

MINING PROJECTS

Special Report



Key takeaways

- \$12.5bn of mining projects likely and \$4bn under way
- Looming need for replacement iron ore mines
- Outlook improving for mineral sands developments (page 16)
- Kwinana lithium refinery could be first of several (page 18)

UP AND RUNNING: Rio Tinto chief executive Jean-Sebastien Jacques and Mark McGowan at the opening of the Silvergrass iron ore mine.

Big spenders mining wealth

More than \$12 billion of mining projects are in the pipeline for WA and likely to proceed, with major iron ore developments the biggest contributor.



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6-PAGE FEATURE

RIO Tinto's investment in increasing its rail capacity provides a useful demonstration of the capital needed to sustain and improve major iron ore operations in the Pilbara.

Greater network flexibility, more efficient maintenance cycles and increased use of automation will cost the business \$200 million in 2018, according to figures revealed by the company at a recent investor briefing.

Rio reported consistent constraints on its rail operations in 2017, with capacity on that part of

its supply chain between 330 and 340 million tonnes per annum, south of the 360mtpa target for the whole network.

The rail productivity program will go a step further with the introduction of 'sprint capacity', so extra supply can be brought onto the market quickly for short periods when the iron ore price is high.

The most significant part of the program is Autohaul, which will make train trips autonomous.

Other moves include changes to yard and maintenance schedules through the use of big data.

Rio has reported it would spend about \$US1 billion annually on sustaining capital, with the Koodaideri replacement mine to cost \$US2.2 billion.

BHP Billiton and Fortescue Metals Group are also set to make large investments in replacement mines as iron ore reserves deplete at their existing operations.

With BHP's Yandi mine to gradually run out of economic ores by the mid 2020s, the business is expected to make a decision to

proceed with the \$US3.6 billion (\$4.6 billion) South Flank project mid-year.

For Fortescue, the Eliwana project will be next in line, with a final investment decision due at the end of the 2018 financial year.

Those three replacement mines will require a capital investment of nearly \$10 billion between them, representing the lion's share of about \$12.5 billion of mining projects *Business News's* research suggests are likely to get under way by the end of the decade.

That would add to the list of around \$4 billion of investments currently in train.

The state's biggest resources project under construction is Tianqi Lithium's Kwinana processing plant (see page 18).

Five lithium projects under way are worth about \$1.4 billion, while a further five projects valued at more than \$1.3 billion are in the 'likely' category.

One commodity to have strengthened its showing on the list of mining projects is mineral sands, with the approval of two

projects costing \$327 million in the past few months (see page 16).

Those were the Iluka Resources Cataby mine and Image Resources' Boonanarring project, while others are potentially on the horizon.

Gold has continued a recent run of strong appearances on the annual projects list, with seven developments under way worth nearly \$1.2 billion.

That is up slightly on last year, when gold projects tallied up to around \$1 billion.

Two projects have had costs rise, however.

Kin Mining announced a blow-out in costs at the Leonora gold project early in April, raising a further \$11 million to fund a capital investment it had initially expected would come in at \$35 million.

Gold Road Resources suffered an increase in capital costs for the Gruyere project, which *Business News* had reported last year to be \$507 million.

The latest figure was \$585 million, at the upper end of the company's forecast range, after

weather delays and flooding affected construction.

Gruyere was 44 per cent built at the end of March.

Capricorn Metals went the other direction, with costs for the Karlawinda gold project falling \$27 million to \$93 million, it announced last week.

More mixed

Outside of the Pilbara, iron ore has had a mixed year.

The state government blocked Mineral Resources' Jackson 5 and Bulgabin East brownfields project (located near Southern Cross) in December after the Environmental Protection Authority rejected the company's mining proposal.

Sinosteel Midwest's Blue Hills mine in the Mid West got the tick, however.

US-based Cliffs Natural Resources flagged in January that it was likely to end iron ore mining operations at Koolyanobbing, also near Southern Cross, later this year.

Softer prices for lower grade ores had meant the operation was making a loss.

