

PYX Resources[#]

BBG Ticker: PYX AU

Price: A\$1.13/sh.

Mkt Cap: A\$471.6m

BUY

A Force for Growth

Expanding High Grade Production Capacity

Since listing in 2020, PYX Resources has increased production 32% YoY to 6.6kt, increased production capacity 200% to 18ktpa and secured three offtake agreements totalling 13.5ktpa for the next two years. We therefore believe that full production capacity can be utilised in 2021F, generating positive EBITDA which will enable further growth to reach the company's mid-term output target of 72ktpa zircon. However, given contained zircon resources of 10.5mnt thanks to the recent Tisma acquisition; this implies a mine life of 146 years. We believe that with strong FCF generation the company will be able to further increase production capitalising on strong zircon market fundamentals and rising prices.

Cost Cutting and Margin Expansion Programme

Currently, PYX processes Heavy Mineral Sands from the high grade Mandiri deposit (7.43%), mined by contract miners to produce an export grade 66% zircon concentrate. The assemblage weighting to zircon is 64%, making Mandiri the highest grade zircon deposit globally amongst listed peers. With this combination of high grades and the weighting to high value zircon, this gives PYX a leading in-situ mineral value assemblage of US\$1,139/t, double its closest peer. We believe that investment of less than US\$10m will enable a transition to in-house mining along with capacity expansion that will enable PYX to cut costs and generate sector leading margins of 60%+ and annual EBITDA of more than US\$65m by 2025F. This is possible due to the high weighting of the assemblage to zircon unlike PYX's peers who in volume terms focus on lower value ilmenite.

Strengthening Zircon Fundamentals and Prices

Between 2015 and 2019, zircon output declined 8% tightening the zircon market. This meant that China's rapid recovery, which wrongfooted major mineral sands producers who cut output dramatically in 2020, caused an unprecedented destocking event in the global zircon market which was already tight going into the start of the year. As end users look to rebuild inventory and satisfy recovering demand, we expect a strong zircon price response. This trend was confirmed by PYX's recent wholesale US\$75/t price increase and string of new offtake agreements.

Target Price and Recommendation

Our risked DCF valuation produces an A\$2.60/sh. target price based on a WACC of 11% and LT zircon prices of US\$1,500/t underpinned by a strong outlook for production growth as well as a transition to high margin in-house mining. **We initiate coverage with a Buy recommendation and target price of A\$2.60/sh.**

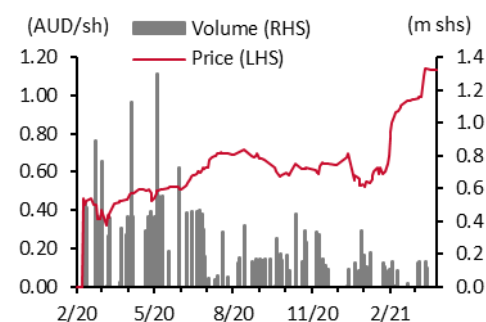
[#]VSA Capital acts as Corporate Broker to Pyx Resources.

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Company Description

Zircon Production in Kalimantan, Indonesia.

One Year Price Performance



Price % chg	1mn	3mn	12mn
	15.3%	62.6%	169.0%
12mn high/low	A\$1.14/0.32		

SOURCE: Eikon, as of 19 April 2021 close.

Market:	ASX
Shares in issue	263.56m
Target Price (p/sh).	2.60
Free float:	31%
Net cash (Dec 2020):	A\$3.4m
Enterprise value:	A\$468.2m

Major shareholders

Phoenix Fund Solutions Ltd	22.3%
Takmur SPC Ltd	20.3%
Tisma (HK) Ltd	12.4%
TGN Holdings (HK) Ltd	12.4%

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Investment Case

PYX Resources is rapidly establishing its position as a new contender in the mineral sands space and in particular the zircon market. Indonesia has historically been the swing producer in the zircon market with informal miners only tending to mobilise at times of high prices, however, after having identified and secured two of the world's largest and highest grade zircon deposits, PYX's aim is to formalise and commercialise its significant zircon endowment and realise its potential.

Historically, Indonesian producers, which are rarely commercial operators, have struggled to produce higher quality mineral sands products, typically only as high as 55% zircon content; narrowing margins further and cementing swing producer status. PYX is able to produce a substantially higher quality product at 65.5% zircon, setting itself at a significant advantage to its peer group and overcoming the laws which prevent the export of such low quality unprocessed product. PYX is therefore seeking to capitalise on current market dislocation caused by COVID-19 and strained Sino-Australian relations to establish a new low-cost competitor with the consolidation and formalisation of the mining process to cut costs and enable globally significant mineral sands deposits to be optimally exploited.

Location of Operations



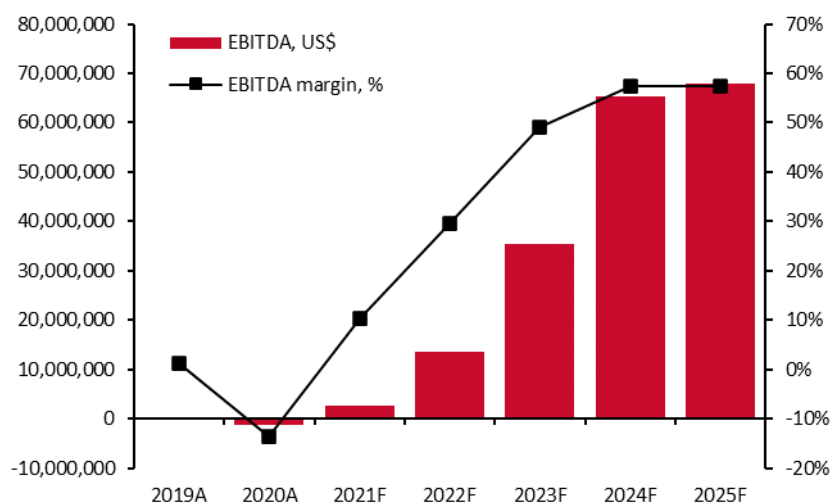
SOURCE: Company data, VSA Capital Research

Since listing in 2020, PYX Resources has increased production 32% YoY to 6.6kt, increased production capacity 200% to 18ktpa and secured three offtake agreements totalling 13.5ktpa for the next two years. This in a rising price environment will lead to stronger near-term earnings potential, enabling PYX to invest in growth to increase production capacity to 24ktpa by the end of 2021F with a further 24ktpa increase in capacity by the end of 2025F. This initial increment is achievable for less than US\$10m in capex largely for processing and mining equipment which will enable the company to move from its current reliance on third party contract mining, cutting costs from over US\$1,000/t to around US\$420/t.

The transformation of group margins will deliver strong earnings' growth, in our view with forecast EBITDA of US\$2.7m in 2021F rising to US\$68m in 2025F. Cash generated will be invested in further expansion of the company's Mandiri operations where production began in 2015, as well as the recently acquired greenfield Tisma deposit. Tisma will require modestly higher capex due to the need to build a plant rather than just additional equipment. However, Mandiri provides indicative estimates for much of the costs, and pre-production costs for Tisma are projected at US\$15m, with the main cost items being US\$3.5m for the mining equipment and US\$3.5m for separation plant and equipment to give 24ktpa

capacity which we expect to be operational in 2023F. Further expansions of the same increment are likely to be around US\$10m per increment at both projects. We expect this growth outlook to drive further share price appreciation.

EBITDA Growth Chart

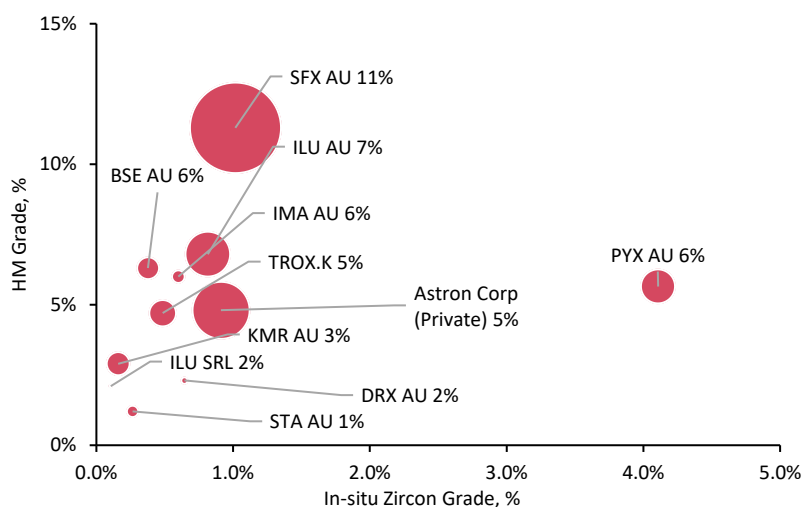


SOURCE: Company data, VSA Capital Research.

High Grade Mineral Sands Deposits with Globally Significant Zircon

Mandiri (126mnt at 7.43% HM) and Tisma (137.2mnt at 3.99% HM) are amongst the highest grade and largest volume zircon deposits globally. Only Iluka and Tronox, Image Resources, Sheffield Resources and recently delisted Astron Corporation have a larger zircon resource in terms of contained zircon volumes. These are however, often combined across multiple projects with multiple deposits within each, furthermore, PYX resources are limited only by the licence boundaries in each case. PYX has the highest grade zircon deposit globally and is in the top five for heavy mineral grades. In terms of contained zircon, it is the fourth largest, but the second largest in production after Iluka, with Sheffield Resources at BFS stage and Astron taken private with just a 4.5yr productive mine life left.

Highest Grade Zircon Resources



SOURCE: Company data, VSA Capital Research. Bubble represents deposit size.

Most heavy mineral sands deposits are heavily dependent based on the economics for producing ilmenite for titanium feedstock. The exception to this is the Sierra Rutile asset, previously listed in London but acquired in 2016 by Iluka. On a company-wide basis, PYX has a heavy mineral grade of 5.7% (although Mandiri has an HM grade of 7.43%) only Iluka

6.8% and Sheffield 11.3% are higher. We see this as significant as it means that these assets are not simply heavily weighted to zircon, but high grade in their own right. Grade is of course crucial to economics across the mining industry and higher grades reduce unit costs as less energy is expended on moving and processing waste material.

Ilmenite is the lowest value of the suite of products typically produced by mineral sands miners, with a current price of around US\$200/t. Zircon and rutile as by-products are often crucial to supporting margins. Sierra Rutile took a different approach; lower overall grades of c2% HM but a stronger weighting 52% to high value rutile (cUS\$1,200/t spot price). PYX's deposits combine the best of both approaches with a combined HM grade of 5.65% and weighting of c70% to zircon which is the highest value mineral of the typical HM suite of products with a spot price of around US\$1,470/t according to Iluka's benchmark. Iluka has built its industry leading position in part due to owning three assets with high zircon/TiO₂ assets notably Jacinth Ambrosia in Australia. We believe that PYX high zircon grades are a foundational block in the PYX's ability to achieve its growth ambitions.

PYX Resources, JORC 2012 as of December 2020

Deposit Specs	Mandiri Deposit	Tisma Deposit	PYX's Mandira & Tisma Deposit Combined
Mineral Resources	126.3 Mt	137.2 Mt	263.5 Mt
HM Grade	7.43%	3.99%	5.65%
HM Tonnage	9.4 Mt	5.5 Mt	14.9 Mt
Contained Zircon	6.0 Mt	4.5 Mt	10.5 Mt
Assemblage	ZIR: 64% RUT: 8.5% ILM: 9.5%	ZIR: 82% RUT: 2% ILM: 8.5%	ZIR: 70% RUT: 6% ILM: 9.1%

SOURCE: Company data, VSA Capital Research.

Kalimantan Placer Mineral Sands Deposits

Indonesia's Kalimantan is well known for its abundance of industrial minerals including kaolin, clay, quartz and zircon, however, commercial exploitation of these deposits has been limited and official records are lacking. Indonesia has been a swing producer in the mineral sands industry and in particular the zircon industry. Often miners have shifted their focus from exploiting placer deposits for gold to zircon when prices have been high such as ahead of the GFC when production increased from 10ktpa in 2005 to 250kt in 2007. The GFC caused production to fall to 6kt in 2010 but high prices encouraged a resurgence to over 120kt in 2011. However, as prices pulled back Indonesia miners switched focus back to gold and pulled out of the market and by 2014, Indonesian production had dropped to c50ktpa.

Location of Main Producing Districts in Kalimantan



SOURCE: Company data, VSA Capital Research.

