WH IRELAND
CAPITAL MARKETS

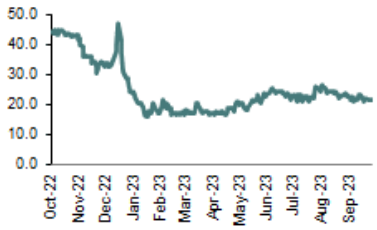
17 November 2023

CORPORATE

Share price	**16.7p**

Ticker	PYX.L/PYX.LN
Index	FTSE AIM
Sector	Mining
Market cap	£119m
Shares in issue	453m
NAV	2.6p

Performance	**All-Share**	**Sector**
1 month:	-24%	-12%
3 months:	-26%	-10%
12 months:	-61%	-16%
High/Low	47p/16p	



Source: © 2020, S&P Global Market Intelligence

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PYX Resources

Growing production, increasing margins

PYX Resources (PYX) is an established and growing producer of premium zircon and now, titanium dioxide sands (rutile and ilmenite), which it supplies to expanding global markets. As a volume-driven business, when production grows, costs are reduced, and margins boosted. With production at Mandiri slated to double in the short term and the optionality to introduce production from Tisma, we forecast improved profits and cash generation, which we expect to fund further brownfield expansions. Debt-free and with a healthy cash balance, we believe PYX has set a solid foundation for continued growth and increasing returns. We see fair value at 82p/share.

Exposure to premium zircon: As oversight on the environmental performance of zircon processors improves, demand for zircon concentrate with low levels of radiation (premium zircon) is increasing. Premium zircon is displacing other zircon sources from the market, and attracts **significant premiums**.

Expanding presence in the premium zircon market: PYX stands out among its peers as one of only a few premium zircon producers with the capacity to expand production. As PYX increases production, some of its peers are winding down operations, as their reserves are exhausted**.** With massive reserves of premium zircon and proximity to China (the major market for zircon concentrate), **PYX is expanding its position in the premium zircon market.**

Diversification: The Mandiri operation produces zircon, ilmenite and rutile. Until recently, revenues have been generated, almost exclusively, via the sale of zircon. With the recent granting of export licences (RNS 07.08.23), PYX has begun to sell down stockpiles of Ilmenite and rutile, which has introduced an organic **revenue diversification**. Production from Tisma would add operational diversification and reduce risk**.**

Growing demand: The traditional uses of zircon and titanium dioxide minerals are the ceramic and paint/ink/dye industries. Long-term demand, driven by rapid urbanisation in developing economies, is **expected to continue growing by market commentators, at a 3% CAGR** – increasingly, this demand will be met by premium zircon. Demand from industries like solar, defence, aerospace and nuclear is growing ten times more rapidly than traditional uses.

Resilience and leverage: Mandiri is a low-cost operation poised to deliver high margins, and is leveraged to zircon prices. Our modelling indicates that the operation would remain profit-making in the event of a 60% reduction in our forecast zircon prices. A 20% increase in our forecast zircon price from our long-term $2,000/t forecast would translate into a 32% increase in NPV_{10}.

Scalable production base: PYX has a stepwise plan to take its zircon production to 50kt/year within five years, and then higher by staged expansions and the bringing in of a second producing site at Tisma. PYX has a large resource, with 263.5Mt of inferred resources (JORC).

WHI view: Recent updates again demonstrate the progress being made by PYX. Increased production is beginning to yield the expected economies of scale and insulate the company from volatility in the zircon price. We see fair value at 82p/share, taking a conservative view on the pace of development and access to capital.

Year-end December (£m)	2020	2021	2022	2023E	2024E	2025E
Revenue	9.0	12.4	22.7	25.0	48.1	100.7
EBITDA	(14.0)	(4.5)	(9.3)	(10.7)	16.3	56.4
PBT	(14.1)	(4.5)	(9.3)	(11.7)	15.3	54.4
EPS (p)	(5.8)	(1.1)	(2.2)	(2.8)	3.2	10.0
P/E (x)	nm	nm	nm	nm	5.3	1.7
EV/EBITDA (x)	nm	nm	nm	6.9	2.0	1.3
Net cash/(debt)	3.5	6.6	1.7	(1.2)	13.1	54.6
Net assets	4.5	83.0	83.6	77.6	92.9	138.3

Source: Company accounts, WH Ireland estimates

Zirconium *– A very strong, malleable, ductile, lustrous, silver-grey metal. Extremely resistant to heat and corrosion.*

Rutile *– The most abundant of three naturally occurring forms of titanium dioxide. Rutile is commonly used in the manufacture of refractory ceramic and as a pigment.*

Ilmenite *– Titanium-iron oxide, the most important titanium ore. Ilmenite is used in the fabrication of paints, inks, fabrics, plastics, paper and sunscreen.*

PYX RESOURCES

Investment case

PYX supplies premium zircon, rutile and ilmenite to growing global markets. As an established cash-rich and debt-free business with scalable assets, we believe the stage is set for continued growth and enhanced margins. We see fair value at 82p/share.

PYX owns and operates one mineral sand production operation in Indonesia, at Mandiri, with another potential site at Tisma recently (RNS 23.02.2023 and 15.08.2023) licensed for operation. In the last year, PYX has also had a change to its licence for Mandiri to allow it to export rutile and ilmenite (RNS 17.08.2023), which are produced as by-products of zircon production. These will add some meaningful revenue to the bottom line for PYX over the coming years, in ever-increasing quantities.

Mandiri is a low-cost operation, operating at a high margin and leveraged to zircon pricing. An increase in zircon pricing would materially improve our valuation – a 20% increase in our forecast zircon prices from our long-term forecast of $2,000/t would boost the NPV_{10} of a combined Mandiri-Tisma operation by 32%. The low-cost nature of operations would translate into resilience in the event of a significant reduction in zircon prices. All else being equal, our DCF would return a positive NPV, even if our forecast zircon prices were reduced by 60%.

Traditional demands for zircon are forecast by market commentators to continue growing, at a 3% CAGR, and processors are increasingly seeking premium zircon feedstocks. This, we believe, underpins the business case for PYX to continue growing zircon production. Few producers of premium zircon can increase supply; in fact, some are winding down production, as reserves are exhausted. We believe that the proximity of PYX's Indonesian operations to China (the major global destination for zircon concentrate) helps boost the attractiveness of PYX zircon.

