

Sheffield Resources Ltd (SFX AU, \$0.55)

Thunderbird: a solution to the world's declining zircon reserves from a Tier 1,+25% IRR project

- The recently released Thunderbird BFS confirms our view that the project is of Tier 1 quality with strong project economics. The project is dominated by zircon (appr. 54% of total revenues in the first 10 years, 35% ilmenite and 11% HiTi and titanomagnetite).
- Headline financial metrics point to a bankable project with a post-tax IRR of over 20% and a pre-tax NPV(10) of A\$675m, at reasonable commodity price and FX assumptions.
- Our valuation of Thunderbird is A\$794m (pre-tax) with an estimated IRR of 26.3%, (vs BFS of 24.9%), largely a result of different underlying commodity price assumptions. We have assumed a zircon price of US\$1250 going forward (vs the BFS \$1387/t long term), and US\$220/t for sulphate ilmenite (vs BFS of \$183/t).
- At spot commodity prices (ilmenite US\$190/t, zircon US\$1050/t) and FX (0.75) we estimate the project's NPV at A\$463m pretax (IRR of 20.3%) and A\$259m post-tax (IRR 16.3%).
- Technical issues (surface induration, trash minerals in the heavy mineral concentrate) have been comprehensively studied in the BFS, with solutions obtained and signed off by study leader Hatch Engineering.
- Specialist mineral sands consultants TZMI estimate that Thunderbird will be a high margin producer (top of the second highest quartile on the margin curve).
- A 681 million tonne/13.3% HM reserve provides the basis for a 42 year mine life.
- Off-take discussions for zircon are well advanced and 3 non-binding MOUs have already been signed with Indian and European end-users, for around 40% of Thunderbird's Phase 1 output.
- The company has engaged corporate advisors to present options to allow the funding of Thunderbird. We understand options include off-take financing, a sell down at the project level, debt and equity.
- Finalisation of permitting (environmental, native title, grant of ML) is expected by 3Q 2017.
- Mineral sand prices perform late in the commodity cycle, partly due to inventory issues. The other bulk commodities, especially coking coal and iron ore have already run hard over the course of 2016-17. Spot sales of ilmenite into China are already above US\$200/t (FOB), from lows of US\$80/t in 2016 with key experts (TZMI and Industrial Minerals) focussed on tight markets for sulphate ilmenite.
- A mis-read of the Chinese pigment industry by feedstock producers has left the market short sulphate quality ilmenite. This we believe is unprecedented in the history of ilmenite production and should keep sulphate ilmenite prices stronger for longer.
- There are few new zircon projects available to fill a forecast zircon deficit over the next 5 years. Prices bottomed in 2016 at US\$850/t, and have since recovered to around US\$1050/t. A significant supply deficit is forecast to develop over the next 3 years, allowing entry of new, zircon-rich sources of supply.

The Thunderbird Project

- Sheffield’s core asset is 100% of the Thunderbird mineral sands deposit (zircon and ilmenite predominantly), located in the Kimberley region (WA). In mid-March 2017, management announced the release of the Hatch-led bankable feasibility study, 15 months in its preparation. Hatch is a highly credentialed speciality engineering that has undertaken mineral sands projects for the majors including Rio Tinto.
- Key outcomes from the BFS are as follows:
 - **A two phase project enabling the staging of capex.** A\$348m is needed for phase 1. Total capex for the 2 phase project is A\$543m (excluding sustaining capital), with A\$195m required to double plant capacity from year 5. This is around 20% higher than our earlier estimates, and 17% higher than the revised PFS number.
 - **Higher capex has driven significantly higher ilmenite production levels than we had expected.** Peak production in years 5 – 10 is estimated at 516ktpa low temperature roast (LTR) ilmenite (our estimate was 398ktpa) and around 133ktpa zircon (premium and in concentrate), in line with our estimate.
 - **What is comforting is that the project is not particularly sensitive to capex.** A 10% rise in capex results in only a 7% decline in NPV(10). This is supported by (1) very strong early cashflows and (2) the very long mine life.
- The production profile is illustrated in the following chart from the BFS. We have amended our estimates accordingly.