Although primary deposits of industrial minerals have been identified, mineral sands are typically exploited in depositional environments following the erosion of igneous granites; in this case from the Schwaner Mountains. Both Mandiri and Tisma are thought to have been formed through the erosion, transportation and subsequent deposition of granite rocks in these mountains onto the flood plains of the rivers to the East. The region is, however, well known for its zircon deposits which are often associated with alluvial gold and is produced in West and Central Kalimantan.

Global Zircon Production, kt

	Zirconium Ores & Concentrates, Mine Production (kt)					
	2015	2016	2017	2018	2019	2020
United States	81	5	80	70	100	75
Australia	567	550	505	500	470	480
China	140	140	140	150	140	140
Indonesia	40	40	110	100	34	60
Kenya	110	110	44	45	29	25
Mozambique	52	55	74	80	100	125
Senegal	45	50	82	80	65	65
South Africa	380	400	377	350	370	320
Other Countries	105	110	138	125	112	110
Total	1,520	1,460	1,550	1,480	1,420	1,400

SOURCE: Company data, VSA Capital Research.

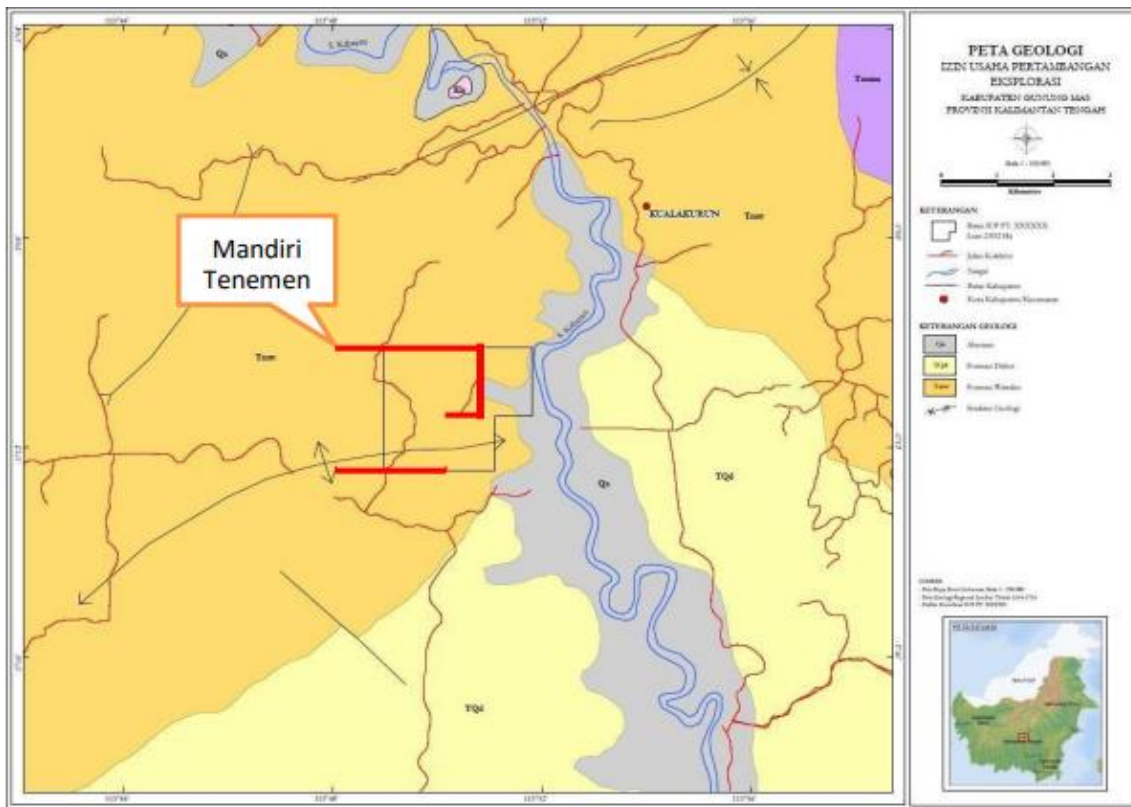
Indonesia is consistently cited as a producer in USGS global zircon production data, however, it is not listed for titanium (ilmenite and rutile) even in periods of high prices such as 2010/2011. “Other Countries” production in 2019 was 74kt out of 7.7mnt. This anecdotal evidence, in place of formal exploration data, indicates that Indonesia has a high prevalence of zircon but not ilmenite and that the primary deposits of Indonesia are significant for the prevalence of zircon in the mineral assemblage compared to ilmenite meaning the high weighting to zircon is typical for the region.

Mandiri

The Mandiri project, the company’s flagship project, is located in Central Kalimantan, Indonesia. The licence area covers 2,032ha and has been in production since 2015. Until 2019, a processing plant of 500tpm (6ktpa) was in operation, however, this has now been expanded 18ktpa and is due to be increased to 24ktpa this year and 48ktpa in the medium term. To date, the processing plant has been filled through the purchase of mineral sands from third party contract miners operating within the licence area. PYZ processes this to a high grade 65.5% zircon concentrate which is suitable for export.

Auger drilling over has established a mineral resource of 126mnt with an average grade of 7.4% of HM sands. Grades within the resource vary between 4% to over 8% meaning that the resource is consistently high grade in a global context and given the average the pockets of lower grades are limited. Exploration was largely guided by artisanal mining which has covered around 60% of the resource area, however, this has only been to shallow depths of 2m, while drilling shows that mineralisation extends to a maximum of 11.5m although mostly to 6m.

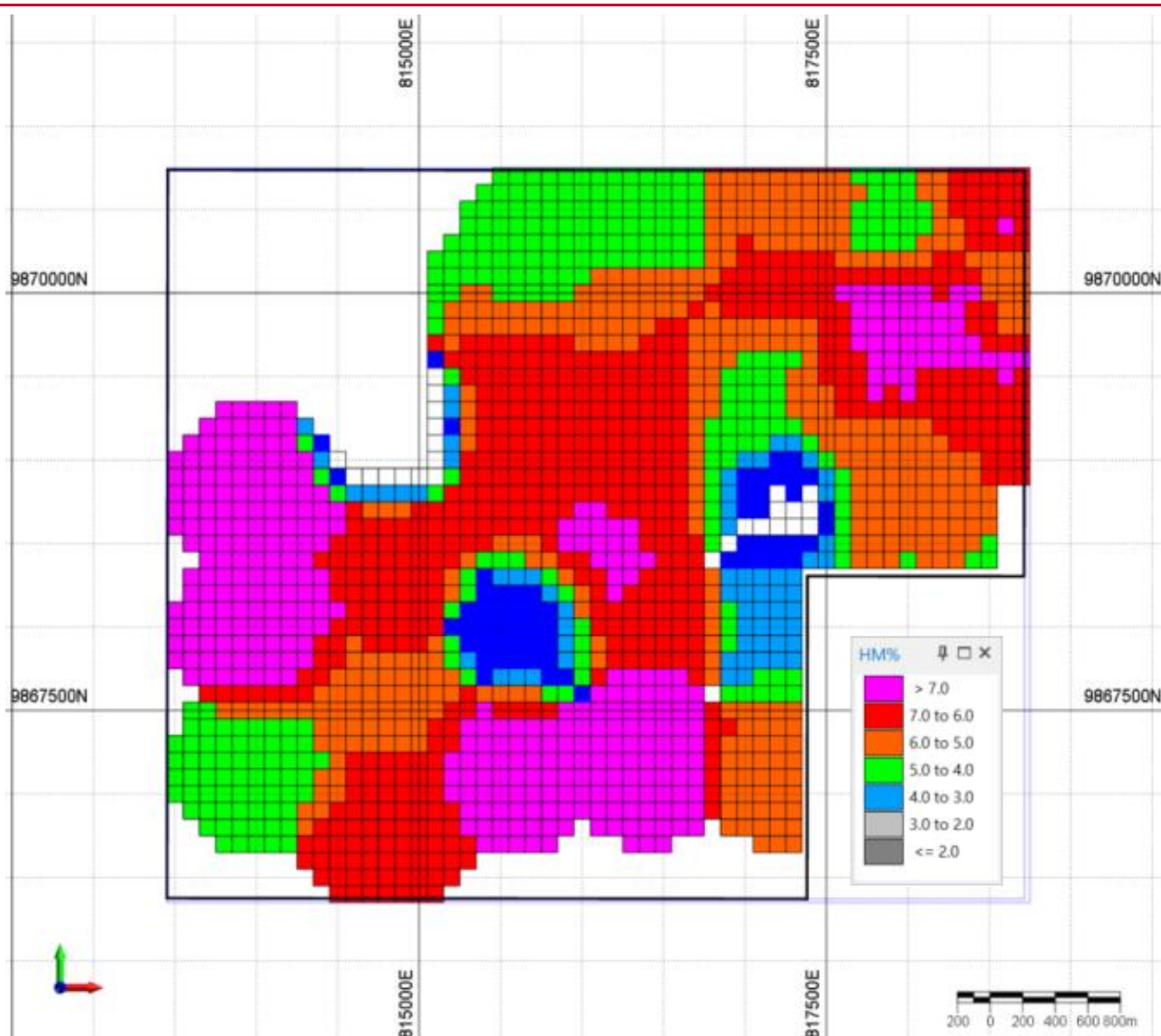
Map Licence Area



SOURCE: Company data, VSA Capital Research.

Drilling in 2019 was carried out to systematically and professionally explore the licence area. Mineral sands are hosted in the form of a placer deposit formed in a flood plain environment of the ancient Kahayan river; the second largest river in Kalimantan. Heavy minerals and gold are thought to have been eroded in the Schwaner Mountains in the Cretaceous, transported along the river and deposited in the floodplain. Deposition during major flood events tends to create more stable distribution of heavy mineral sands than in coastal environments where movement via tide and wind can cause pockets of higher grade zones to build up based on other geological structures present. In a flood, alluvium is deposited more evenly, however, it is possible for high grade zones to form within relict meanders and other river features where deposition is encouraged. Consequently, the ore block model demonstrates a relative high level of consistency in terms of grade typical in excess of 6% HM, albeit with some high grade pockets.

Mandiri Deposit Ore Block Model Output



SOURCE: Company data, VSA Capital Research.

We do note that in the original drilling programme, the water table height meant that auger drilling reduced the quality of samples and in some cases in the Eastern area of the licence, drilling was terminated. However, given the consistency of results across the remainder of the licence, we are confident of a large resource with consistent grades. There is potential to expand the resource using aircore drilling. This would allow for both more rigorous sampling and testing of the bedrock where older depositional structures may be discovered. Bedrock was intercepted at a minimum of 10m depth and the CPR indicates overall upside of 25-30mnt at 4-7% HM grade. At the current run rate of 24ktpa, the mine life is around 250 years.

Tisma

In February 2020, PYX closed the transaction to acquire the rights to the Tisma deposit 110km from Mandiri. Like Mandiri, it has a higher weighting to zircon within the assemblage than is typical globally, whilst the overall deposit has an HM grade comparable to the highest grade deposits in the world despite being lower grade than Mandiri.

Location of Tisma Tenement



SOURCE: Company data, VSA Capital Research.

Tisma is accessed via a tarmac road and access to the tenement is good but limited previous mining activity means that travelling within the licence area is more challenging. The road links to the regional capital Palangkaraya which is roughly 75km away.

Licence Area



SOURCE: Company data, VSA Capital Research.

The geological history is similar to that of Mandiri with Tisma being a placer deposit created by major flood and depositional events associated with the ancient Kahayan river. Eroded material from Schwaner Mountain granites was transported to the floodplain by the river and deposited over time. Generally, the alluvium is between 2m-10m in depth. All the available technical data is based on that collected during 2020 prior to acquisition. 36 holes of up to 11.3-16.5m were drilled by local drillers. These widely spaced holes substantially covered the 1,500ha licence area to define an inferred mineral resource of 137mnt at 3.99% HM grade of which 82% is zircon with a lesser proportion being ilmenite with a minimal presence of zircon. Unlike at Mandiri, the zircon grade was determined by XRF analysis, rather than based on production data. Gold was also identified by XRF.