Zircon demand from fast-growing industries

Newer demands in zircon, such as the defence, aerospace, nuclear, solar and fuel-cell industries, are growing ten times more quickly than traditional demands in the ceramics industry. PYX's zircon is recognised for its whiteness, and low thorium and uranium content, which makes it suitable for these newer industries. This is demonstrated by PYX having secured sales (at significant premiums) to international blue-chip customers in Europe, America and Asia.

Zirconium – the most abundant zircon-bearing mineral

Zircon is an increasingly important mineral, owing to its use in critical industries, including those linked to decarbonisation, like solar and nuclear. Zirconium is the main zircon-bearing mineral, and is recognised by Australia (the main global source of zircon) and the USA (Critical Minerals act) for its importance in future economies. If, for strategic reasons, Australia were to limit exports of zircon to China, this would have a material impact on Chinese zircon processors, which would turn to alternative sources, such as PYX zircon from Indonesia.

Growing margins

As a volume-driven business, increased production drives down costs and boosts margins. Production of zircon concentrate at Mandiri is set to grow significantly with the addition of plug-in modular processing units, and further growth potential is offered via the introduction of production from Tisma. The lower production costs (per tonne of product produced) will, we believe, translate into a significant earnings boost.

Diversification and reduced risk

The introduction of revenues from the sale of rutile and ilmenite, along with the potential to introduce a second operation at Tisma, are positives. PYX continues to reduce risk, with the commencement of warehouse operations at Kuala Lumpur's Port Klang, which reduces shipping times to end-use markets, and allows for stockpiling to mitigate the impact of seasonal storms on sales.

Summary investment case

Strong, scalable production base: PYX has a stepwise plan to take its zircon production from Mandiri to 50kt/year within five years, and then higher by staged expansions and the bringing in of a second producing site at Tisma; we estimate production to 150kt from the two sites by 2029. PYX has access to large resources (263.5Mt of inferred resources (JORC) with a high assemblage value, with the mineralogy mainly zircon – a high-value component.

High-grade: There are few other high-grade zircon projects in the world.

Surface deposits: Little or no stripping is required, and the mineral sands are unconsolidated. Operating costs are low, and will fall as production scales up.

Short time to production – fast track: There are no long construction times – simple plant is built and fed with material from the mineral resource quickly, and leaves no lasting trace.

Mineral assemblage sets PYX aside from its peers: PYX's resource base sets it apart from its competitors. These are high-grade zircon deposits compared with those of its peers. Premium zircon – with its low radioactivity (U+Th <500ppm), low alumina and high whiteness – attracts a premium.

Absence of a zircon project pipeline a positive for PYX: The current market value for PYX does not, in our opinion, fully reflect the lack of global projects for zircon. With growing demand, an uncertain supply and a poor project pipeline, we expect a robust zircon price for several years to come. It is during these years that PYX will be established as a significant global zircon producer, in our view.

Strong returns: Our simple DCF model returns strong NPVs, using a long-term zircon price that is lower than today's level (we use $2,000/t – see Figure 11). Returns are driven by the grade (high) and capex/opex (low) against our conservative pricing as the mineral sands sector enters a boom. We risk the operations lightly, as there is little operational risk, with much of PYX derisked by ongoing operations, with a 0.6x NPV/P/E included in our model for capital risk and for the uncertainty over the pace of development. We will look to reduce our risk rating as PYX achieves its milestones.

Figure 1: Location of Mandiri and Tisma

Figure 2: Bags of PYX ilmenite for export sale

Source: WH Ireland Research, PYX Resources

Key risks and other considerations

Investing in PYX does carry certain risks – many in common with similar companies. We highlight the most significant risks, as we see them, below.

While the MRE classifies resources as Inferred, based on past performance, we expect production to be in line with expectations

Mineral Resource Estimate (MRE): The Mandiri and Tisma inferred resources are based on small and wide-spaced samples in what is an inherently highly variable environment. Although the modelling of the tabular alluvial body is overly simplistic, we expect production to be in line with expectations. There will be variability in the resource, and this may affect production targets and, therefore, economic performance. We note that PYX has a history of delivering production targets and that, with further exploration, there is scope to derisk and grow resources.

Differences between resources create a moderate risk

Mandiri and Tisma: Although mineral assemblages are similar, significant differences exist between the Mandiri and Tisma resources. The Mandiri resource outcrops, or is very near surface, whereas, at Tisma, the resource is under 6m to 10m of overburden and thick forest, which must be cleared before production can commence. This adds a degree of operational complexity and expense.

Sovereign risk is low

Sovereign risk: Indonesia is an emerging market. As with any market, PYX is exposed to potential political, economic and social risks. However, many international companies operate successfully in Indonesia, and we see the country's risk, in this case, as low.

Product market risk is low

Product market risk: The market for premium zircon is bullish. Demand is high, and supply is restricted. PYX's zircon is recognised for its quality, and it attracts a premium.

Operating risk is low

Operating risk: Operational risk is low, and is in line with the risk for other producers of mineral sands. The process of separating heavy minerals from the sand is simple, and makes use of proven technology. PYX has shown itself to be capable of producing quality saleable zircon, rutile and ilmenite concentrates.

Permitting risk is low

Ownership/permitting risk: PYX has Exclusive Operation and Management Agreements for Mandiri and Tisma; it is not the direct owner. Permit renewal is subject to the direct owner honouring government, social and other commitments. However, so far, the Indonesian government has provided licences and renewals, and we expect this to continue.

Supply risk is low

Supply risk: PYX currently relies on a supply of heavy mineral sands from artisanal miners. Supply could be interrupted for any number of reasons, although PYX has established fruitful relationships with local miners. We expect that, at higher production rates, the majority of production supply will come back in-house.

Capital market risk is low

Capital market risk: PYX is revenue-generating, debt-free and has cash on hand. Our valuation assumes that Tisma will start production in 2025, reaching full production in 2027, and we estimate that this will require $15m capital funding. Based on PYX's record as a profitable miner, we expect PYX to be able to acquire the capital it needs for growth. If capital is not available, we expect the company to use cash generated to achieve production growth, albeit at a slightly slower rate.

Currency risk is low

Currency risk: PYX's operational and sales footprint spans international borders, which introduces currency risk. Sales are, however, denominated in US dollars, which mitigates much of this risk.