Snapshot 2017 - Mining projects

Company	Project	Value	Commodity	Region	Completion date
COMPLETED IN THE PAST YEAR					
Rio Tinto	Silvergrass	\$441m	Iron Ore	Pilbara	Aug 2017
Dacian Gold	Mt Morgans	\$200m	Gold	Goldfields	Mar 2018
Newmont	Tanami expansion	\$120m	Gold	NT	2017
Western Areas	Cosmic boy mill recovery	\$18m	Nickel	Goldfields	Mar 2018
Eastern Goldfields	Davyhurst plant refurbishment	\$17m	Gold	Goldfields	2017
Tawana Resources	Bald Hill plant conversion	\$13m	Lithium concentrate, tantalum	Goldfields	Apr 2018
Northern Star	Millennium underground	ND	Gold	Goldfields	Sep 2017
UNDER WAY					
Tianqi Lithium	Kwinana lithium plant	\$700m	Lithium Hydroxide	Perth	Late 2018
Gold Road	Gruyere	\$585m	Gold	Goldfields	Q1 2019
Rio Tinto	Yandi-oxbow- life extension	\$367m	Iron Ore	Pilbara	ND
Talison Lithium	Greenbushes expansion	\$320m	Lithium concentrate	South West	2021
Newmont	Tanami power project	\$275m	Gold	NT	2019
Illuka Resources	Cataby	\$275m	Mineral sands	Mid West	Q2 2019
Mineral Resources	Wodgina processing plant	\$220m***	Lithium concentrate	Pilbara	2020
Rio Tinto	Pilbara rail productivity works	\$200m	Iron Ore	Pilbara	2018
Pilbara Minerals	Pilgangoora	\$184m	Lithium concentrate, tantalum	Pilbara	Jun 2018
Altura Minerals	Pilgangoora	\$140m	Lithium concentrate	Pilbara	Q2 2018
St Barabara	Gwalia extension	\$100m	Gold	Goldfields	2020
Mt Gibson Iron	Koolan Island	\$97m	Iron Ore	Pilbara	2019
Newcrest	Telfer	\$93m	Gold	Pilbara	-
Sandfire Resources	Monty	\$90m	Copper	Pilbara	End 2019
Gascoyne Resources	Dalgaranga	\$86m	Gold	Mid West	May 2018
Northern Minerals	Browns Range pilot plant	\$56m	Rare earths	Kimberley	June 2018
BHP Nickel West	Kwinana nickel sulphate plant	\$54m	Nickel sulphate	Perth	April 2019
Image Resources	Boonanning	\$52m	Mineral sands	Mid West	Q4 2018
Kin Mining	Leonora	\$45m**	Gold	Goldfields	Q4 2018
Primary Gold	Coolgardie	-	Gold	Goldfields	2018
Rio Tinto	Western Turner Syncline 2	-	Iron Ore	Pilbara	Dec 2018
LIKELY					
BHP Billiton	South Flank	\$4.6bn	Iron ore	Pilbara	2020s
Rio Tinto	Koodaideri	\$2.9bn	Iron ore	Pilbara	2021
Fortescue Metals Group	Eliwana	\$2bn	Iron ore	Pilbara	-
Albermarle	Kemerton lithium plant	\$560m	Lithium hydroxide	South West	2020
Talison Lithium	Greenbushes phase	\$500m	Lithium concentrate	South West	TBD
K+S Group	Ashburton salt	\$350m	Salt	Pilbara	2022
Sheffield Resources	Thunderbird	\$348m	Mineral sands	Kimberley	2019
Western Areas	Cosmos - Odysseus	\$210m	Nickel	Goldfields	2020+
Pilbara Minerals	Pilgangoora stage 2	\$207m	Lithium concentrate, tantalum	Pilbara	Q4 2019
Altura Mining	Pilgangoora stage 2	\$118m	Lithium concentrate	Pilbara	Late 2019
Kidman Resources/SQM	Mt Holland/Earl Grey	\$111m	Lithium concentrate	Goldfields	Mid 2019
Capricorn Metals	Karlawinda	\$93m	Gold	Pilbara	2019
Sinosteel Midwest	Blue Hills	ND	Iron Ore	Mid West	-
POSSIBLE					
BBI Group, Flinders Mines	Balla Balla	\$6bn	Iron ore- mine, rail, port	Pilbara	-
Perdaman	Burrup fertiliser	\$4bn	Fertiliser	Pilbara	-
Coogee Chemicals	Burrup chemicals	\$1.3bn	ND	Pilbara	-
TNG	Mount Peake	\$853m	Vanadium-titanium	NT	-
Fortescue Metals Group	Iron Bridge	\$800m+	Magnetite	Pilbara	-
Altech Chemicals	Meckering	US\$298m^^	High purity alumina/kaolin	Wheatbelt	-
Tronox	Cooljarloo West	\$220m^	mineral sands	Mid West	-
Tronox	Dongara	\$220m^	mineral sands	Mid West	-
Kallium Lakes	Beyondie	\$220m	Potash	Pilbara	2020
Diatreme Resources	Cyclone	\$161m	Zircon	Goldfields	2019
Primary Gold	Mt Bundy	\$155m	Gold	NT	-
St Barabara	Gwalia Mass Extraction	\$100m	Gold	Goldfields	2020
Tellus Holdings	Sandy Ridge	\$96m	Kaolin & storage	Goldfields	-
Gascoyne Resources	Glenburgh	\$75m	Gold	Gascoyne	2020
Atlas Iron	Corunna Downs	\$53m	Iron ore	Pilbara	Mar-2018
Mineral Resources	McIntosh flake graphite	n/a	Graphite	Kimberley	-
Mineral Resources	Lithium carbonate refinery	-	Lithium carbonate	Pilbara	-
Mineral Resources	Bulk Ore Shuttle System	-	Rail, port	Pilbara	-
BHP Nickel West	Kwinana nickel sulphate plant - phase 2	-	Nickel sulphate	Perth	-
Kidman Resources/SQM	Lithium refinery	-	Lithium carbonate or hydroxide	TBD	-
Metalicity	Admiral Bay	-	Zinc	Kimberley	-
Newmont	Tanami expansion 2	-	Gold	NT	-
Salt Lake Potash	Lake Way	-	Potash	Goldfields	2019
Explurum	Tampia	-	Gold	Goldfields	-
STOPPED					
Mineral Resources	J5, Bungalbin	-	Iron Ore	Yilgarn	-