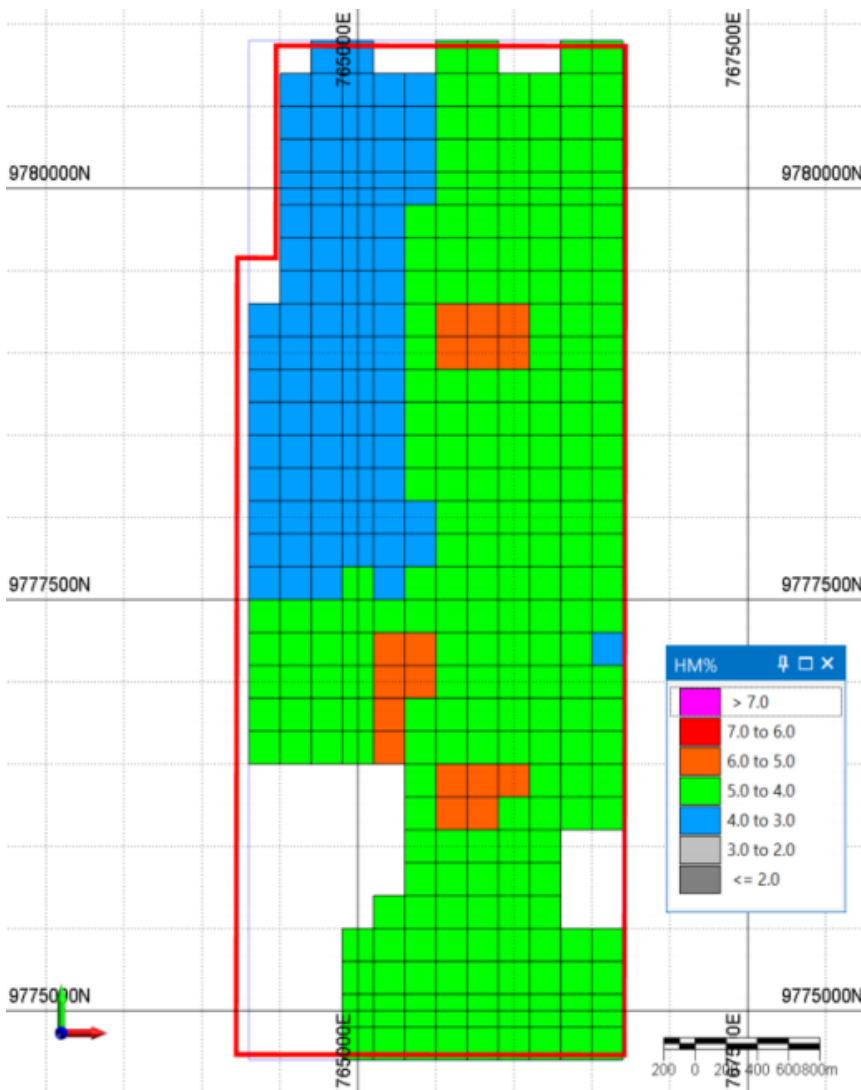
Typical Drilling Setup



SOURCE: Company data, VSA Capital Research.

The resource is a tabular body of alluvium which ranges between 3.5m-8.3m thick and is covered by overburden which varies between 6-10m thick. The majority of the licence is covered by vegetation and much of it is boggy. HM grades ranged from 1.53% to 7.18% with a mean value of 3.80%, however, with two outlying values removed, the range is narrower at 2.4-5.2% which over the 34 remaining holes demonstrates consistency across the licence area and resource in a similar style to Mandiri.

Tisma Deposit Ore Block Model Output



SOURCE: Company data, VSA Capital Research.

The resource CPR recommends that further drilling is carried out to achieve the full results aimed from the original programme to test the full extent of mineralisation below the typical 15m extent of drilling and with tighter spacing. Oversight by more experienced drillers during July – October 2020 was not possible due to COVID-19 travel restrictions; however, a modest amount of time and cost could quickly shore up confidence ahead of project development.

Offtake agreements

Since going public in 2020, PYX has established itself as a capable marketer of its zircon products increasing ad hoc sales YoY and securing three offtakes despite the impact of COVID-19. Mineral sands are not sold on exchange and establishing marketing relationships is a crucial part of realising success in this industry. To date, PYX Resources has demonstrated it has the ability to build a broad and increasingly deep customer base. Traction with these types of deals is about momentum and investors should note the challenging circumstances and COVID-19 context in which PYX secured its initial offtake agreements. Face to face meetings were obviously difficult; a perceived greater risk for new customers.

With tailwinds from a recovery in China and vaccine rollout, we expect the strong demand environment to enable PYX to secure further offtake agreements which will underpin the expansion plans.

- In November 2020, PYX signed a two-year offtake for 6,000t over two years with Qingyuan Jinsheng ZR&TI Resources Co.Ltd. PYX agreed to supply 250 tonnes per month.
- Later the same month, PYX secured an offtake agreement for 4,000tpa for two years of 65.5% zircon product. The offtake was signed with Euronics, a leading distributor of zircon into Taiwan and China.
- In March 2021, PYX announced an offtake agreement for 3,600t of zircon over a two year period, i.e. 1,550tpa with an India-incorporated group Microtech Zircon which is a member of the Delta Tiles group of companies.

Prior to this, PYX had largely sold to customers on an ad hoc basis building a customer base across Indonesia, Taiwan, China, India, France, UK, Germany, Spain and Mexico. In 2020, PYX made significant progress in diversifying its customer base; the share of the top three customers in 2020 was 47.9% of total sales, down from 83.6% in 2019. However, longer term contracts with established customers will give investors’ confidence over the near and medium term outlook for sales volumes. In the current market environment, we expect that PYX will be able to secure further offtake agreements which will establish its position as a significant supplier of zircon.

With over 13kt now secured across these offtake agreements, this will give a firm platform and commitment to increase sales beyond the 6.6kt sold in 2020 despite the disruption of COVID-19, in addition to sales to its existing customer base. We therefore expect PYX to be able to operate at full capacity in 2021. PYX produces a high-quality product averaging 65-68% zircon which is above the 65% benchmark considered suitable for use across all zircon applications; PYX typically produces a 65.5% zircon product although it ranges between 66-68% zircon content. This is in line with typical global benchmarks for high grade zircon products. Many of PYX’s peers produce do produce two product streams including a lower content zircon concentrate, however, given the export requirements PYX is focused on its high quality product.

PYX Resources Product

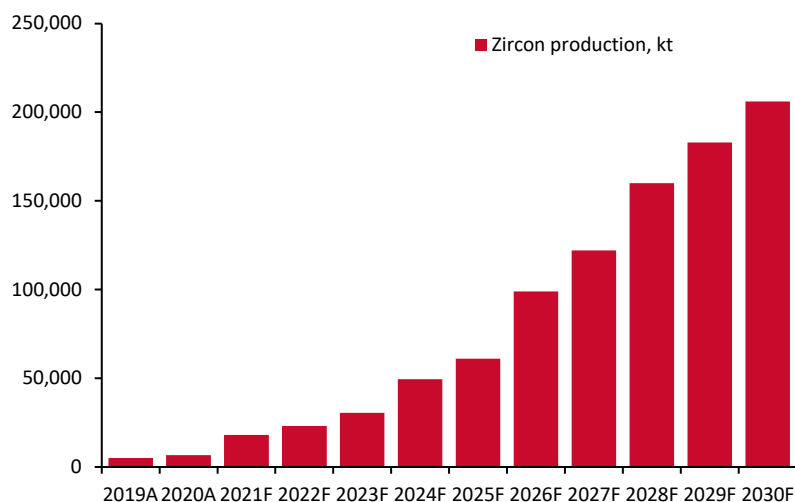


SOURCE: Company data, VSA Capital Research.

Growth Strategy

When PYX acquired Mandiri, plant capacity was 6,000ktpa: through 2020 the capacity was increased to 18ktpa or 1,500tpm zircon production following the installation of additional drying equipment. A near term increase to 24ktpa is planned in 2021F with a further increase to 48ktpa at Mandiri soon after. Following the acquisition of Tisma earlier this year, PYX has the opportunity to grow further still, initially 24ktpa. We therefore believe that 24ktpa capacity will be achieved in 2021F, 48ktpa by the end of 2022F and 72ktpa by the end of 2023F with the latter increase from Tisma. This will provide cashflow for further growth which will enable PYX to fully exploit its mineral resources.

PYX Resources Zircon Output



SOURCE: Company data, VSA Capital Research.

We believe that expanding capacity in this manner is low cost and high impact; at Mandiri the expansion to 48ktpa can be completed within the existing warehouse and plant facility simply through the purchase of low cost equipment. This makes the commissioning and ramp up of additional capacity a fast process. At Mandiri, the mineral separation plant is 23km to the south of the tenement by river. Concentrate will be shipped by barge downriver and separated at the processing plant before being readied for export.

To get to 24ktpa from 18ktpa, PYX needs to acquire additional shaking tables, dryers and magnetic and separation lines. The total cost of this according to management is likely to be around US\$700k; acquiring equipment directly from China. This is comparable to the similar 6ktpa increment achieved during 2020 and therefore we believe that this capex estimate is robust.

To go from 24ktpa to 48ktpa, the same process needs to be repeated on a larger scale. However, with infrastructure and land already in place, the cost of this modular expansion is relatively limited. We estimate that the cost of this expansion of the plant facility will be US\$3.5m.

PYX has benefited greatly from the existing infrastructure for operations at Mandiri, however, Tisma is a greenfield site which will require spending on infrastructure and construction of warehousing etc in addition to the purchase of equipment. Management has guided us towards an additional cUS\$2m for these costs. This ties in closely with a now private group called Matilda Zircon which anticipated US\$5m in startup capex for a similar greenfield project in Indonesia. It also ties in closely with the costings around the incremental ramp up at Mandiri.

Given the scale of the resources combined with our bullish outlook on zircon and the lack of forthcoming supply from elsewhere in the market, we believe that PYX has the potential to grow further still and its large zircon resources mean that the company has an opportunity to gain a meaningful market share. Indeed, PYX has identified and acquired an additional 9.4km² to secure sufficient space for future expansions at Mandiri's Mineral Separation Plant. Consequently, we have projected further growth beyond the near-term group target of 72ktpa zircon. We believe that Mandiri can support 160ktpa by 2030F, while Tisma should be able to support an increase to 48ktpa by 2025F. We expect each incremental 24ktpa of zircon capacity to cost around US\$10m with the major ticket items being US\$3.5m for a Mining Field Unit (MFU) and US\$3.5m for commensurate levels of processing capacity.

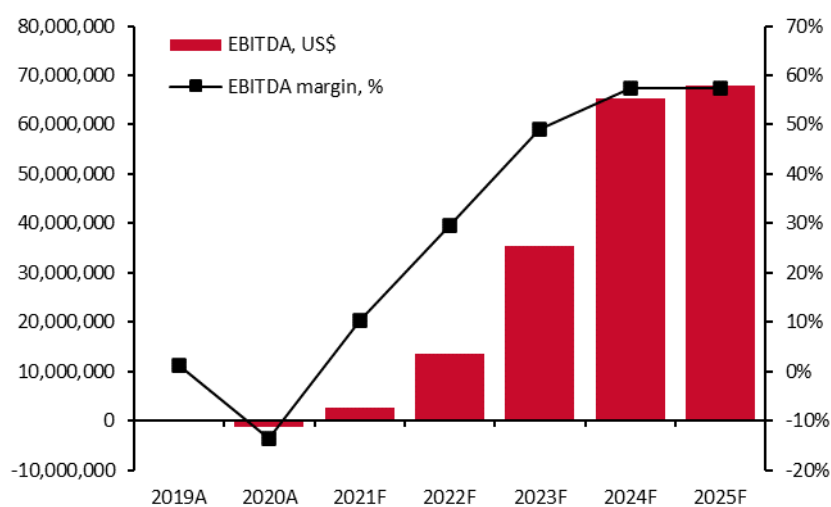
Given the size of PYX's resource base and the grade in relation to its peers, we believe that it is correct that they have an ambitious strategy to expand. The scale and grade of the underlying deposit, in our view, means that we believe that this is an achievable target. It would make PYX the fourth largest zircon producer globally behind Rio Tinto, Iluka and Tronox. Given the low hurdles in terms of capital cost, PYX's expansion will likely be determined by its ability to expand its marketing capabilities and given our outlook for the zircon market and the fact that export rules limit swing

production from being turned on in Indonesia as in previous cycles there is an opportunity for PYX underpinned by market fundamentals.