Valuation

Our fair value for PYX Resources is 82p/share

We value PYX using a sum-of-the-parts methodology, and we and take the simple arithmetic average between the NPV_{10} and P/E of 5x to determine a fair value for the mineral sands operations, and we add an estimate (WHIe) for net cash to arrive at our fair value (Table 1).

We show our discounted cashflow (DCF) model of operations in Table 2. Our model assumes continued growth at Mandiri and the introduction of production from Tisma. Based on our model, we determine a net present value (NPV) discounted at 10%. We apply a subjective risk factor of 60% to our NPV_{10}; this is a reduction compared with our previous note at 90% (report 5.4.2022. The reduction reflects the need to raise capital in difficult markets, if modelled production increases are to be delivered. As PYX is an established producer, we consider that operational and technical risks have improved since our last note.

Secondly, using our forecast financial performance of peer companies (Table 4), we determine a P/E to use for our projected economics in 2028 of 5x. This is a conservative multiplier compared with that we use for peers (5.7x). We also apply a 60% subjective risk factor to our P/E valuation.

We see fair value in PYX at 82p/share.

Table 1: PYX valuation (US$m*)

Asset	Valuation approach	Valuation (US$m)	Valuation (£m)**	Owned (%)	Risk* (%)	Valuation (GBPp/sh)
Mandiri/Tisma DCF	NPV_{10}	877.0	730.8	100	60	97
PYX Resources	5x P/E 2028E	582.0	485.0	100	60	64
Arithmetic average						81
Net cash***	WHIe Sept 2023	7.2	6.0	100	100	1
PYX Resources						**82**

Source: WH Ireland Research.
** Subjective risk*
** WHI est. FX US$: £ = 1.20:1. *** WHI est. Sep 2023. # based on 453m shares in issue

Upsides

We recognise several upsides that could enhance our valuation:

- Australia, globally the most significant producer of zircon, has listed zirconium as a crucial mineral that is vital for the wellbeing of the world's major emerging economies. If Australia were to limit the export of zircon to China (the major processor of zircon globally) for strategic reasons, this would have a material impact on supplies to Chinese processors. In such an event, we would expect demand for other sources of premium zircon (including PYX) to increase, and attract significant premiums.
- Our NPV valuation is modelled based on production out to 2040. Based on the size of available resources and potential to grow them further, we believe operations are likely to continue well beyond 2040, although the value of this distant production is not reflected in our NPV.
- Our DCF is most sensitive to commodity prices (Figures 1, 2, 3 and Tables 5, 6, 7). We apply conservative long-term commodity prices to our DCF. A 20% increase in our forecast zircon prices (from our long-term $2,000/t forecast) would boost NPV_{10} by 32%. Conversely, a 20% reduction in the zircon price used in our model would reduce NPV_{10} by 32%, although remaining very healthy. All else being equal, our DCF would

remain cash-generating if zircon prices were to reduce by over 60%.

WHI model cost inputs

In-house mining and expansion at Mandiri (2022/23), then expansion at Mandiri (2025,) and then addition of Tisma to production (2026)

Capital cost: $18m (WHIe) for bringing Mandiri in-house, and then $15m for each 24kt modular unit at Mandiri and Tisma

Operating cost: $400/t zircon when in full production

Revenue:
Ilmenite $350/t
Rutile $1,700/t
Zircon $2,700/t

Royalty: 1.5%

Export tax: ~$6/t exported

Assumed $45/t land and ocean freight

Financial returns

IRR	n/a
NPV 5% ($m)	1,340
NPV 8% ($m)	1,032
NPV 10% ($m)	877
NPV 15% ($m)	606

Combined Mandiri-Tisma cashflow

Our DCF models production from combining the Mandiri and Tisma operations (Table 3). First zircon production from Tisma is modelled from 2025. Tisma peaks at 100kt in 2029, with Tisma peak production at 50kt, also in 2029.

Zircon is the main revenue driver in our model (>90%) (Figure 3). In 2024, we apply a zircon price of $2,500/t; this tapers to our long-term price of $2,000/t in 2028. Fixed long-term prices for rutile and ilmenite are applied to our model.

As production grows, direct mine site costs reduce from $1,300/t in 2023 to $500/t from 2026 onwards. We add a consideration for transportation, port and ocean costs totalling $45/t of product shipped.

We apply a 1.5% production royalty and a 22% tax rate across the model.

Between 2023 and 2028, we consider $24m in expansion capital. This is required to deliver projected growth. Capital costs are depreciated in our model.

At full production, our DCF indicates that the combined Mandiri-Tisma operation would generate $156m cashflow annually. Our DCF indicates an NPV_{10} of $877m.

Table 2: DCF for the combined Tisma and Mandiri projects

		2023	2024	2025	2026	2027	2030
Mandiri zircon	kt	13.0	18.0	36.0	48.0	50.0	100.0
Tisma zircon	kt			6.0	12.0	24.0	50.0
Ilmenite	kt	2.5	4.0	5.6	8.0	9.5	21.0
Zircon	kt	13.0	18.0	42.0	60.0	74.0	150.0
Rutile	kt	1.0	2.0	3.1	6.3	6.6	8.0
Total production	**kt**	16.5	24.0	50.8	74.3	90.1	179.0
Ilmenite price	$/t	250	300	300	300	300	300
Zircon price	$/t	2,300	2,500	2,300	2,200	2,100	2,000
Rutile price	$/t	1,500	1,500	1,500	1,500	1,500	1,500
Ilmenite gross revenue	$m	0.6	1.2	1.7	2.4	2.8	6.3
Zircon gross revenue	$m	29.9	45.0	96.6	132.0	155.4	300.0
Rutile gross revenue	$m	1.5	3.0	4.7	9.4	9.9	12.0
Gross revenue	**$m**	**32.0**	**49.2**	**103.0**	**143.8**	**168.1**	**318.3**
Port plus Ocean Freight (SE Asia)	$m	(0.7)	(1.1)	(2.3)	(3.3)	(4.1)	(8.1)
Net revenue	**$m**	**31.3**	**48.1**	**100.7**	**140.5**	**164.1**	**310.2**
Direct operating costs	**$m**	**(21.5)**	**(21.0)**	**(30.5)**	**(37.1)**	**(45.0)**	**(89.5)**
Royalty	$m	(0.5)	(0.7)	(1.5)	(2.2)	(2.5)	(4.8)
Export tax	$m						
EBITDA	**$m**	**9.4**	**26.4**	**68.7**	**101.2**	**116.5**	**216.0**
Depreciation	$m	(1.0)	(1.0)	(2.0)	(2.5)	(2.5)	(3.5)
EBIT	**$m**	**8.4**	**25.4**	**66.7**	**98.7**	**114.0**	**212.5**
Interest	$m						
Tax	$m			(7.0)	(15.0)	(25.1)	(46.7)
Operating profit	**$m**	**8.4**	**25.4**	**59.7**	**83.7**	**88.9**	**165.7**
Add back depreciation	$m	1.0	1.0	2.0	2.5	2.5	3.5
PYX corporate costs	$m	(8.0)	(9.0)	(10.0)	(10.0)	(10.0)	(10.0)
Sustaining capex	$m	(0.5)	(1.0)	(1.0)	(1.0)	(2.0)	(3.0)
Expansion capex	$m	(1.0)	(2.0)	(5.0)	(12.0)	(12.0)	
Cashflow	**$m**	**(0.1)**	**14.4**	**45.7**	**63.2**	**67.4**	**156.2**