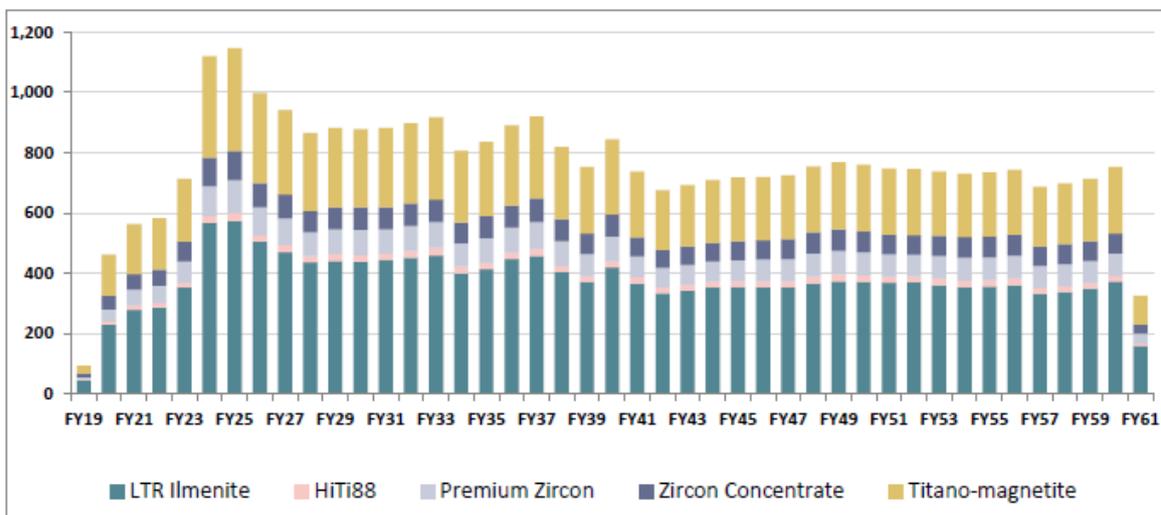


Figure 3: Annualised production of Final Products over Life of Mine (Kt)

Source: Sheffield Resources, March 2017

- **How does this compare with the PFS?** As with our own estimates, early ilmenite production is much higher than presented in the PFS, but comparable on an LOM basis. Zircon, the LOM production estimate was 100ktpa of premium zircon. Now, Thunderbird will produce a greater proportion of zircon in concentrate (ZIC, to be sold into China). Total zircon production from both sources will be around 100-110ktpa, LOM.
- **The big difference with the PFS is the production profile.** The BFS is forecasting a slower ramp up, Phase 2 is now starting in Year 5 (vs Year 7 in the PFS) and then very strong production levels driven by a pull-forward of grade as SFX focuses on Thunderbird’s high grade core.

- **Favourable cash costs.** SFX commissioned TZMI to prepare a cost curve (using the Iluka revenue to cost methodology). Thunderbird is favourably positioned, located at the top of the 2nd highest margin quartile. This is not unexpected from our earlier work.