Strong Margin Potential; Transition to In-House Mining

Aside from growing capacity, PYX has a plan to exploit the fact that it is one of the highest grade zircon projects globally and to cut costs by investing in owner operated mining. Currently, third party contracted miners provide PYX with a heavy mineral concentrate which is processed at the MSP into the 66% zircon product which is exported. As a high grade mineral sands project with existing infrastructure, PYX should be a low cost producer. Using comparable costs from the BFS' of peer projects we believe that A\$25/t or US\$20/t is an appropriate unit cost for gravel mined, which with the Tisma grade and recoveries of 95%, implies costs closer to US\$515/t at Tisma and US\$430/t at Mandiri. The key difference between the two projects is the difference in grade.

PYX Resources EBITDA and margin outlook

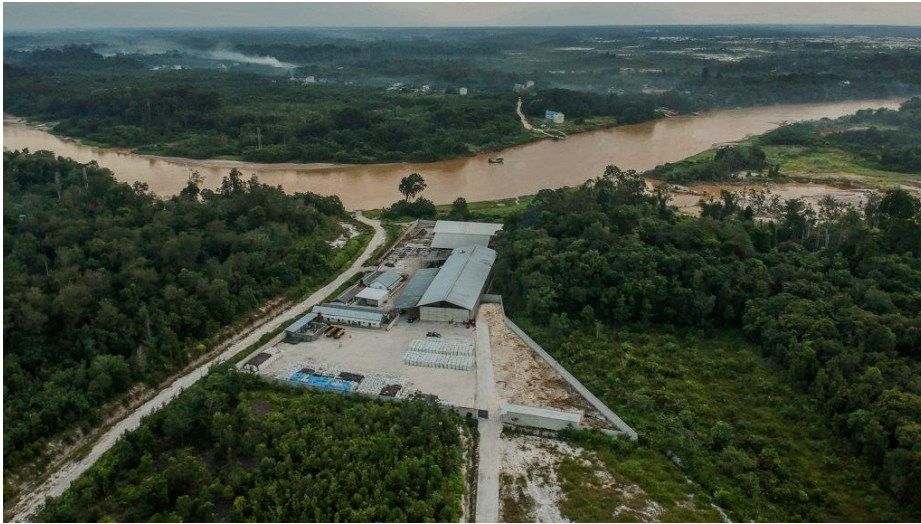


SOURCE: Company data, VSA Capital Research.

To determine projected unit costs, PYX has a five year production history and internal assessments of processing costs as well as an in depth understanding of the cost of mining. Currently, PYX pays third party contract miners operating on the tenement area for the low grade concentrate which is processed at the Mandiri MSP. This price is linked to the price of contained mineral sands and unit costs have been cUS\$1,100/t over the past two years. Clearly, this is not an optimal situation and with the cost of the concentrate linked to the contained value produced by the third party miners, switching to in-house mining at the soonest opportunity to enable PYX to capture the full value uplift we expect from further price increases will be important to PYX realising its valuation potential.

The zircon production process is as follows and for a 24ktpa operation PYX must process around 480kt of mineral bearing sands to achieve this output. The wet processing plant beneficiates zircon and other saleable minerals and rejects non-commercial waste through gravity separation and classification. The existing plant uses a conventional flow sheet which starts with wet concentration using Wilfley gravity separation tables followed by batch dry mineral separation and then separation processing using electrostatic rolls, electrostatic plates and magnetic rolls. This is an established operational part of PYX's business.

The Mandiri Separation Plant



SOURCE: Company data, VSA Capital Research.

The mineral separation plant is 23km south of the Mandiri tenement and can be accessed via barge from the Kahayan River; this easy access is important to the overall potential of the operation, in our view. Final product is then trucked and shipped to the Sampit and Banjarmasin ports which are 360km and 351km away, respectively. Therefore, to reduce the volume that is transported via boat, the company will continue to beneficiate at the mine site. By purchasing mobile Mine Field Units (MFU), PYX intends to bring this aspect of the process in-house and capture the additional margin. The MFU along with scrub, trommel, cyclone desliming, CD tank and spiralling modules enables PYX to produce this low grade concentrate ahead of barging to the mineral separation plant.

Mining Method Schematic Image



SOURCE: Company data, VSA Capital Research.

Trial mining will be used to confirm the mine field unit design at which point the initial pilot solution will enable PYX to rapidly transition to in-house mining, cut costs and generate cash flow to fund further growth.

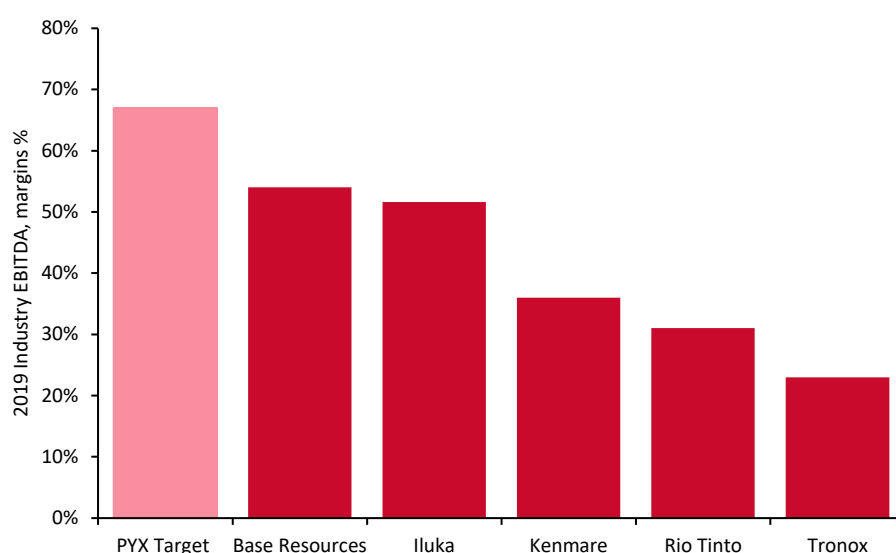
Mineral sands mining methods depend on the deposit type. There are three main methods; the monitoring method suitable where the minerals occur in purely sand form and water guns can be used to turn the compacted sand into slurry, the mechanical method where ore consists of gravel, sand and rocks and size reduction is required. Deposits are mined by front end loaders and diggers with the product transported to a primary and secondary mineral separation plant. Thirdly the dredging method where an artificial pond is constructed for the collection of beach and sand deposits, a floating dredge collects sand via a bucket wheel starts the process while the dredge has basic beneficiation equipment on board and the slurry is then pumped to the processing plant.

PYX is best suited to the mechanical method in conjunction with a water management programme due to its location and the variation in clast size. Because of the height of the water table, PYX will need to undertake site drainage, surface water catchment and build settling ponds, mine roads and pit access ramps. PYX will construct these in phases before moving to the next area and undertaking reclamation of the exploited areas. This approach will allow PYX to mine deeper than the third party miners to the maximum depths of up to 11m as indicated by drilling and potentially deeper should follow up claims to explore the bedrock be successful.

The trade-off between the approaches is that capital costs for dredge mining are higher but operating costs are substantially lower. We expect the transition to in-house mining to enable a substantial reduction in costs from contract mining. To calculate our forecasts for future mining we have reviewed industry costs based on mining comparable projects with a particular focus on mining method.

Across the industry, EBITDA margins for listed peers range from 23-54%, however, many of the peers focus on low value ilmenite production and higher value rutile and zircon are the differentiator in determining margins. PYX is the other way round with the high value product being the dominant revenue driver which implies the potential for industry leading margins, in our view. Therefore, directly comparing unit costs which include by-products can be particularly misleading in this subsector of the mining industry.

Industry Margins, Driven by Product Mix



SOURCE: Company data, VSA Capital Research.

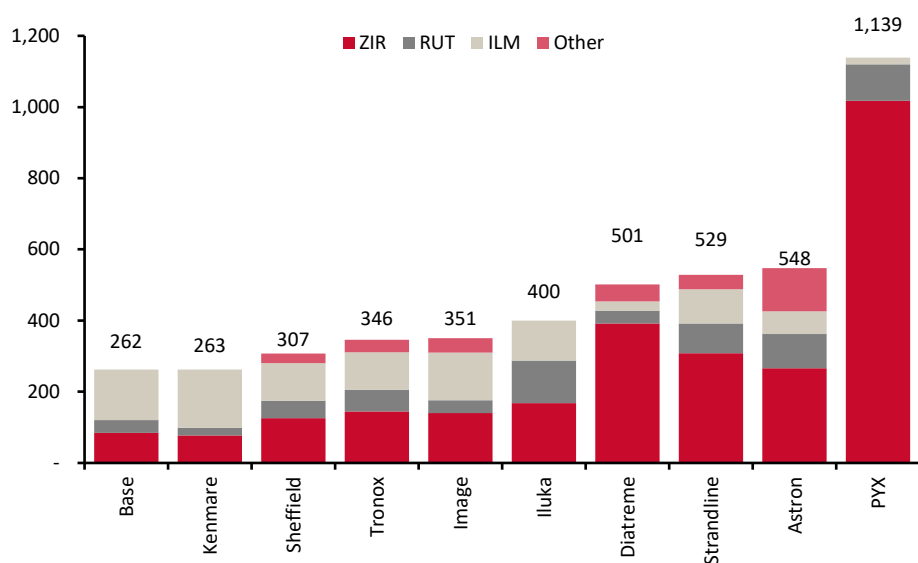
Indeed, Kenmare has sector leading unit costs due to the use of a dredging platform at its Moma Mine in Mozambique which on a net basis are around US\$80/t or US\$120/t on a gross basis. However, given that Kenmare's output is 63% ilmenite, the company's revenue base is substantially lower than its peers meaning that margins are the lowest of the peer group aside from Rio Tinto (31%) and Tronox (23%) who have opted to increase the value of their final product by vertically integrating and processing their mineral sands to produce a titanium dioxide feedstock. This highlights the

importance of product mix to margins, and PYX’s production history and resources demonstrate that if operating costs can be reduced in line with the peer group, PYX has the potential to generate sector leading margins. The industry cash-cost to revenue metric is often cited simply because unit costs often exceed the predominant ilmenite spot price which implies weaker margins than realised. However, PYX’s focus and zircon weighting means that margins are far more readily understandable and relatable to unit costs and EBITDA margins.

PYX will adopt a similar approach to Sheffield Resources and Strandline in its development, although it will not be constructing a full wet concentration plant at the mine site. However, dry mining methods and processing will be similar. Our analysis in conjunction with management guidance indicates that US\$430/t is a reasonable unit cost for zircon production at Mandiri. Recent BFS from Sheffield Resources and Strandline suggests unit costs of US\$721/t and US\$290/t respectively on a zircon equivalent basis.

Iluka’s Jacinth Ambrosia project, the closest comparable in terms of HM grade and zircon weighting, has averaged unit costs over the last five years of US\$450/t; achieving US\$360/t in 2019 and US\$450/t in 2020. Grade is a major differentiator for PYX against the other development projects. As mentioned earlier, PYX not only has leading HM grade globally but the highest grade zircon component in the world. PYX’s HM grade at Mandiri is 7.43% with 4.7% zircon grade, compared to Strandline which is just 1% HM and 0.6% zircon while Sheffield’s HM grade of 11% is dominated by 6% for ilmenite and 1% for zircon. This is where PYX’s product mix comes into its own and is clearly demonstrated by the value per tonne of HM output, almost double that of the closest peer.

Weighted in-situ assemblage value, US\$/t



SOURCE: Company data, VSA Capital Research.

Applying like for like US\$/t mined figures of around US\$8/t from Sheffield Resources BFS would lead to unit costs of US\$200/t at Mandiri. Therefore, recognising that the mobile concentrator is likely to be higher cost than a larger fixed site as at Sheffield and for the smaller scale of the project, we believe that using overall cost per tonne mined of US\$20/t is sufficiently conservative and leads to US\$430/t unit costs for Mandiri. Applying a similar approach recognising the lower grade Tisma indicates average long term unit costs of US\$515/t.