Source: WH Ireland Research Not gap in years

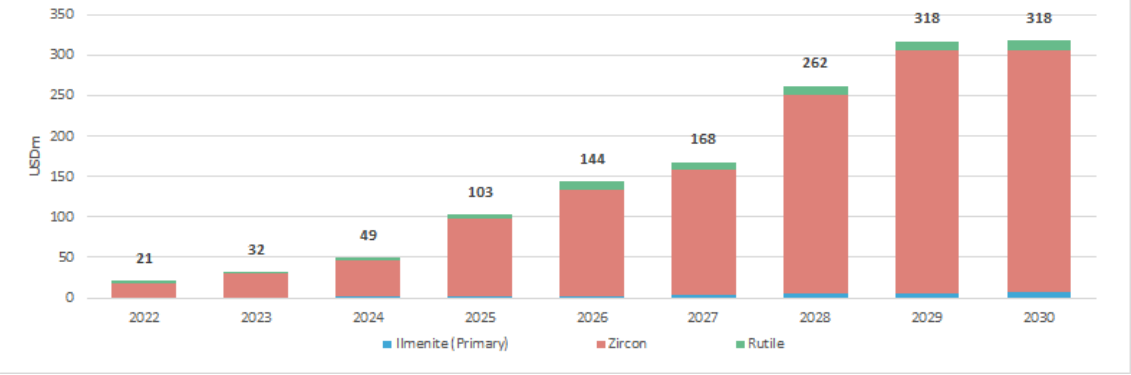
Table 3: PYX Resources – projected total zircon production (kt)

Asset	2023	2024	2025	2026	2027	2028	2029	2030	2031
Mandiri	13.0	18.0	36.0	48.0	50.0	75.0	100.0	100.0	100.0
Tisma	-	-	6.0	12.0	24.0	48.0	50.0	50.0	50.0
PYX total	**13**	**18**	**42**	**60**	**74**	**123**	**150**	**150**	**150**

Source: WH Ireland Research

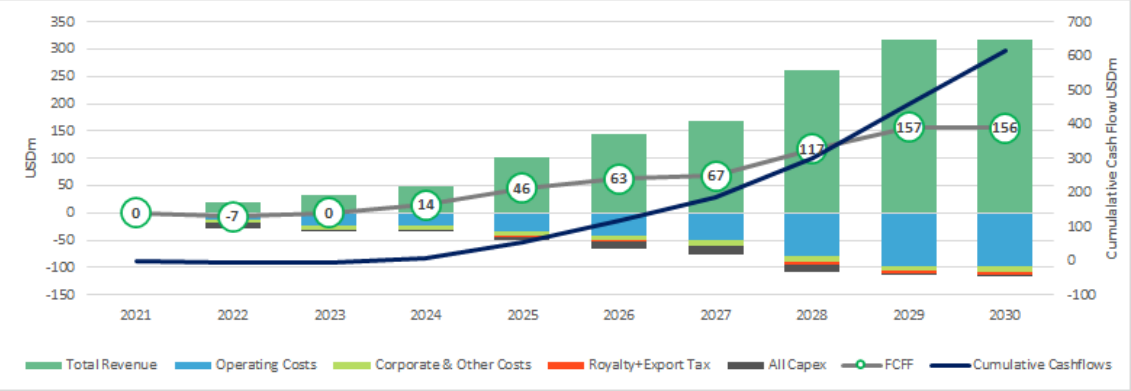
From 2030 onwards, zircon production is projected to remain constant, at 150kt/year

Figure 3: Revenue breakdown by product



Source: WH Ireland Research

Figure 4: Evolution of DCF



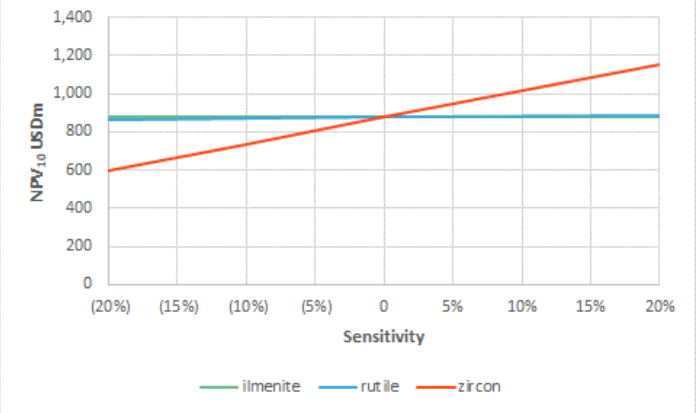
Source: WH Ireland Research

Table 4: Peer producers and forward multiples

	Mkt cap ($m)	EV/EBITDA FY +1	EV/EBITDA FY +2	P/E FY +1	P/E FY +2	EV/EBIT FY +1	EV/EBIT FY +2	P/CF FY +1	P/CF FY +2
PYX Resources Limited*	148.7	9.2	2.6	6.5	2.1	9.2	2.6	6.7	2.0
Iluka Resources Limited	1,892.0	4.9	4.4	11.1	8.8	6.7	5.5	11.4	6.4
Base Resources Limited	93.0	0.0	0.0	8.6	n/m	0.0	0.0	-	-
Kenmare Resources plc	435.5	1.6	1.9	3.0	3.5	2.4	2.8	2.2	1.9
Sierra Rutile Holdings Limited	37.9	0.1	0.1	-	-	0.1	0.2	1.1	1.5
Average		**1.6**	**1.6**	**5.7**	**4.1**	**2.3**	**2.1**	**3.7**	**2.5**