Shift in sands drives project optimism

Eight mineral sands projects are either under construction or consideration as the sector finally enjoys some pricing relief.

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STRONGER pricing for mineral sands due to a reduced supply from depleted, older mines has created a window of opportunity for up to eight projects in Western Australia worth around \$1 billion.

Prices for zircon, for example, have risen about 40 per cent in the past two years, according to Iluka Resources, giving a major boost to a sector that had been languishing, in WA at least, for half a decade.

The price for another sand product, rutile, used in manufacture of titanium dioxide for pigments, has risen about 8 per cent during that period.

Two projects have got under way in recent months, led by Iluka and Image Resources respectively.

Iluka, which is the world's biggest zircon producer, gave the green light to the Cataby project in the Perth Basin at the end of 2017.

The \$275 million investment will support production of about 200,000 tonnes annually of synthetic rutile and 50,000t of zircon for 8.5 years.

Production is expected to start in the first half of 2019.

Managing director Tom Leary told shareholders at Iluka's recent annual general meeting that zircon markets looked strong.

"The company is of the view that there is a structural deficit in zircon supply when compared with genuine demand, and that this deficit will likely widen as demand grows and grades drop at various mines across the industry, resulting in less production," Mr Leary said.

More broadly, commodity cycles have hit mineral sands players hard.

Only two years ago, Iluka put its Jacinth-Ambrosia mine in South Australia under care and maintenance to draw down existing

inventory because demand was so low.

Mr Leary said the industry needed to reflect on what had happened in the past decade, after prices rose rapidly in 2011 and 2012 – to the extent that 200,000 tonnes of demand was permanently knocked out of the market.

When prices fell, the problem was the opposite.

"Few in the industry were making even a cash margin, let alone a profit," Mr Leary said.

In March, West Perth-based Image got construction under way at the \$52 million Boonanarring project, with first production due by the end of 2018.

Image also has the potential Atlas project, located in reasonably close proximity to Boonanarring, with production there forecast for start in 2023.