Operating Highlights Table, US\$

	2019A	2020A	2021F	2022F	2023F	2024F	2025F
Zircon production, kt	4,966	6,555	18,000	23,039	30,499	49,478	60,997
Ilmenite production, kt	-	-	-	2,880	2,880	4,320	5,760
Rutile production, kt	-	-	-	3,219	3,219	4,828	6,437
Operating costs, per tonne zircon	1,111	1,156	1,222	1,546	787	487	474
Revenue	6,858,289	8,956,694	26,180,606	46,179,530	72,442,616	113,998,692	118,306,102
EBITDA	86,196	(1,213,403)	2,675,488	13,639,387	35,466,850	65,348,753	67,844,696
Operating Profit	9,797	(14,062,503)	2,330,362	7,494,765	43,900,639	84,865,392	80,387,446
Net Income	(58,386)	(13,820,603)	1,726,798	4,361,718	32,164,386	62,807,193	59,065,112
P/E, x	neg	neg	nm	nm	14.6x	7.5x	7.9x
EV/EBITDA, x	0.1x	neg	nm	34.4x	13.2x	7.2x	6.9x
Capex	(148,246)	(748,923)	(1,000,000)	(8,750,000)	(5,000,000)	(500,000)	(13,000,000)
FCF	245,695	(3,364,508)	1,565,854	(4,013,725)	31,333,360	67,974,798	49,837,173

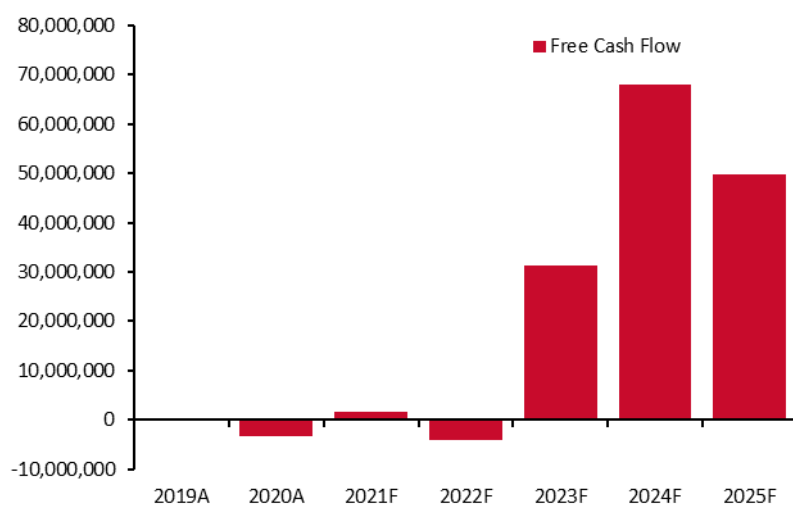
SOURCE: Company data, VSA Capital Research.

Combined Potential for Strong Margins and Free Cash Flow Growth

Our investment case centres around PYX transitioning to low-cost, in-house mining and investing free cash flow in growth to gain market share and capitalise on an historic opportunity within the zircon market as mineral sands producers. We expect that at Mandiri the transition to in-house mining will take between 18 months to two years before the full benefits of the switch are reflecting in earnings. To keep the local community on side, the transition must be gradual from contract mining to in-house, although in all likelihood, many of the current contract miners will become part of the PYX team. In addition at Mandiri, PYX is currently looking to connect the MSP to the grid which will play a further role in cost reductions. Management have guided that this requires a modest cost of less than US\$100k and will take six months. It requires an agreement with the electricity company but no further permitting. PYX will be able to substantially reduce its diesel consumption as a result.

We anticipate that through an increase to c200ktpa zircon output by 2030F, PYX can achieve annual EBITDA in excess of US\$200mpa, assuming that unit costs of around US\$420/t are achieved as we expect. Given the minimal sustaining capital required once the modular expansions of production capacity are achieved EBITDA is a strong proxy for free cash flow generation. We believe that each modular 24ktpa expansion drives EBITDA growth of US\$28mpa based on our long run US\$1,500/t zircon price forecast. This ability to deliver strong cash flow growth is the key to our investment case and we believe will be the major driver of future share price growth.

PYX Resources, Free Cash Flow Outlook, US\$



SOURCE: Company data, VSA Capital Research.

The transition to in-house mining will also have a significant and positive impact on PYX ESG credentials, in our view. Currently, by using contract miners, PYX has relatively less control over the activities and operating methods compared to in-house mining. PYX currently operates an Environmental Monitoring Plan, however, clearly with wholly owned equipment and a directly employed workforce PYX will be better able to directly enforce operating standards commensurate with a professional mining company.

PYX Resources Transaction History & Structure

In January 2021, PYX entered into a share purchase agreement to acquire the entire capital of Tisma Development (HK) Limited; a fully licensed mineral sands project in Central Kalimantan. PYX issued 147,277,370 shares in PYX to the shareholders of Tisma which at the time of announcement (13 January) and share price of A\$0.54, implied a valuation of A\$79.5m (US\$61m) or US\$13.6/t of contained zircon on an EV/Resource basis.

The transaction was approved by shareholders and it completed on the 15 February 2021.

Tisma Development (HK) Limited is the operator of the fully licensed Tisma project, the licence is held by PT Tisma Global Nusantara (PTTGN) which is a fully licensed Indonesian company with an IUP-OP permit allowing the mining, production and export of zircon. This was granted in August 2012 and it is valid for 10 years. There are no outstanding environmental and social claims against PT Tisma or its parent companies. PTTGN has the exclusive right to perform exploration, mining works and export sales within the tenement area. PYX holds 100% of TD, TD owns 99% of the wholly owned Indonesian company PT Tisma Investasi Abadi, which controls PTTGN through a Management and Operations agreement, which also gives PTTIA right to 95% of the pre-tax net profit among others. Structure is similar to Takmur Pte. Ltd's structure.

In July 2019, the company signed a sale & purchase agreement to acquire Takmur Pte. Ltd. a Singapore based company that has exclusive rights to the operation and management of a mineral sands tenement and production facility. Under the Exclusive Operation and Management Agreement with PTIM, the holder of IUP-OP zircon production and export licence 16/DPE/IX/2010, PT AUM has committed to provide mining equipment, technical and management knowhow to develop the Mandiri Project. This Exclusive Operations and Management Agreement forms the basis of the Takmur's interest in the Mandiri Project. Takmur does not have a direct ownership interest in PT Investasi Mandiri. Under the terms of this agreement PTIM and its shareholders have delegated to PT AUM:

- the power to determine the financial and operational policy of PTIM;
- the right to appoint the majority of PTIM directors; and
- the right to receive 95% of PTIM's net profit on an annual basis as a compensation for the services provided to PTIM.

PTIM was granted mining permit Izin Usaha Pertambangan-Operasi Produksi (IUP-OP) (Special Business Mining License) for a total area of 2,032 ha, by Bupati Gunung Mas, No. 16/DPE/IX/2010, on 2nd September 2010. This licence was extended for a period of 5 (five) years from September 2, 2020, to September 1, 2025 and can further be extended under statutory provisions.

PYX operates under IUPs rather than the old system of Contracts of Work as they were granted after 2010 when the law initially changed. IUPs are granted for a maximum of ten years and renewed for further periods of up to ten years. All mining licences are now issued solely by the Central Government. The Mining Bill confirmed that Indonesian shareholders must hold at least 51% of the mining company after the fifth anniversary of the relevant mine's production period. PYX corporate structure complies with this and given that the Mandiri mining licence was renewed for a further five years from September 2020 we see this as a validation of PYX's corporate structure.

The Indonesian Government has passed various legislation to prevent the export of unprocessed minerals; this was primarily aimed at the nickel industry to encourage the construction of smelters in country, increase domestic activity and improve tax revenues by limited foreign mining companies who used transfer pricing on low value concentrates. Mineral sands were captured by this, however, the 65.5% zircon concentrate which PYX produces is at the very top of the range for global quality.

Currently PYX only has the ability to sell zircon under its current mining licence, however, it has submitted an application which is expected to be received in the summer 2021 to enable the export and sale of ilmenite and rutile.

Ownership Structure

Name of Subsidiary	Country of Incorporation & Principal Place of Business	Ownership Interest Held by the Group		Proportion of Non-controlling Interests	
		2020	2019	2020	2019
Takmur Pte Limited (Holding Company)	Singapore	100%			
PT Andary Usaha Makmur (Operator & Manager)	Indonesia	99%	99%	1%	1%
PT Investasi Mandiri (Operations)	Indonesia			100%*	100%*

** This entity is accounted for as a controlled entity on the basis that control was obtained through the execution of an exclusive operations and management agreement between PT Andary Usaha Makmur and PT Investasi Mandiri and was for nil purchase consideration.*

The non-controlling interests in PT Andary Usaha Makmur is not material to the Group.

Subsidiary financial statements used in the preparation of these consolidated financial statements have also been prepared as at the same reporting date as the Group's financial statements.

SOURCE: Company data, VSA Capital Research.

The operations agreement means PYX may invest up to US\$15m over ten years as part of the agreement to maintain its economic interest.

Following the completion of the transaction, PYX raised A\$14m and listed on the National Stock Exchange of Australia.

Valuation

Our valuation of **PYX Resources (PYX NSX)** is based on a risked DCF valuation. We have considered other valuation metrics and present them below, however, we believe that entering into a rapid growth phase, DCF analysis is the most suited methodology to demonstrate the investment opportunity underpinned by transformational earnings growth potential. On a one year basis, PYX is up 169% as the company has delivered on management's milestones expanded the resource base, strengthened earnings and set an ambitious roadmap to grow production and capture market share, all underpinned by strong market fundamentals. The target production rate implies that PYX will be a top four zircon producer and it is right that our target valuation reflects that ambition.

Our DCF valuation separates Mandiri and Tisma. Both are valued on an 11% WACC, suitable given the growth risks and jurisdiction. Our 15 year DCF implies that 50% of the resource will be exploited, we therefore apply a terminal value using a 2% growth rate to value the remaining portion of the resource. At Mandiri which is an established producer, we do not apply a risk factor, however, Tisma is a greenfield development asset and we believe that it is appropriate to apply a 0.65x risk factor to our DCF valuation to reflect the higher risk nature of the earnings outlook.

Peer Group Comparison

Company Name	Price Close	Company Market Cap	Current EV	Resources (in situ THM)	Weighted Avg Assemblage Value	EV/Resources	% Value
	Lcl Ccy	US\$ m	US\$ m	Mt	US\$	US\$/t	
PYX Resources Ltd	0.87	367	326	14.9	1,145	21.86	1.9%
Strandline Resources Ltd	0.16	137	118	30.0	518	3.93	0.8%
Image Resources NL	0.14	139	107	16.1	405	6.62	1.6%
Iluka Resources Ltd	5.76	2,434	2,292	126.8	367	18.07	4.9%
Tronox Holdings PLC	19.96	3,051	5,926	74.4	345	79.65	23.1%
Base Resources Ltd	0.23	270	195	70.9	324	2.75	0.8%
Kenmare Resources PLC	6.03	661	723	182.0	224	3.97	1.8%
Sheffield Resources Ltd	0.33	114	100	407.3	176	0.25	0.1%
Diatreme Resources Ltd	0.02	40	35	4.7	575	7.42	1.3%
Astron Corp (Private)	n/a	n/a	-	182.8	554		0.0%
Iluka Sierra Rutile 2016	n/a	n/a	310	8.0	1,015	38.75	3.8%

SOURCE: Company data, VSA Capital Research.

EV/t on contained resources at first appears to show that PYX trades at a significant premium to its development peer group, however, unless this is considered in conjunction with PYX's higher assemblage value, then it is not a fair comparison. The closest peer in terms of approach in this case is Sierra Rutile which was acquired by Iluka in 2016 for A\$375m with the IFC investing a further US\$60m for a 10% stake in 2019 although this was subsequently written down to the acquisition price. Sierra Rutile's deposit had an 52% weighting to rutile which currently trades at US\$1,200/t in the spot market currently. This higher value assemblage weighting meant strong margins could be achieved despite a lower HM grade overall. The ratio of EV/t to in-situ assemblage value therefore represented a significant premium to the rest of the peer group. PYX combines this higher assemblage value with sector leading grades. This metric offers a clearer indication of potential value for PYX, in our view. However, we continue to favour the DCF given PYX's producer status.

Furthermore, the low capex, modular expansion plan will enable PYX to rapidly expand and capitalise on underlying market conditions and grow earnings. This more nimble expansion approach means that PYX can more quickly ramp up production than peers reliant on finalising significant project finance packages. Sheffield Resources is seeking A\$478m in pre-production capex leading to 400ktpa ilmenite production, 200ktpa titano-magnetite and 210kt non-magnetic concentrate of which 39% is zircon first production, and is likely to be 18 months after FID later in 2021. Strandline the next most advanced, has recently raised funding to cover the A\$238m capex with first production targeted in late 2022; again, a high weighting to ilmenite with 110ktpa expected and 58ktpa zircon. PYX will meanwhile be expanding its

existing production base whilst benefitting from stronger prices and earnings upside, in our view over the two or more years these peer developers will be constructing.