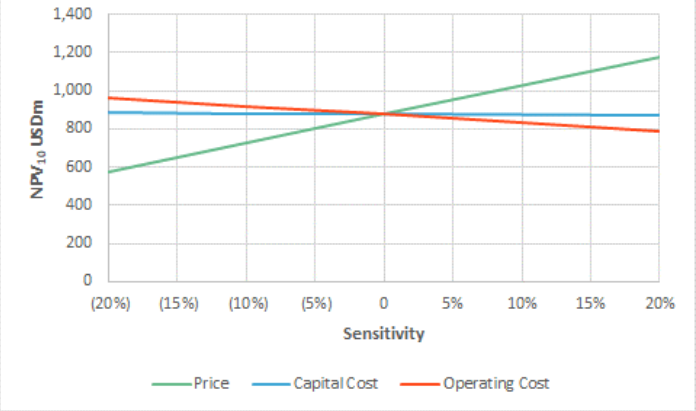
Source: WH Ireland Research, PYX, S&P Capital IQ Pro (data from 13/11/2023) *estimates of financial ratios from WHI economic model

Figure 5: Sensitivity to individual mineral sand prices



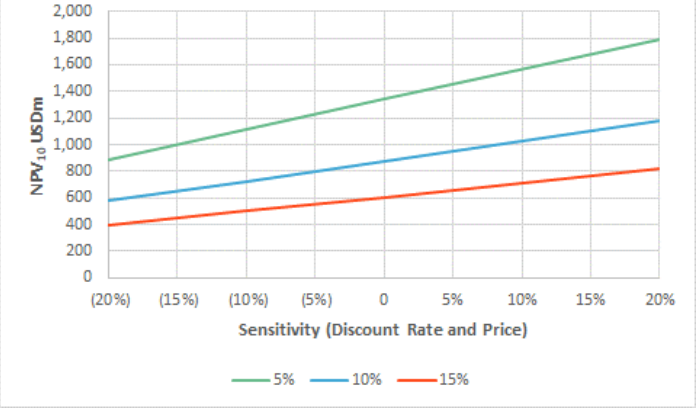
Source: WH Ireland Research

Figure 6: Sensitivity to model inputs



Source: WH Ireland Research

Figure 7: Sensitivity to discount rate and price



Source: WH Ireland Research

Sensitivities

We have sensitised our DCF for mineral sands pricing (ilmenite, rutile and zircon) in Figure 5 and Table 5, capex and opex in Figure 6 and Table 6 and 7, and the discount rate in Figure 7.

The Mandiri and Tisma projects are robust projects, most sensitive to the zircon price. However, the low capex demand and the returns generated mean that they are relatively insensitive to the discount rate.

Low-capex, low-opex and high-grade mean that this is a project to produce meaningful returns, with a resource we view as expandable, which we believe will be company-changing for PYX.

There are obviously different sensitivities for the discount rate. We use our standard mining 10% rate in our analysis, but, with its established production and simple expansion, a lower discount rate could be more appropriate for investors.

Table 5: NPV sensitivity to zircon price $m

DR	(20%)	(10%)	0%	20%	150%
5%	922.4	1,131.2	1,340.0	1,757.5	4,471.7
10%	598.8	7,37.9	8,77.0	1,155.1	2,963.0
15%	409.9	507.9	605.8	801.7	2074.9

Table 6: NPV sensitivity to capex $m

DR	(20%)	(10%)	0%	20%	150%
5%	1,346.9	1,343.4	1,340.0	1,333.1	1,288.2
10%	882.9	879.9	877.0	871.1	832.9
15%	610.9	608.3	605.8	600.8	567.9

Table 7: NPV sensitivity to opex $m

DR	(20%)	(10%)	0%	20%	150%
5%	1,468.4	1,404.2	1,340.0	1,211.6	377.1
10%	962.8	919.9	877.0	791.2	233.4
15%	666.5	636.2	605.8	545.1	150.5

Source: WH Ireland Research DR = discount rate

PYX Resources company background

PYX holds a 100% interest in the fully permitted Mandiri and Tisma mineral sands deposits in Indonesia. The deposits stand out globally for their high-grade and high-value assemblages, and, as near-surface, open-pitable deposits, they are readily minable at low cost.

Among the publicly traded producers, PYX controls the third-largest zircon resource globally (263.5Mt inferred resource). Titanium dioxide products (rutile and ilmenite) add diversification to the mix.

The Mandiri deposit has been in production since 2022, zircon has been sold to international buyers, and, following the awarding of export licences in August 2023, stockpiles of rutile and ilmenite are being sold down.

PYX is trading debt-free, and, as production volumes increase, production costs are falling to boost margins.

Pricing for premium zircon has increased from $1,400/t in January 2021 to $2,100/t in 2Q 2023, and market forecasters suggest that prices will trend upwards, registering a 3.3% CAGR to 2026. As an established producer, we believe PYX is well-placed to benefit from forecast increases in zircon prices.

Figure 8: Project locations

Source: WH Ireland Research, PYX Resources

Mandiri

Mandiri is well-served with infrastructure

The licenced concession area at Mandiri extends over 2,032 hectares in the Kalimantan region of central Indonesia. The Mandiri operation is adjacent to Chayan River and Benjamasin port, facilitating incoming and outgoing shipments. The property also benefits from paved roads and a proximity to electrical grids.

Significant potential remains to grow the Mandiri resource with further exploration

The inferred Mandiri resource (March 2019) is reported at 126Mt, containing an estimated 9.4Mt of heavy minerals, including an estimated 6Mt in zircon. Less than 46% of the property has been explored; with additional exploration, there is significant potential to grow the resource further.