At least one other project is likely (see list, page 15), with Sheffield Resources having hit some major milestones for the Thunderbird heavy mineral sands development on the Dampier peninsula.

Offtake agreements have been secured for about 60 per cent of the \$348 million project's production, while a native title hearing is scheduled for mid May and finalisation of a debt facility is well advanced.

GR Engineering was appointed preferred engineering, procurement and construction contractor.

US company Tronox has two potential projects on the horizon, at West Cooljarloo and Dongara, worth a combined \$220 million.

Tronox has operated the existing Cooljarloo mine, inland from Cervantes, since 1989.

That mine has low-grade ore, offset by economies of scale, low-cost dredging and good processing characteristics of the sands, according to Tronox.

Nearly three decades of activity has produced 18 million tonnes of

mineral concentrate, while remaining heavy mineral reserves are about 5.8mt.

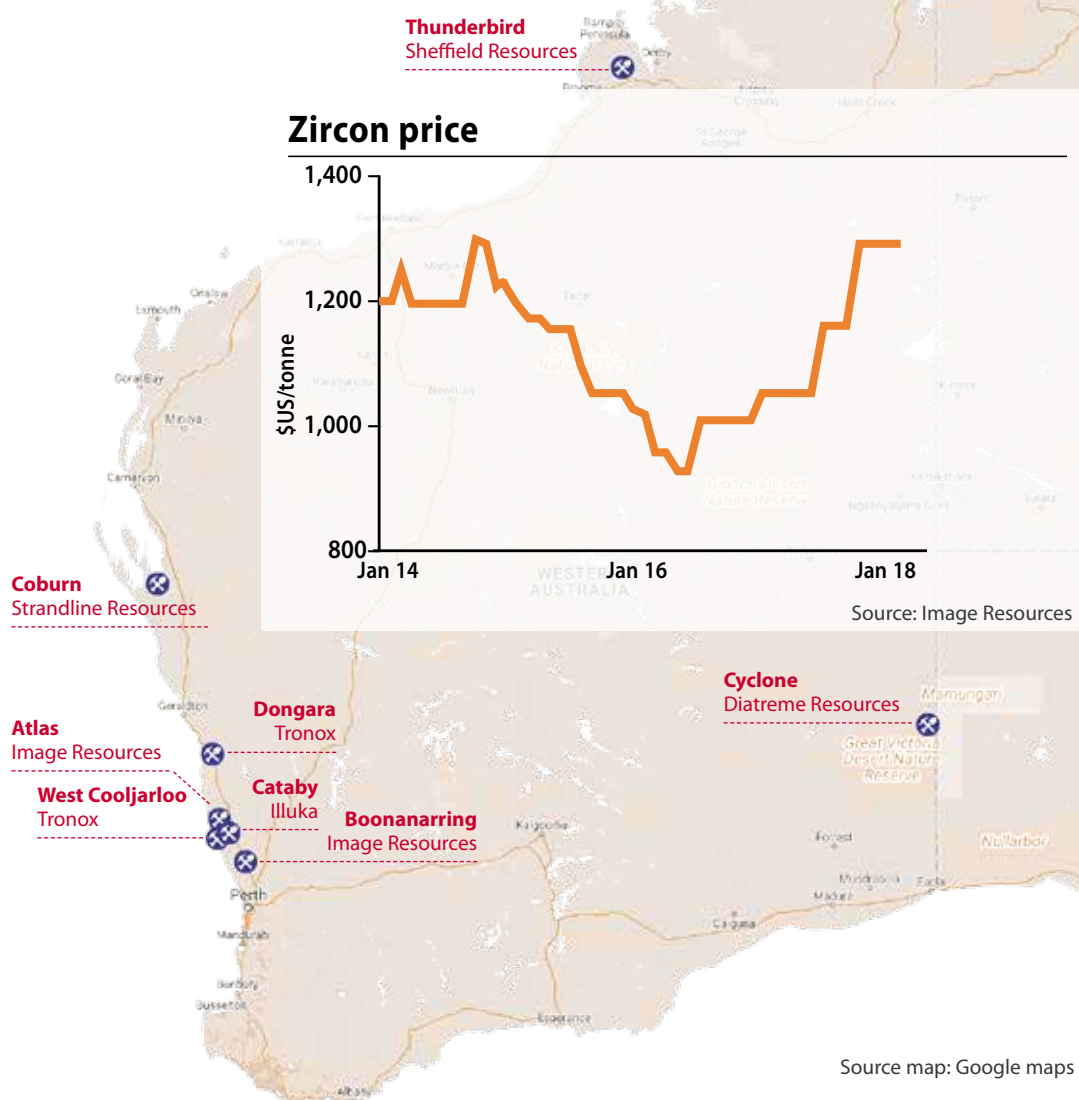
Just over 5mt of reserves are available at West Cooljarloo and Dongara together, with Tronox calculating it would have enough feedstock between the three mines to last at least 20 years.