Our sum of the parts target price for PYX is A\$2.60/sh. which implies 130% upside potential.

Valuation Summary

Division	Division NAV, US\$'000	Division NAV, A\$'000	Attributable NAV, A\$mn	P/NAV	Fair Equity Value, A\$mn
Mandiri	700,155,027	933,540,037	933,540,037	1.00	933,540,037
Tisma	169,504,422	226,005,896	226,005,896	0.65	146,903,832
Total NAV, A\$mn					1,080,443,869
Consolidated Net Debt					(3,509)
Total Equity Value					1,080,447,378
# of shares					415,054,407
Current price, AUD/share					1.13
12-mo Target Price, AUD/share					2.60

SOURCE: Company data, VSA Capital Research.

Risks

- **Commodity Prices.** The company is primarily exposed to the mineral sands market and unexpected changes to commodity prices are likely to affect our valuation. Prices are based on industry benchmarks and often through direct negotiation which reduces transparency.
- **Political Risk.** Located in Indonesia and operating as a foreign owner of a mining business, the company is subject to a higher than normal level of jurisdictional risk as mining laws change frequently.
- **Macro Risk.** The company may choose to sell into global markets in which case currency exposure could be a risk.
- **Execution Risk.** The potential for delays and operating issues are an inherent industry risk, this may include delays in receiving financing or hold ups to the completion of development milestones.
- **Financing Risk.** Access to financing is a perennial risk for junior natural resources companies.

Financial Model Summary

VSA Commodity Price Forecasts

		2021	2022	2023	2024	2025	2026	2027
Zircon	USD/t	1,454	1,800	2,200	2,150	1,800	1,600	1,500
Ilmenite	USD/t	250	300	350	250	200	200	200
Rutile	USD/t	1,200	1,300	1,400	1,400	1,200	1,200	1,200

SOURCE: VSA Capital Research.

The zircon market has experienced significant destocking at the downstream end in 2020 as major producers cut production in response to the pandemic. Returning production to normal will be insufficient to meet the combined recovery in demand and restocking of supply chains, however, incumbent producers have only modest zircon supply growth plans while other developers who are primarily focused on ilmenite have long lead times. Furthermore, given their product mix weighting to ilmenite, high zircon prices alone may not be sufficient to incentivise new production. Consequently, we anticipate strong demand and constrained supply leading to rising prices.

Key macro assumptions

	2018A	2019A	2020F	2021F	2022F	2023F	LT
USDAUD	0.98	0.92	0.77	0.75	0.80	0.80	0.80

SOURCE: IMF, VSA Capital Research.

Much of PYX's cost base is denominated in local currency, however, given our cost cutting projections, variation in currency is unlikely to have a significant bearing on our forecasts. The relationship between the USDAUD between the company's reporting currency and trading currency is likely to have a more significant bearing on near term valuation.

Capital Costs

The expansion at Mandiri to 24ktpa is expected to cost US\$700k with a transition to in-house mining budgeted at US\$3.5m for a 480ktpa mobile mine field unit. At Tisma, development plans are projected at US\$15m including US\$3.5m for the same scale MFU, and US\$3.5m for processing plant equipment. This tallies closely with costings already attributable to expansions to date. The remaining budget covers working capital, land clearance, construction of buildings and connection to power and water.

Further modular expansions of 24ktpa are projected at US\$10m with US\$7m accounting for new equipment in terms of processing and the MFU.

Capital Expenditure, US\$'000

	2019A	2020A	2021F	2022F	2023F	2024F	2025F
Capex	(148,246)	(748,923)	(1,000,000)	(8,750,000)	(5,000,000)	(500,000)	(13,000,000)

SOURCE: Company data, VSA Capital Research.

Cost of Capital

We have applied a WACC of 11% and used a terminal growth rate of 2%.

Production Overview

In 2021, we expect PYX to increase capacity from 18ktpa to 24ktpa zircon and with three offtake agreements signed in recent months, we expect sales volumes to rise YoY. PYX has stated near term plans to increase Mandiri output to 48ktpa zircon, which we believe can be achieved by 2025F while at Tisma construction of a 24ktpa facility is targeted to begin

in early 2022 based on our forecasts with a one year construction period. Thereafter we expect internal cash flow generation to be sufficient to fund production expansions at Mandiri to 161ktpa by 2030F.

PYX Forecast Production

Mandiri	2021F	2022F	2023F	2024F	2025F	2026F	2027F
Throughput, kt	-	480	480	720	960	1,440	1,920
HM Grade, %	-	7.43%	7.43%	7.43%	7.43%	7.43%	7.43%
Recovery, %	-	95%	95%	95%	95%	95%	95%
Zircon, t	18,000	23,039	23,039	34,558	46,078	69,117	92,156
Rutile, t	-	2,880	2,880	4,320	5,760	8,640	11,519
Ilmenite, t	-	3,219	3,219	4,828	6,437	9,656	12,875
Tisma							
Throughput, kt	-	-	240	480	480	960	960
HM Grade, %	-	-	3.99%	3.99%	3.99%	3.99%	3.99%
Recovery, %	-	-	95.00%	95.00%	95.00%	95.00%	95.00%
Zircon, t	-	-	7,460	14,919	14,919	29,839	29,839
Rutile, t	-	-	-	-	-	-	-
Ilmenite, t	-	-	-	-	-	-	-

SOURCE: Company data, VSA Capital Research

Ilmenite and rutile production are reflected in our model, however, PYX does not currently have a licence to sell these minerals. An application for Mandiri has been submitted and is expected to be received within six months. Rutile and ilmenite production is based on assemblage weightings as stated in the company's current JORC resources statements. We have conservatively not reflected the additional potential from Tisma's ilmenite and rutile output which offers further future upside potential should an export license be granted for this tenement also.

Tax and Royalties

Dead rent is payable to the Government of Indonesia at a rate of US\$4 per hectare per annum;

- Royalty on zircon exported is 1.5%;
- Corporate tax of 22% is payable and set by the Government of Indonesia;
- Land and building taxes payable to the local government are applicable, at a rate of 5% based on estimated value;
- Environmental obligations, including reclamation bonding and plans, approved by the local government as part of the mine approval process.
- A zircon royalty of US\$2/t is payable on export.
- Dividends to foreign owners are taxable at 30%.

Zircon Market

Price Outlook

Mineral sands are not exchange traded and therefore past performance relates to prices reported by the major producers. Realised prices by other producers will therefore also vary based on product quality and other marketing factors, however, fundamentals are the major driver of price. Following a boom in prices at the start of the last decade driven by China's recovery after the GFC and a lack of available supply, the zircon price rallied to over US\$2,500/t. Producers still recovering from the GFC were unable to react and therefore unable to increase supply and prices went up strongly before new supply from Indonesia, a swing producer came online. Indonesia increased production to 100ktpa largely from fragmented and uncommercial producers prompting prices to fall.

Zircon production has fallen 8% since 2015 and ahead of COVID-19 prices had increased c50% between 2015 and 2018 to US\$1,490/t. Having been in a tight position going into the COVID-19 pandemic, 2020 prompted significant production cuts by the major producers resulting in a destocking event as China's industry recovered faster than expected which leaves the industry exposed to a 2011 style price rise, in our view.

As a swing producer, Indonesia has the potential to fill the gap but typically the supply response lacks organisation and is only incentivised about US\$1,400/t. However, this is different this time due to changes in the law which prevent the export of low grade unprocessed minerals including zircon. Typically these miners are only capable of producing a low quality concentrate product grading c42% Zr(Hf)O₂ while the benchmark for an export grade product is 58-65%. Indonesia passed a law in 2012 preventing the export of unrefined or processed products, which this informal production will not be able to come online with relative ease as it did in 2011 stymieing the price rise.

The pullback in supply in recent years combined with 2020 which saw a major destocking event and a faster Chinese recovery than many anticipated has substantially tightened the zircon market especially due to the swift reaction of mineral sands producers reducing production to prevent price falls. Major producers with the exception of Iluka which has marked 7-9ktpa of near-term expansion capacity are not discussing zircon project expansions indeed, declining production is the consensus view; currently therefore the ability of the industry to respond to rising demand is severely constrained. From close to US\$1,500/t at the start of the COVID crisis, prices pulled back to around US\$1,200/t although have been staging a recovery which we expect to continue as confirmed by PYX recent US\$75/t wholesale price increase.

VSA Commodity Price Forecasts

		2021	2022	2023	2024	2025	2026	LT
Zircon	USD/t	1,454	1,800	2,200	2,150	1,800	1,600	1,500
Ilmenite	USD/t	250	300	350	250	200	200	200
Rutile	USD/t	1,200	1,300	1,400	1,400	1,200	1,200	1,200

SOURCE: VSA Capital Research.

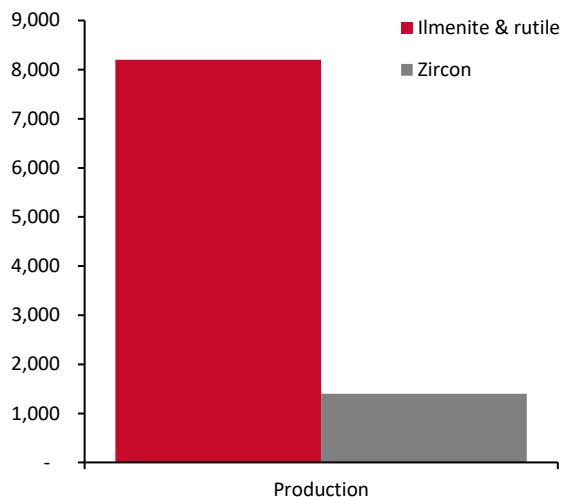
Market Overview

Mineral sands covers the mining and processing of zircon and titanium dioxide feedstocks. Deposits typically contain a combination of ilmenite, rutile and zircon. Although found in combination, in varying ratios, the end markets for zircon are somewhat differentiated to those of titanium dioxide feedstock and, unlike rutile which is somewhat substitutable with ilmenite, zircon has separate demand drivers. 80-90% of ilmenite and rutile goes to the production of pigments with the remainder being used in aerospace, chemicals and other uses of titanium metal. Zircon meanwhile is primarily used in ceramics, refractories and foundry casting as well as a growing number of speciality chemical uses including semiconductors and nuclear fuel rods.

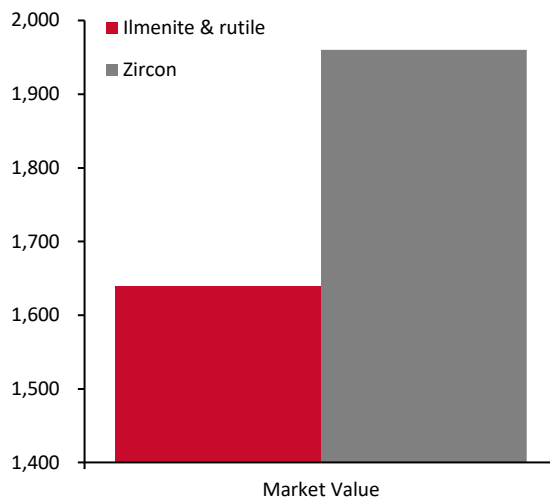
As industrial minerals with uses geared to basic industry, global demand across the mineral sands market has tended to grow in line with global GDP. In 2019, mineral sands mined volumes were 8.5mnt of which zircon made up 1.2mnt; this has grown from 1mnt in 2014 implying CAGR of around 2%pa. However, zircon is a premium product and accounts for 54% of the total value of mineral sands produced.

Zircon typically forms a minor portion of the volume assemblage of any one mineral sands deposit, but its high value position can be an important differentiator in terms of a primary ilmenite or rutile deposit’s economic potential. Deposits which are primary zircon are rare, however, costs of mining and processing are comparable therefore presenting the potential for a far higher margin operation. Furthermore, given that the largest mines producing zircon are primarily ilmenite projects owned by Iluka, Rio Tinto and Tronox this affects supply-side decision making.