Table 8: Mandiri – MRE (30 June 2021)

Category	Tonnage (Mt)	HM (%)	Slimes (%)	Oversize (%)
Inferred	126.3	7.43	8.98	16.14

Source: WH Ireland Research, PYX Resources

Table 9: Mandiri – mineral resource assemblage

Component	Zircon	Ilmenite	Rutile	Other	Waste + H_20	Total
Relative %	68.0%	9.5%	8.5%	1.0%	13.0%	100%
Contained mineral	6Mt	0.84Mt	0.75Mt	0.09Mt	1.15Mt	8.82Mt

Source: WH Ireland Research, PYX Resources

Mandiri is currently PYX's only operating asset. Operations are simple, requiring minimal stripping and no explosives, prior to front-end loaders feeding alluvial sands into a simple concentration plant. The Mineral Separation Plant (MSP) consists of conventional wet concentration processes, followed by dry mineral separation processing – electronic rolls, electrostatic plates and magnetic rolls.

Figure 9: Processing plant – (left: shaking table, right: electrostatic & electromagnetic separators)

Source: WH Ireland research, CRM Australia, PYX Resources

PYX produces a premium zircon concentrate that is recognised for its exceptional whiteness, low aluminium oxide, and low radium and thorium content

Final products are a premium >65.5% zircon concentrate and titanium dioxide (rutile, ilmenite) by-products. Mandiri's zircon concentrate is recognised for its exceptional whiteness, low aluminium oxide content, and low thorium and uranium content.

PYX has been exporting zircon from Mandiri since 2022, and was awarded licences to export rutile and ilmenite in August 2023.

Plans are in place to double the capacity of current mineral processing circuits from 24kt currently to 48kt by 2026.

Tisma

The licensed concession area at Tisma extends over 1,500 hectares in central Kalimantan.

An inferred resource (November 2020) at Tisma measures 137Mt, including an estimated 5.5Mt of heavy minerals and 4.5Mt of zircon. Metallurgical studies show that Tisma has a unique mineral assemblage, with a zircon content of 82%.

In February 2023, the Tisma mining licence was extended for 10 years, allowing for the extraction of up to 48kt of premium zircon annually.

The introduction of production from Tisma would introduce synergies and economies of scale

The introduction of production from Tisma, on top of production from Mandiri, would introduce synergies and economies of scale.

Table 10: Tisma – MRE (30 June 2021)

Category	Tonnage (Mt)	HM (%)	Zircon (%)	Slimes (%)	Oversize (%)
Inferred	137.2	3.99	3.27	14.75	24.90

Source: WH Ireland research, PYX Resources

Table 11: Tisma – mineral resource assemblage

Component	Zircon	Ilmenite	Rutile	Other	Waste + H_20	Total
Relative %	68.0%	9.5%	8.5%	1.0%	13.0%	100%
Contained mineral	6Mt	0.84Mt	0.75Mt	0.09Mt	1.15Mt	8.82Mt

Source: WH Ireland research, PYX Resources

Mineral sands

PYX mines heavy mineral sands to produce two main products, zircon (zirconia and zirconium) and titanium dioxide (rutile and ilmenite).

Mineral sands are old beach, dunal or alluvial sands that contain significant proportions of "heavy" minerals, which have been separated out by physical processes (wave, wind, river, tide) due to their physical (and chemical) resistance and their specific gravity. They usually lie at or close to the surface and are unconsolidated, meaning they are easy to dig or dredge, and are separated firstly into HMC and then into their constituent parts by physical process – density, magnetic and electrostatic properties. Deposits actively form at the beach, with further upgrade possible due to wind on old dunes, away from the sea. Due to changes in sea level, over time, there can also be a series of "fossil" deposits behind the new coast where the former coastline used to be.

Zircon [$ZrSiO_4$] is typically (50%) used in the ceramic industry for glazes on tiles, and as an opacifier for kitchen and bathroom tiles, dinnerware, and decorative ceramics. 25% is also used in the foundry and refectory industries due to its resistance to high temperature corrosion and thermal shock.

Ilmenite [$FeTiO_3$] and **rutile** [TiO_2] are principally (90%) used as feedstocks to produce titanium dioxide (TiO_2) pigment for the manufacture of paints and other coatings (50%), plastics (25%) and paper as well as a number of other applications, including cosmetics, food additives, ceramics and textiles. TiO_2 pigment is favoured for its brilliant whiteness, ultraviolet protection, non-toxicity, inertness, and its "covering power" (it disperses light as a result of its high refractive index). Titanium metal and welding electrode applications account for the remaining 10% of global TiO_2 feedstock consumption. Titanium metal's unique properties, including its high strength-to-weight ratio, high melting point and its resistance to corrosion and chemical attack make it the preferred metal for a number of demanding applications.

The Australian Government classes zircon, rutile and ilmenite as crucial minerals – minerals that are vital for the economic wellbeing of the world's major emerging economies. The USA publishes a list of critical minerals (the 2022 Critical Minerals List) that identifies critical minerals and materials used in many products important to the United States' economy and national security; this list includes zirconium.

Mineral sand deposits are typically large and require significant capital to come online. Few new deposits have been brought into production in the last 20 years, and reserves are being exhausted. As demand for mineral sand products accelerates, driven, in large part, by urbanisation of the populations of emerging economies, a structural supply gap of around a 3.3% CAGR is forecast by market commentators.

Zirconium

Zirconium (zircon) is a lustrous, grey-white transition metal with a number of physical properties that make it suitable for use in a wide range of industries; these properties include opacity, hardness, low thermal expansion, low conductivity, a high melting point, chemically inert and low neutron absorption.

The most significant traditional demand for zircon is the ceramics industry (50% of demand), which uses zircon as an opacifier in ceramics to give a white, opaque finish. The thermal characteristics of zircon make it suitable for use in aggressive, high-temperature environments. It is often used to form moulds for molten metals.

Fast-growing carbon zero industries increasingly use zircon. Although demand is still small, overall, the rate of growth in these industries is ten times greater than that of traditional demand.

The solar industry increasingly uses white zirconium oxide in solar panels because of its low thermal absorptance and superior solar selectivity compared with conventional materials. The use of zirconium in solar panels boosts their efficiency, and enhances their environmental impact.

Low-neutron absorption makes zirconium suitable for use in alloy form in the cladding of nuclear reactors.

Other demands include additive manufacturing, semiconductors, implants, fuel cells, batteries, electronics, fuel rods, paper, brake pads and catalysts.

