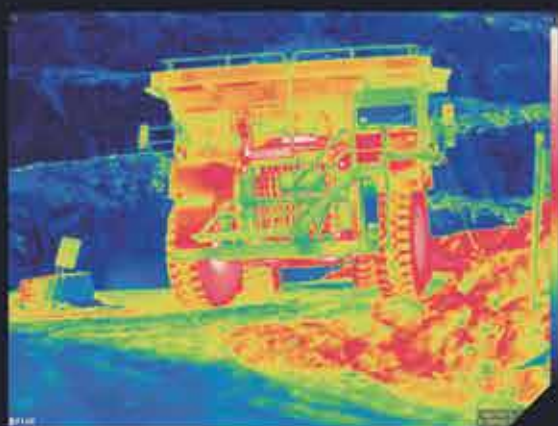
Although I can't possibly comment on size and grade, it is clear to me that the ISCG exploration model has evolved rapidly and elegantly, and is now delivering very tangible results, and we expect many more.



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