Demonstrating the poor climate for mineral sands projects in recent years, West Cooljarloo was actually given environmental approval in 2013, yet little progress was made for some time.

The state government announced last October that it had agreed to vary the state agreement with Tronox to facilitate the two projects, although *Business News* understands both are still on hold.

Strandline Resources is working to develop the Coburn heavy mineral sands project in parallel with a project in Tanzania, with

Possible projects - Mineral sands



“Few in the industry were making even a cash margin, let alone a profit – Tom Leary

managing director Luke Graham telling *Business News* his optimistic target was to have a decision made in early 2019.

Mr Graham said he was positive that prices would keep improving in the coming financial year, with mine depletion prompting the market to seek new supply options. “There were some quite big (price) uplifts through 2017 and they have continued,” he said.

“There’s a supply gap forecast for 2018 ... and that’s coming through.” Mr Graham said the big producers were reporting stronger sales prices.

“It’s a really good time to be a producer in mineral sands,” he said.

“Everyone is looking for the next capital projects that are going to be developed to fill the supply gap.”

The Coburn asset is one that had got close to entering production under previous owner Gunson Resources, Mr Graham said, although that business hit a wall when funding partner, South Korean business Posco, pulled out.

Market dynamics had changed for the better in the six years since, he said.

“Coburn creates a good zircon product, and it creates a chlo-ride-grade ilmenite and rutile,” Mr Graham said.

“It’s a really good time to be a producer in mineral sands

– Luke Graham

“Coburn’s products are in really high demand in China and (elsewhere in) Asia.”

China was moving away from sulphate ilmenites and towards chloride products for environmental reasons, he said.

Resources consultancy TZMI noted that trend in a January 2018 industry update, arguing that pricing momentum was building for high-grade chloride feedstocks, while demand had declined for sulfate-grade feedstocks in 2017.

Mr Graham said Strandline’s focus this year would be on optimisation work, including using improved technology in flow-sheets to reduce cost.

A recent forecast for capital spending on Coburn was \$180 million, although Mr Graham said he was confident that could be reduced.

Brisbane-based Diatreme Resources is working on the Cyclone zircon project, located near the South Australian border.

Chief executive Neil McIntyre told *Business News* that China ENFI Engineering was working on a definitive feasibility study for Cyclone, due in around July.



\$554m
WA MINERAL SANDS SALES
IN FY17 Source: DMIRS

DEPTH: Drilling at the Diatreme Resources Cyclone project.

Finding offtake partners and financing was happening concurrently, Mr McIntyre said, with a construction start targeted for early 2019.

Capital costs have previously been estimated at \$160 million, although he said he was confident that would be reduced.

“We’ve got a pretty small balance sheet so we’re looking to attract partners during this process as well,” Mr McIntyre said.

“We’ve met with a number

of potential parties looking at supporting us ... there are some very large companies showing interest.

“Sometimes you can get your timing right, in terms of trying to develop a project, if the wind is in your sails, so to speak.

“Mineral sands is enjoying that period, it’s been overdue for a while, but we’re seeing sustained commodity price increases.”

A research note by Blue Ocean Equities last year said zircon

supply would be expected to drop roughly 350,000tpa, or 30 per cent, by 2025 without new sources.

That would be driven by mine closures in North Stradbroke (Queensland, closing 2019), Mat-araca (Brazil), Murray Basin (Victoria), Eneabba, Capel (WA) and Old Hickory (Virginia).