Titanium minerals

Titanium minerals (rutile and ilmenite) are used in a wide variety of applications.

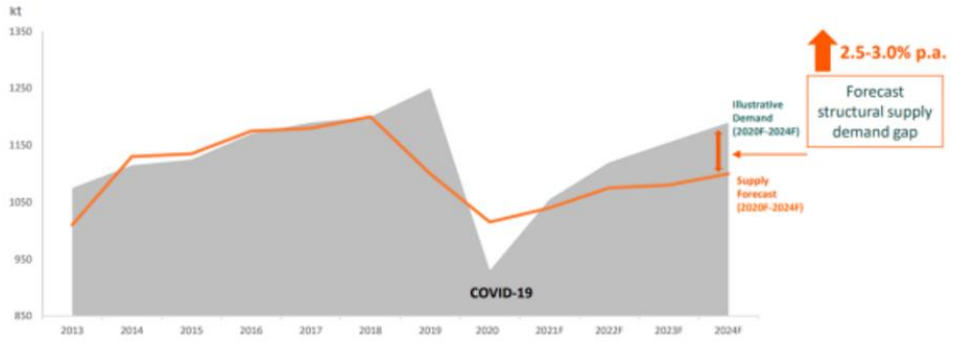
Rutile crystals are recognised for their high refractive index at visible wavelengths. Because of its optical qualities, rutile is widely used in the manufacture of paint, ink, make-up and suncream.

Ilmenite is the principal source of titanium and titanium dioxide, which are important components in the defence and aeronautics industries.

Outlook and price

Zircon is the principal revenue generator for PYX. Global zircon demand is forecast to grow at a CAGR of 3%, with demand currently set to outpace potential supply (Figure 10).

Figure 10: Zircon supply and demand



Source: WH Ireland research, PYX Resources, Iluka, TZMI, Sheffield Resources, Strandline Resources

Figure 11: Zircon price history

Source: WH Ireland Research, PYX Resources, Iluka, TZMI, Sheffield Resources, Strandline Resources

Shareholders

Significant shareholders are summarised below, in Table 12.

Table 12: 20 largest shareholders (31 December 2022)

Ordinary shareholders	Number of ordinary shares	Percent holding
Computershare Clearing Pty Ltd <CCNL DI A/C>	107,557,398	24.37%
Phoenix Fund Solutions Limited	92,520,635	20.96%
Cedrus Investments Ltd <Nominees 2 A/C>	84,822,342	19.22%
TGN Holdings (HK) Limited	51,638,685	11.7%
Citicorp Nominees Pty Limited	42,361,688	9.6%
Jura Ventures Limited	13,000,000	2.95%
BNP Paribas Nominees Pty Ltd (Group #48232)	12,758,533	2.89%
Cedrus Investments Ltd <Nominees 1 A/C>	11,965,373	2.71%
Edelweiss Partners Limited	7,920,710	1.79%
Sino Ventures Limited	5,934,257	1.34%
HSBC Custody Nominees (Australia) Limited (Group #56367)	2,593,410	0.59%
Augment Holdings Ltd	1,023,720	0.23%
HSBC Custody Nominees (Australia) Ltd <GSCO Customers A/C>	1,000,000	0.23%
Lightglow Enterprises Pty Ltd <Paloma Investments A/C>	759,964	0.17%
Apezo Pty Ltd	740,000	0.17%
HSBC Custody Nominees (Australia) Limited	700,000	0.16%
BNP Paribas Nominees Pty Ltd ACF Clearstream	510,114	0.12%
Brad Hawkins Consulting Pty Ltd	431,000	0.1%
Mr. Julian Lionel Sandt	315,000	0.07%
Mr. Ross Edward Cargeeg	245,000	0.06%
Total	**438,797,829**	**99.42%**

Source: WH Ireland Research, PYX Resources

PYX team

Board members

Oliver B. Hasler – Chairman and Chief Executive Officer: Oliver is an accomplished chief executive, president and board member, successfully leading world-class businesses and brands spanning multiple industries and markets, including natural resources, agroindustry, innovative manufacturing, and various industrial sectors. He was named in the Top 50 CEOs' list in Spain by Forbes magazine.

Oliver is a Swiss citizen. He has a degree in Materials Engineering and a master's degree 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.

Raden Sukhyar – Non-Executive Director: Dr. Sukhyar, a highly regarded geologist and Indonesian executive, has vast experience and knowledge of operating in Indonesia, including key government roles. He was Head of the Indonesia Geological Agency from 2008 to 2013, and Director General of Mineral and Coal, Ministry of Energy and Mineral Resources from 2013 to 2015. From 2016 to 2019, he was adviser to the Minister of Industry of the Republic of Indonesia. He served as a commissioner of state-owned mining enterprises PT Timah (2002-08), PT Aneka Tambang (2011-15) and PT Petamina Geothermal Energy (2006-09). He has been an independent commissioner of PT Vale Indonesia since 2018.

Dr. Sukhyar received his bachelor's degree in Geology Engineering from Institut Teknologi Bandung ("ITB"), Bandung, Indonesia, in 1980. In 1990, he obtained his Doctorate Degree (Ph.D) in Earth Science from Monash University, Melbourne, Australia.

Alvin Tan – Non- Executive Director: Alvin has more than 25 years' corporate experience in Australia and Asia, including mergers, acquisitions, capital raisings and listings on the Australian Stock Exchange (ASX), the AIM market of the London Stock Exchange, the Kuala Lumpur Stock Exchange (KLSE) and the German Stock Exchange.

Alvin studied at the University of Western Australia, gaining a Bachelor of Commerce degree with honours, and he was subsequently employed by KPMG in Kuala Lumpur, from 1993 to 1995, as a financial consultant. Returning to Australia, Alvin worked with the stockbroking firm, DJ Carmichael, before pursuing other business interests.

Bakhos Georges – Non- Executive Director: Bakhos has more than 40 years of experience in management and operation in the wholesale, retail and pharmaceutical sectors, with significant, direct involvement in internationally focused import and export operations.

Bakhos received a B.Ph.Chem from the University of Santa María in Caracas, Venezuela, in 1982.

Financials

We present high-level forecasts for PYX in Table 13. Our forecasts consider a projected cashflow based on projected continued growth at Mandiri and the introduction of production from Tisma from 2026 – in line with our DCF valuation in Table 2 and our production forecasts in Table 3.