2020 Production Mineral Sands, kt



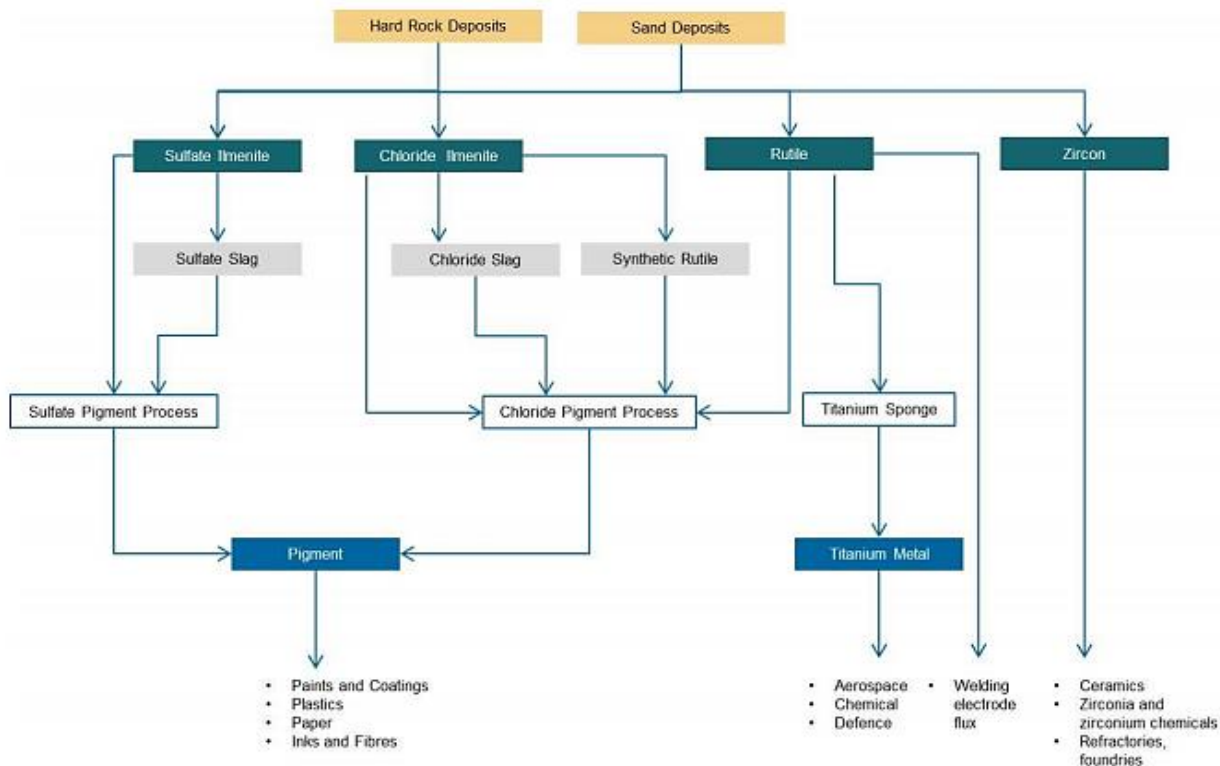
2020 Market Value Mineral Sands, US\$m



SOURCE: USGS, VSA Capital Research.

Zircon is an opaque white inert mineral chemically known as $ZrSiO_4$, it is a hard mineral with 7.5Mohs on the hardness scale. It is primarily found as a sand, but it can also be found in gem form with heat treatment resulting in loss of the typical brown colour. In this form it is considered a semi-precious gemstone and is the natural form of the manmade diamond substitute cubic zirconia due to the comparable albeit inferior clarity and refractive capabilities of the mineral.

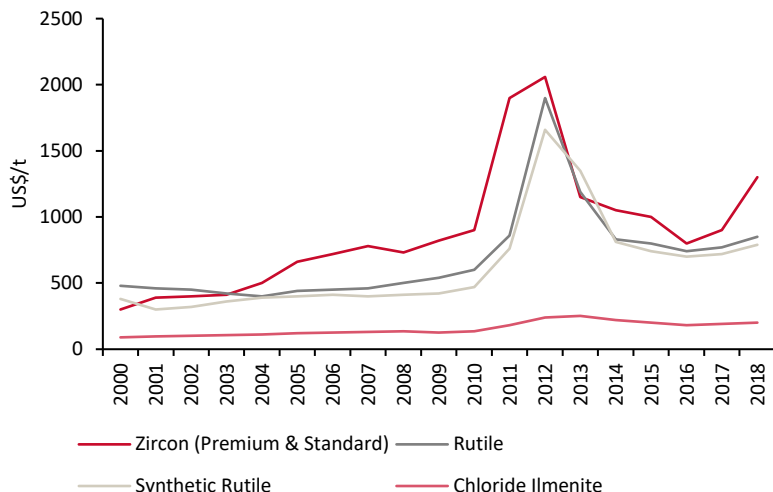
Mineral Sands Industry Flowchart



SOURCE: Iluka, VSA Capital Research.

Since 2004, zircon has traded at a premium to ilmenite and rutile, however, the spread has varied in recent years. With growing uses outside of ceramics and refractory and foundry uses, the price performance may be increasingly differentiated from that of ilmenite and rutile. A step change in industry pricing occurred in 2010 with a major revamp of how producers negotiated prices with end users at regular intervals rather than on long term contracts. In 2015, Iluka specifically changed its approach to zircon pricing, opting to combine an internal benchmark against which to set pricing on a spot or contract basis. This approach blends premium and standard grade zircon so remains useful for understanding pricing trends but does not provide a transparent industry benchmark. Marketing and negotiation continue to play a key role in realising prices as well as market fundamentals.

Mineral Sands Price Performance

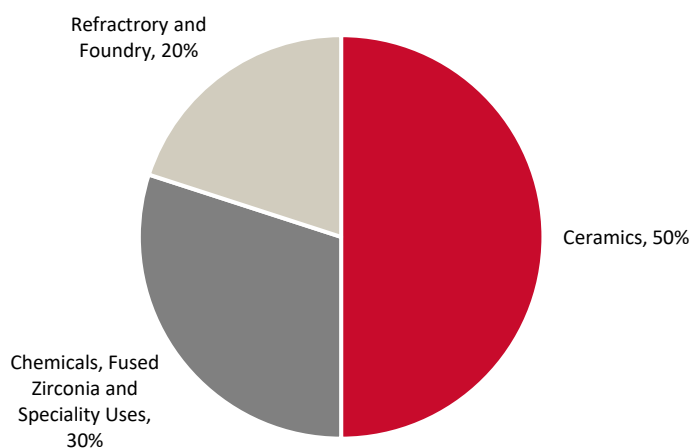


SOURCE: Iluka, VSA Capital Research.

Demand

Around 50% of zircon demand comes from the ceramics industry where it is used to enhance whiteness and opacity in traditional ceramics. When used as a glaze, it enhances resistance to abrasion and chemical attack. The product is zircon flour or sand. Zircon’s refractive properties are crucial here as fine zircon grains scatter visible light making ceramics appear white and opaque. Around 90% of ceramics demand relates to tile manufacture for sanitary ware and bathrooms etc. Zircon’s properties of thermal stability at increased temperatures make it an ideal material for refractory uses and in foundries; zircon sand and flour are both used in the casting process. It has a high melting point (2,430° C), low thermal expansion, high thermal conductivity, thermal shock resistance. Silica sand is the dominant product in this market and zircon has a minority of the market share, but it is used for high quality products where a high level of precision is needed due to its chemical properties. Olivine and chromite sands are competitors and substitutable products. Refractories and foundry account for around 25% of demand and this is expected to grow in line with basic industry and therefore be correlated broadly to GDP growth.

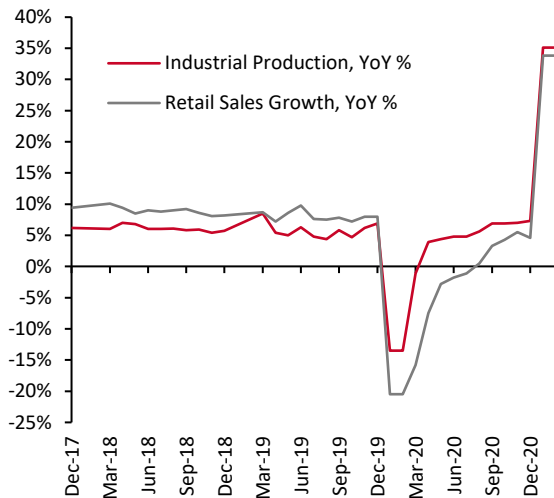
2019 End uses for Zircon



SOURCE: Company data, VSA Capital Research.

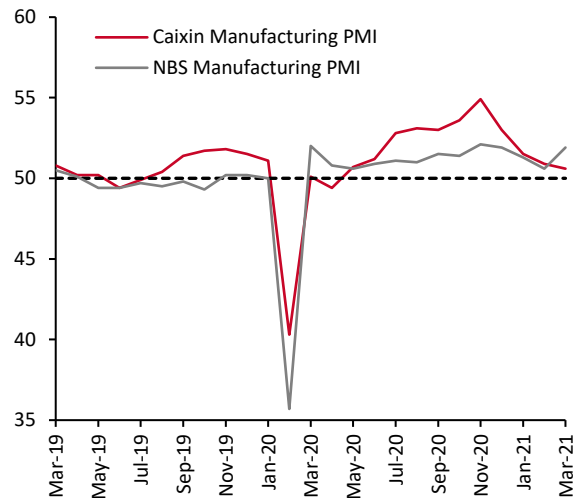
Chemical uses are the fastest area of growth accounting for around 20% of demand currently, up from less than 10% in 2000. These uses include catalytic converters, nuclear reactors cores and rods, heat exchangers, superalloys, coating electronics a polishing agent in the production of silicon wafers for the manufacture of semiconductor components. There are various downstream products including zirconia and zirconium chemicals which are produced to fulfil these needs. China’s semiconductor demand, which accounts for between 30-50% of world demand, has been very strong post COVID-19 driving shortages in commodities markets notably tin.

Retail Sales and Industrial Production Strong



SOURCE: Company data, VSA Capital Research.

Manufacturing PMIs Strong



SOURCE: Company data, VSA Capital Research

Demand by region; China dominates with around 40% of global annual zircon demand. Europe follows with 25% and North America 8%. Many of the products that China manufactures for zircon are then subsequently exported to the rest of the world. Rising electronics demand post-COVID is driving semiconductor demand in China and this is a key reason supporting zircon demand in the years ahead.

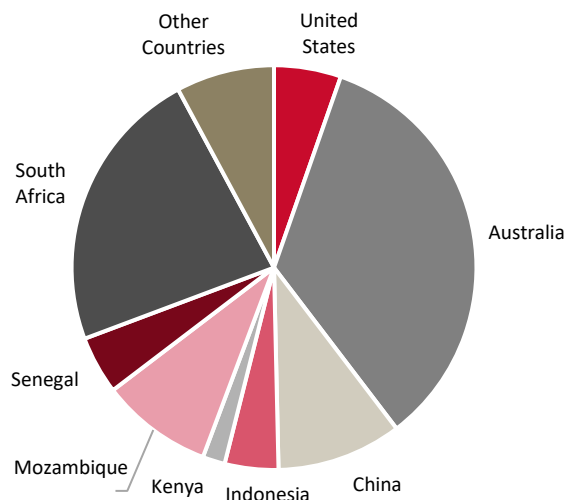
During 2018/2019 the major producers consistently referred to the bottom of the destocking cycle, which COVID-19 exacerbated. The uncertainty that consumers felt in H1 2020 led to drawdown of inventories downstream while due to China’s strong second half demand recovery YoY, demand overall was broadly flat. Consumers are therefore short on zircon and looking to restock to meet the post COVID bounce back. Firm numbers on inventories are hard to come by, but anecdotal data combined with recent price hikes confirms that the market is increasingly tight.

Supply

Zircon is produced in conjunction with ilmenite and rutile as mineral sands, and production is dominated by a handful of producers with key assets. Between 2012 and 2018, the market share of the top four has changed little with Iluka in 2012 having a market share of 26% of the 1.3mnt market and accounting for 28% in 2018 when production was 1.5mnt. Global zircon output has, however, been falling since 2017 despite rising demand and is now at least 10% down from the 2017 peak of 1.55mnt **Rio Tinto** has lost share to the combined **Tronox Cristal** group which were separate entities in 2012 with 14% and 6% respectively and now holding 19% while Rio dropped from 19% to 16%. Smaller producers account for the remaining 37%.