Grades would decline at Kwale

(Kenya) and Namakwa (South Africa), among other locations.

One challenge would be in South Africa, which is the second biggest zircon producer after Australia (50 per cent market share).

The country recently raised taxes and increased restrictions on mine ownership based on race, Blue Ocean said.

BNiQ SEARCH Iluka Resources



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BATTERY BOOM

has a way to run

Few projects are more meaningful for WA's economic direction than the Greenbushes lithium mine expansion and the new lithium refinery in Kwinana.

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THE first step in Western Australia's bid to move further along the lithium supply chain should be in production by the end of this year, while at least three other proponents are considering similar facilities.

Work on train one at **Tianqi Lithium's** Kwinana processing plant is about 65 per cent complete, according to contractor MSP Engineering chief executive Peter McSweeney, with commissioning of non-processing infrastructure under way.

The West Perth-based company is also building a further processing train in a stage-two development, with the whole project worth more than \$700 million.

Combined, the two trains will have a capacity of 48,000 tonnes per annum of lithium hydroxide, used as an input in battery making.

Mr McSweeney told *Business News* the second phase of the project, which received the green light in October, was about 10 per cent complete.

That part of the project is expected to go into commissioning in the September quarter of next year.

The two trains will be supplied with spodumene concentrate (lithium ore beneficiated to 6 per cent purity) trucked up from the Greenbushes mine in the South West owned by **Talison Lithium**, which is 51 per cent controlled by Tianqi.

To provide the increased output required, the Greenbushes mine is undergoing a \$320 million expansion, which was approved in March 2017.

Production capacity is being roughly doubled to 1.3mtpa of concentrate.

MSP Engineering has been contracted to work on that project, building on a relationship developed over many years.

"We've been working exclusively with Talison for the past 20 years in terms of doing their major lithium works at Greenbushes ... we've done all the major expansions at Greenbushes," Mr McSweeney said.

The association predates even that.

"I went down there as a young engineer working on the mine doing maintenance work," he said, while his father had been mine manager at the project in the 1960s.

Mr McSweeney said commissioning at Greenbushes was scheduled to get under way in the first half of 2019.

After that, a further capacity increase is being considered by Talison, with a feasibility study due by year's end.

“We picked the construction cycle really well ... it's a very competitive environment” - Peter McSweeney

Business News understands an additional expansion would be worth around \$500 million, and would nearly redouble production at the mine.

At Kwinana, there is space for at least one more processing train, and there has been industry speculation that Tianqi might move to include a third leg of the project.

Mr McSweeney said MSP had been working with Tianqi for nearly four years, analysing stage one of the plant.

It had originally been considered for development in China.

There were good reasons to choose Kwinana, however.

Cheap gas was available in WA, and the project had been timed to be at a low point in the labour costs cycle, Mr McSweeney said.

In addition, shipping costs for highly concentrated lithium hy-

droxide were much lower than for spodumene concentrate.

Kwinana was also a good location to make use of local industry, Mr McSweeney said.

"We've written about \$600 million in contracts for local suppliers," he said.

"We picked the construction cycle really well ... it's a very competitive environment.

"We can manage our quality a lot better here, we can manage our timelines.

"All the fabrication and construction activity is happening by suppliers in a 20-kilometre radius, which makes delivering the project less challenging."

Contractors at Kwinana include RCR Tomlinson, Kerman Contracting, Civmec, Georgiou Group, EC&M and AusGroup.

Mr McSweeney said suppliers from Kemerton and the South West were also used at Greenbushes.

He cautioned that businesses seeking to build lithium processing plants would need to find experience in the sector, as the projects were highly complex.

Charging up

Three other businesses are hopeful of getting lithium processing projects up.

US-based **Albemarle**, which owns 49 per cent of Talison Lithium, is planning to spend \$US425 million on a processing plant in Kemerton, although a final investment decision has not been made.

Speaking to analysts in February, chief executive Luke Kissam said he was confident of demand for the company's next wave of lithium processing proj-

ects, which included Kemerton.