Table 13: Financial statements – model snapshot

PYX Resources SNAPSHOT (AIM:PYX)
Share price: 16.8p
Dated: 10 November 2023
Market capitalisation: £119m
Recommendation: Corporate

Key ratios/metrics	2020	2021	2022	2023E	2024E	2025E	2026E
EPS (p)	(5.8)	(1.1)	(2.2)	(2.8)	3.2	10.0	15.0
P/E (x)	(2.9)	(15.7)	(7.7)	n/m	5.3	1.7	1.1
FCFPS (p)	(1.2)	(0.8)	(1.4)	(1.2)	2.5	9.1	12.7
Dividend/share	-	-	-	-	-	-	-
Dividend yield	-	-	-	-	-	-	-
Weight average shares in issue (m)	238	405	436	445	453	453	453
Currency	USD	USD	USD	USD	USD	USD	USD
Year-end June							
Income statement ($m)	**2020**	**2021**	**2022**	**2023E**	**2024E**	**2025E**	**2026E**
Revenue	9.0	12.4	22.7	25.0	48.1	100.7	140.5
Operating costs	(7.6)	(10.5)	(17.3)	(19.0)	(22.7)	(34.0)	(41.8)
Gross profit	**1.3**	**1.9**	**5.4**	**6.0**	**25.4**	**66.7**	**98.7**
Other	(7.1)	(1.3)	(2.8)	(8.0)	1.0	2.0	2.5
Overheads	(8.2)	(5.1)	(11.9)	(8.7)	(10.1)	(12.3)	(13.3)
Depreciation	(0.1)	0.0	0.0	(1.0)	(1.0)	(2.0)	(2.5)
Operating profit/(loss)	**(14.1)**	**(4.5)**	**(9.3)**	**(11.7)**	**15.3**	**54.4**	**85.4**
Other adjustments	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Profit before tax	**(14.1)**	**(4.5)**	**(9.3)**	**(11.7)**	**15.3**	**54.4**	**85.4**
Tax	0.3	0.2	(0.2)	(1.0)	(1.0)	(2.0)	(2.5)
Profit after tax	**(13.8)**	**(4.3)**	**(9.5)**	**(12.7)**	**14.3**	**52.4**	**82.9**
Balance sheet ($m)	**2020**	**2021**	**2022**	**2023E**	**2024E**	**2025E**	**2026E**
Non-current assets	**1.7**	**76.1**	**77.9**	**75.1**	**76.1**	**80.1**	**90.6**
Cash and cash equivalents	3.5	6.6	7.2	6.8	18.1	59.6	116.9
Other current assets	0.9	2.1	4.0	3.6	3.6	3.6	3.6
Current assets	**4.4**	**8.7**	**11.2**	**10.5**	**21.8**	**63.2**	**120.5**
Total assets	**6.2**	**84.8**	**89.1**	**85.6**	**97.9**	**143.3**	**211.1**
Total non-current liabilities	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total current liabilities	1.6	1.8	5.6	8.0	5.0	5.0	5.0
Total equity	4.5	83.0	83.6	77.6	92.9	138.3	206.1
Total equity and liabilities	**6.2**	**84.8**	**89.1**	**85.6**	**97.9**	**143.3**	**211.1**
Net assets	**4.5**	**83.0**	**83.6**	**77.6**	**92.9**	**138.3**	**206.1**
Cashflow statement ($m)	**2020**	**2021**	**2022**	**2023E**	**2024E**	**2025E**	**2026E**
Profit for the year	(2.0)	(2.1)	(4.2)	(4.9)	13.3	45.4	67.9
Depreciation	0.1	0.0	0.2	1.0	1.0	2.0	2.5
Other	(0.2)	(0.2)	0.0	0.0	0.0	0.0	0.0
Cash from operating activities	**(2.1)**	**(2.3)**	**(3.9)**	**(3.9)**	**14.3**	**47.4**	**70.4**
Net cash used in investing	**(0.8)**	**(1.1)**	**(2.0)**	**(1.5)**	**(3.0)**	**(6.0)**	**(13.0)**
Net cash used in financing	**6.3**	**6.8**	**6.9**	**5.0**	**0.0**	**0.0**	**0.0**
Net change in cash and cash equiv.	**3.4**	**3.4**	**0.9**	**(0.4)**	**11.3**	**41.4**	**57.4**
Opening cash and cash equiv.	0.1	3.5	6.6	7.2	6.8	18.1	59.6
Effect of FX	0.1	(0.3)	(0.3)	0.0	0.0	0.0	0.0
Closing cash and cash equiv.	**3.5**	**6.6**	**7.2**	**6.8**	**18.1**	**59.6**	**116.9**
EV/EBITDA (x)	(8.1)	(24.8)	(12.1)	(10.5)	6.9	2.0	1.3

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As at the month ending 31st October 2023 the distribution of all our published recommendations is as follows:

Recommendation	Total Stocks	Percentage %	Corporate	Percentage %
Corporate	65	100.0	65	100.0
Buy	0	0.0	0	0.0
Speculative Buy	0	0.0	0	0.0
Outperform	0	0.0	0	0.0
Market Perform	0	0.0	0	0.0
Underperform	0	0.0	0	0.0
Sell	0	0.0	0	0.0
Total	**65**	**100.0**	**65**	**100.0**

Valuation and Risks

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A draft of this research report has been shown to the company following which factual amendments have been made.

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Company/Issuer Disclosures

Company Name	Table of interest number	12-month recommendation history	Date
PYX Resources (PYX)	4,5	Corporate	05.04.22

https://www.whirelandplc.com/capital-markets/research-recommendations

Companies Mentioned

Company Name	Recommendation	Price	Price Date/Time
Iluka Resources Limited	No Rec	AUD 7.15	13/11/2023 16:30
Kenmare Resources plc	No Rec	GBP 3.98	13/11/2023 16:30
Base Resources Limited	No Rec	GBP 0.06	13/11/2023 16:30
Sierra Rutile Holdings Limited	No Rec	AUD 0.13	13/11/2023 16:30

Headline	Date
A high margin producer of premium zircon	05.04.2022
Growing production, increasing margins	17.11.2023

Recommendation	From	To	Analyst
Corporate	05.04.2022	present	CA

Current Analyst (CA), Previous Analyst (PA)

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