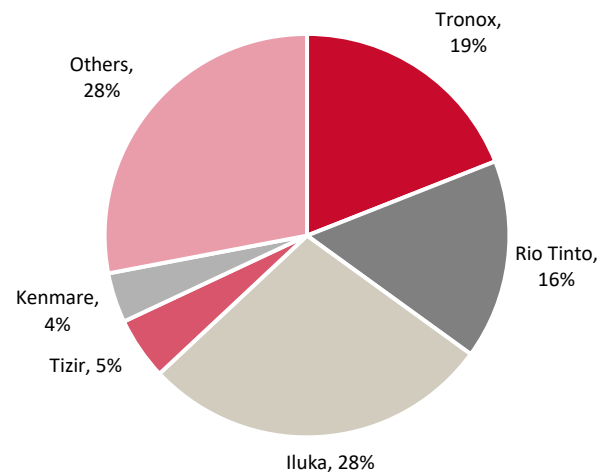
In 2020, Iluka dramatically reduced output to 185kt (-43% YoY) in the face of COVID-19 uncertainty. This was a major factor in prompting downstream users to work down inventory which is now having significant repercussions having reset the markets position. Iluka only guide to 285ktpa in 2021, given that shutting down is easier than ramping up but this is only 89% of 2019 output and 82% of 2018 output. Tronox produced around 235kt in 2020 roughly 80% of nameplate capacity. Listed development companies Sheffield Resources and Image received substantial funding in recent months, however, long lead times mean first production is not expected until 2022 at the earliest.

2019 Supply by Region



SOURCE: Company data, VSA Capital Research.

2018 Zircon Supply by Producer



SOURCE: Company data, VSA Capital Research

Geographic concentration is a function of the major assets owned by Iluka, Tronox and Rio Tinto who respectively own the Jacinth-Ambrosia, Namakwa and Richard’s Bay mines. China accounts for just 8% of global production meaning that it is dependent on rest of world production and has heavily relied on Australia in recent years. It is a structural short for China; this, in our view, is typically positive for commodity price outlooks where this is the case. China’s limited production is also reportedly being cut back with new rules forcing production shutdowns on the back of tougher environmental restrictions (as felt across a number of commodities). Roskill previously estimated that up to 40% of China’s production was impacted by the new rules.

Global Zircon Production

	Zirconium Ores & Concentrates, Mine Production (kt)					
	2015	2016	2017	2018	2019	2020
United States	81	5	80	70	100	75
Australia	567	550	505	500	470	480
China	140	140	140	150	140	140
Indonesia	40	40	110	100	34	60
Kenya	110	110	44	45	29	25
Mozambique	52	55	74	80	100	125
Senegal	45	50	82	80	65	65
South Africa	380	400	377	350	370	320
Other Countries	105	110	138	125	112	110
Total	1520	1460	1550	1480	1420	1400

SOURCE: Company data, VSA Capital Research

The major producers must all consider a number of factors when ramping up production, not least the impact of inadvertently impacting the ilmenite or rutile price by focusing too keenly on zircon. Currently, Iluka’s near-term growth is limited to just 7-9ktpa over the next two years at Eneabba. Tronox claims 294ktpa of zircon capacity and was likely producing close to capacity in 2019 having acquired Cristal in 2018 to increase capacity from around 220ktpa. One other factor is rising tensions between Australia and China which is prompting Chinese consumers to diversify supply from Australia which could prevent the already constrained major producers from expanding their supply with offtake uncertainty arising from the spat.

Appendix 1: Key Personnel

Oliver B. Hasler; Chairman of the Board & Chief Executive Officer

An accomplished CEO, President and Board Member, Mr. Hasler successfully led several world-class businesses and brands spanning multiple industries and markets across natural resources, agribusiness, advanced manufacturing and various industrial sectors globally. Named a Top 50 CEO's in Spain by Forbes magazine, Mr. Hasler has a proven track record in delivering shareholder value by improving existing operations; creating new businesses and brands; crafting creative, synergistic mergers and acquisitions; and assuming a leadership role in start-ups and divestments for listed companies, private equity-funded and family-owned businesses.

Most recently, he successfully oversaw the three-year transformation of Europac from a small, publicly-traded Spanish firm (Papeles y Cartones de Europa S.A.) into a mid-cap international firm, tripling its share price from €5.28 to €16.80 (as of the close on January 25, 2019) before selling it for US\$2 billion. Amongst other major assignments, Mr. Hasler redefined the strategy of Douwe Egberts' professional division, headquartered in the Netherlands and its joint venture with U.S.-based Mondelez, and led the restructuring of France's Arc International.

For more than 20 years, Mr. Hasler has been doing business in China, where he built and operated several factories while setting up national distribution networks and managing significant import/export activities.

A Swiss citizen, Mr. Hasler holds a degree in Materials Engineering and a Master in Metallurgy from the Federal Institute of Technology in Zurich, Switzerland and an MBA with honours from the Universidad Iberoamericana in Mexico City. He is fluent in English, German, Spanish and French.

Gary J. Artmont; Director

With a mining career spanning more than four decades and 21 countries, Mr. Artmont is intimately familiar with all aspects of mineral exploration, from grassroot assessment and project pre-feasibility studies to development and mining operations. Over the last 46 years, Mr. Artmont worked as a geologist and project manager for multiple leading mining firms, including Geostar Consulting, Rio Tinto, PT Pelsart Indonesia, PT Freeport Indonesia and Ivanhoe Mining China.

A fellow member of AUSIMM #312718 and thus qualified to write NI 43-101 and JORC Competent Person reports for various stock exchanges, Mr. Artmont holds a Bachelor Degree from Waterloo University, Ontario, Canada.

Alvin Tan; Director

Mr. Tan has over 15 years corporate experience in Australia and Asia, including mergers, acquisitions, capital raisings and listings (on ASX, the Alternative Investments Market (AIM) of the London Stock Exchange, the Kuala Lumpur Stock Exchange (KLSE) and the German Stock Exchange). In addition to working as financial consultant for KPMG in Kuala Lumpur, Mr. Tan acted as founding director of several companies listed on the ASX and currently serves on the boards of ASX listed Advanced Share Registries Ltd and BKM Management Ltd. He also has interests in companies in exploration, property development, plantation and investment holdings.

Mr. Tan graduated with a Bachelor of Commerce with honours from the University of Western Australia.

Bakhos Georges; Director

Mr. Georges has more than 40 years of experience in management and operation across the wholesale, retail and pharmaceutical sectors, and has been mostly involved in globally-oriented import-export operations.

Recipient of the Order of Australia Medal (OAM) – awarded in 2019 in recognition for his service to the community – he currently serves as Director of Saint Charbel’s Aged Care Centre.

A Justice of the Peace (JP) in and for the State of New South Wales. Mr. Georges received his B.Ph.Chem from USMV in 1982.

Appendix 2: Financial Statements

Profit and Loss (US\$), Dec Year End

Profit & Loss	2019A	2020A	2021F	2022F	2023F
Revenue	6,858,289	8,956,694	26,180,606	46,179,530	72,442,616
Cost of sales	(5,596,003)	(7,630,173)	(22,001,801)	(35,611,944)	(23,992,302)
Gross Profit	1,262,286	1,326,521	4,178,805	10,567,587	48,450,314
Corporate and administration expenses	(1,094,458)	(7,731,742)	(1,848,442)	(3,072,822)	(4,549,674)
Selling & Distribution Expenses	(260,831)	(492,248)	-	-	-
Foreign Exchange Loss	(11,659)	(29,376)	-	-	-
Listing Costs	-	(5,356,997)	-	-	-
Acquisition Costs	-	(1,889,237)	-	-	-
(Loss)/profit before income tax	9,797	(14,062,503)	2,330,362	7,494,765	43,900,639
Finance costs	(57,091)	(20,961)	-	-	-
Net finance costs	(57,091)	(20,961)	-	-	-
Profit before taxation	(47,294)	(14,083,464)	2,330,362	7,494,765	43,900,639
Mining and income tax	(11,092)	262,861	(512,680)	(2,903,482)	(10,043,391)
Profit for the year	(58,386)	(13,820,603)	1,817,682	4,591,283	33,857,249
Non controlling interest	38,112	(1,045,162)	(90,884)	(229,564)	(1,692,862)
Attributable to equity holders of the company	(96,498)	(12,775,441)	1,726,798	4,361,718	32,164,386

SOURCE: Company data, VSA Capital Research.

Balance Sheet (US\$), Dec Year End

Balance Sheet	2019A	2020A	2021F	2022F	2023F
Non-current Assets					
Property, Plant & Equipment	654,751	1,317,834	1,972,708	10,280,967	14,839,225
Total Non-Current Assets	751,968	1,736,101	2,390,975	10,699,234	15,257,492
Current Assets					
Trade & Other Receivables	468,522	368,627	717,277	1,265,193	1,984,729
Available for sale investments	-	77,316	77,316	77,316	77,316
Cash and bank balances	93,071	3,509,395	4,233,158	812,931	28,077,553
Total Current Assets	962,654	4,430,103	5,738,477	3,140,142	31,484,094
Total Assets	1,714,622	6,166,204	8,129,452	13,839,376	46,741,586
Equity					
Share Capital	1,178	14,873,158	14,837,158	14,837,158	14,837,158
Exchange Reserve	-	2,782,451	2,782,451	2,782,451	2,782,451
Retained Earnings	(101,607)	(12,877,048)	(11,059,366)	(6,468,083)	27,389,166
Total Equity	704,983	4,520,849	6,302,531	10,893,814	44,751,063
Current Liabilities					
Obligations Under Finance Leases	40,797	1,780	1,780	1,780	1,780
Trade & Other Payables	456,459	1,626,802	1,808,367	2,927,009	1,971,970
Total Current Liabilities	990,494	1,628,582	1,810,147	2,928,789	1,973,750
Total Equity & Liabilities	1,714,622	6,166,204	8,129,452	13,839,376	46,741,586

SOURCE: Company data, VSA Capital Research.

Statement of Cash Flows (US\$), Dec Year End

Cashflow Statement	2019A	2020A	2021F	2022F	2023F
Cash Flows From Operating Activities					
Net income	(58,386)	(13,820,603)	1,817,682	4,591,283	33,857,249
Adjustments for:					
Depreciation	76,399	129,173	345,126	441,741	441,742
Share based payments	-	3,938,578	-	-	-
Loss on sale of available for sale investments	-	(102,560)	-	-	-
Impairment of available for sale investments	-	(41,100)	-	-	-
Impairment of exploration costs	-	(235,024)	-	-	-
Movements in working capital:					
Decrease/(increase) in trade and other receivables	(388,804)	99,896	(348,650)	(547,916)	(719,537)
Decrease in trade and other payables	20,862	1,170,343	181,565	1,118,642	(955,039)
Change in working capital	(128,218)	1,167,347	(403,045)	296,749	(2,034,369)
Net cash generated by operating activities	(110,205)	(2,086,711)	1,759,763	5,329,773	32,264,622
Cash flows from investing activities					
Payment for property, plant and equipment	(148,246)	(784,923)	(1,000,000)	(8,750,000)	(5,000,000)
Payments for acquisitions, net of cash acquired	17,468	311	-	-	-
Other	1,500	(88,984)	-	-	-
Net cash (used in)/generated by investing activities	(129,278)	(873,596)	(1,000,000)	(8,750,000)	(5,000,000)
Cash flows from financing activities					
Proceeds from issue of share capital	444	9,378,600	-	-	-
Share issue costs	-	(2,618,065)	-	-	-
Net cash used in financing activities	332,554	6,278,117	-	-	-
Net increase in cash and cash equivalents	93,071	3,380,324	759,763	(3,420,227)	27,264,622
Cash and cash equivalents at the beginning of the year	-	93,071	3,473,395	4,233,158	812,931
Cash and cash equivalents at the end of the year	93,071	3,473,395	4,233,158	812,931	28,077,553

SOURCE: Company data, VSA Capital Research.

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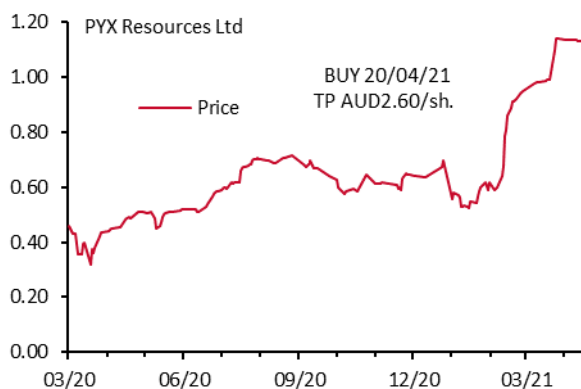
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Recommendation and Target Price History



Valuation basis

Our valuation is derived from a risked NPV calculation and peer group EV/t in situ resource value.

Risks to that valuation

Commodity prices, political risk, execution risk, financing risk.

This recommendation was first published on 20 April 2021.