"The first phase of the (Kemerton) greenfields site will initially have 40,000tpa of conversion capacity, but we will build an infrastructure that is scalable for significant expansion," he said.

"The permits we've applied for at Kemerton are for 100,000tpa capacity ... but we're going to bring it in in (increments of 20,000tpa)."

Chilean business **SQM** is working with Melbourne-based **Kidman Resources** to build a lithium refinery using production from the Mount Holland mine, located near Southern Cross.

A location for the refinery is to be announced in the June quarter, with Kwinana, Bunbury and Kalgoorlie all possibilities.

Mineral Resources is building three lithium concentration plants at the Wodgina project, with the last to be finished in 2020.

MinRes is working on a feasibility study for a lithium carbonate processing plant in the Pilbara, with construction touted as early as next year.

Miners moving

Pilbara Minerals chief executive Ken Brinsden said the West Perth-based business expected to be shipping concentrates from its Pilgangoora lithium project by late June.

"We've been able to progress construction in a very efficient and fast manner; it's gone as well as could be expected," Mr Brinsden told *Business News*.

There's a good chance the project will be followed by a phase two development, which the company has previously estimated would cost about \$207 million.

"We're actively working on (feasibility for) the stage two project, which takes our processing capacity from 2mtpa to 5mtpa," Mr Brinsden said.

DEVELOPMENT: Peter McSweeney

"In its own right, that's a significant expansion, but our expectation is that's exactly what's going to happen.

"We'll continue to grow the mine because we have a massive resource, massive reserves, and the customers are demanding more product, so we're happy to be a part of that."

Pilbara has offtakes secured for all of the stage two sales, with an expanded operation to produce about 564,000tpa of concentrate annually.

A downstream plant with South Korean outfit Posco is one possible future development option.

Mr Brinsden said he felt the industry was overestimating





energy says using local contractors provides major benefits for the project. **Photo: Attila Cszaszar**

the potential for new supply from producers who extracted lithium from brines (mostly in South America) and underestimating the level of hard rock lithium (Australia's product) to come onto the market.

"But the really important thing is everybody is grossly underestimating the speed of the demand response, especially from China," he said.

During the early part of the iron ore boom, the market had similarly underestimated how much and how quickly Chinese blast furnace capacity would be built out, Mr Brinsden said, and the lithium market was likely to follow a similar path.

2 PROCESSING TRAINS UNDER CONSTRUCTION AT KWINANA

Altura Mining managing director James Brown was another to be optimistic about the potential for the sector.

"Up in China, and talking to our partners, there's new supply coming along but history tells us that hasn't appeared on the market the way you'd think," Mr Brown said.

"And all of us have a home for our material to go to.

"Looking at prices, everyone thought they'd pull back a year

or two ago ... we were quite buoyed to see (MinRes) releasing strong prices for 6 per cent (spodumene concentrate).

"I can't see any (major fall) in the next, at least year and a half.

"A lot of it depends on conversion capacity, and what the market doesn't realise is the speed and the agility that China can adapt to put that capacity in."

He said work at Altura's Pilgangoora project was progressing well, with wet commissioning due in May.

The company recently finished a feasibility study to double capacity to 440,000tpa at a cost of \$114 million.

Nameplate capacity would be reached by 2020, according to an ASX release by the company.

The battery boom isn't just driving lithium projects, however.

BHP Nickel West is investing about \$54 million into 100,000tpa nickel sulphate plant at its Kwinana refinery, due for completion next year. An expansion to double that capacity is under consideration

Australian Vanadium is working towards the Gabanintha vanadium project, with that metal used in a particular type of battery.

Another battery metal, cobalt, has provided a boost for uranium mining hopeful **Vimpy Resources**.

The business's Mulga Rock project will be able to produce cobalt, which has tight supply globally, and other base metals, according to chief executive Mike Young.

Cobalt production of about 2,500tpa would contribute credits to reduce the project's uranium production costs about \$US4 a pound.

That would reduce all in sustaining cost to about \$25 a pound, competitive with around half the world's uranium production, he said.

Mr Young said Vimpy would be working to secure offtake partners, while front end engineering was due later this year or early next year.

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BNiQ SEARCH Mining projects



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