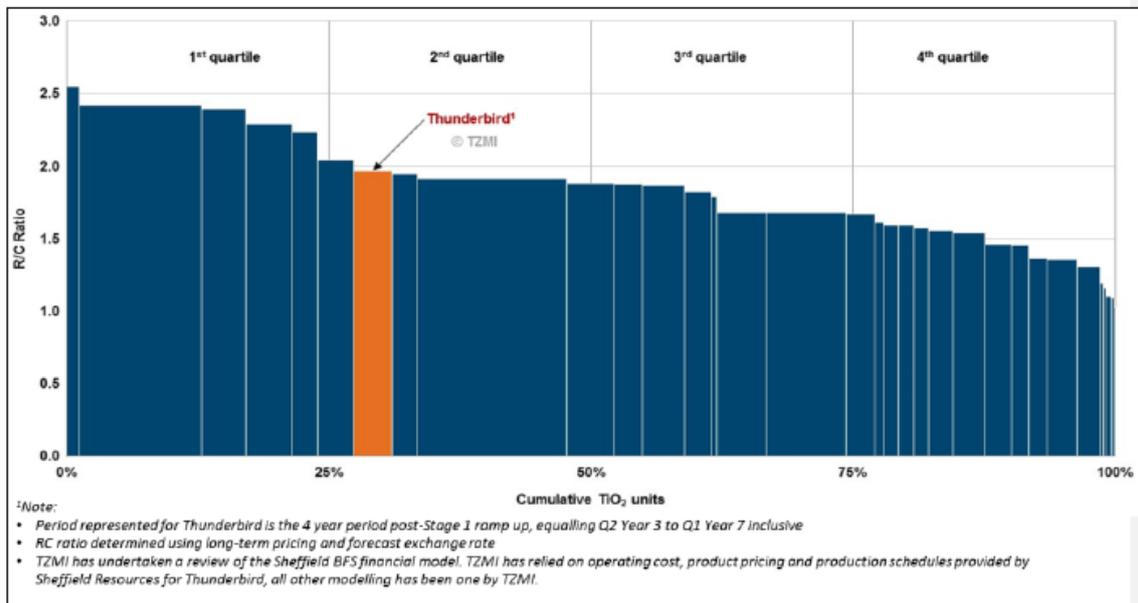


Figure 2: TZMI 2020 Industry Revenue to Cash Cost Curve

Source Sheffield Resources BFS support documents, March 2017

- Comparing with the PFS, the headline Revenue/Op cost measure are the same: 2 to 1, at much the same commodity price assumptions.
- **The mine life?** JORC reserves of 42 years.
- **Commodity price assumptions underlying the BFS.** SFX have used long term numbers recommended by TZMI (US\$1,387/t for zircon have ramped them up from current spot levels over the next 5 years. This generates a \$1,287/t estimate for the first 5 years. We are reasonably comfortable with that number, but have taken a more conservative US\$1250/t flat in our estimate. They have used a recommended US\$183/t for ilmenite, which we think is low (and is less than the current spot price). We are now using US\$220/t (FOB) which we think is still quite conservative given a structural shortage of ilmenite suitable for the sulphate process. A\$/US\$ is set at 0.75 flat.
- **Together these production, cost and commodity price assumptions make for an attractive project.** An IRR of over 20% with a 40% EBITDA margin based on mid-cycle commodity prices yields a very attractive project, in our view.

\$Am, Real 2017 Prices	
Pre-Tax Project NPV (10)	675.6
Pre-Tax IRR %	24.9
Post-Tax Project NPV (8)	620.4
Post-Tax IRR %	20.6
Peak revenue	460
Peak EBITDA	250
PEAK EBITDA margin	54%
LOM revenue, average	304
LOM EBITDA, average	123
LOM EBITDA margin	40%

Source: SFX report, 24/3/17

Release of the BFS

Sheffield's management are to be congratulated for the amount of detail provided from Hatch's bankable feasibility document. On top of the 60 pages released to the ASX, the company has provided access to summaries of all segments of the BFS. These include the following, and amount to some 650 pages. This is as close as it gets to a Toronto Stock Exchange NI43-101, and is probably unprecedented in the Australian investment environment. The report is available on Sheffield's web site. (www.sheffieldresources.com.au)

Chapter 01 - Executive Summary

Chapter 02 - Introduction

Chapter 03 - Reliance on Other Experts

Chapter 04 - Accessibility Climate Physiography and Infrastructure

Chapter 05 - Ownership and Legal Obligations

Chapter 06 - Tenure and Approvals

Chapter 07 - Mining Acts and Regulations

Chapter 08 - Native Title

Chapter 09 - Environmental Studies and Stakeholder Engagement Reprint

Chapter 10 - Human Resources

Chapter 11 - History

Chapter 12 - Geology and Mineralisation

Chapter 13 - Mineral Resource Estimation

Chapter 14 - Mine Geotechnical

Chapter 15 - Hydrology and Hydrogeology

Chapter 16 - Mining

Chapter 17 - Tailings

Chapter 18 - Metallurgy and Process Selection - WCP and MSP Facilities

Chapter 19 - Metallurgy Variability Test Work

Chapter 20 - Processing Plant - WCP and MSP

Chapter 21 - Project Infrastructure and Services - General

Chapter 22 - Power Generation

Chapter 23 - Permanent Accommodation Village

Chapter 24 - Port and Marine Facilities

Chapter 25 - Product Logistics

Chapter 26 - Market Analysis

Chapter 27 - Operations Management

Chapter 28 - Project Execution

Chapter 29 - Capital Cost

Chapter 30 - Operating Cost

Chapter 31 - Financial Analysis

Chapter 32 - Conclusion Risk Opportunity Further Work

It is well beyond the scope of this document to summarise this work.

Key technical and marketing issues addressed in the BFS

We are of the view that it is most relevant to tackle the issues and risks we identified in our October 2016 report and discuss how Hatch and associated consultants have dealt with them.

- ✓ ***The sandstone host rock is indurated (cemented) and may create difficulties in mining. Is this an issue?***

We continue to hear stories of indurated rock (or so-called coffee rock) within the Thunderbird resource. In our minds, the BFS has put that issue to bed.

As we know, Thunderbird is an unusual mineral sand deposit, hosted in very weathered rocks of the Canning Basin. In the near-surface environment where mineralisation comes close to the surface a weakly indurated crust can occur. But below the crust the ore becomes increasingly weathered and softer with depth. As well, typically on the periphery of the deposit are outcrops of the Melligo Sandstone, which is variably indurated.

Hatch’s consultants have undertaken a detailed review of the hardness of the deposit and associated overburden and concluded that the indurated crust can be dealt with by the proposed earth moving equipment. A detailed review of geotechnical information obtained from drilling and from the three 9 metre deep trenches bulldozed last year, have generated the following data:

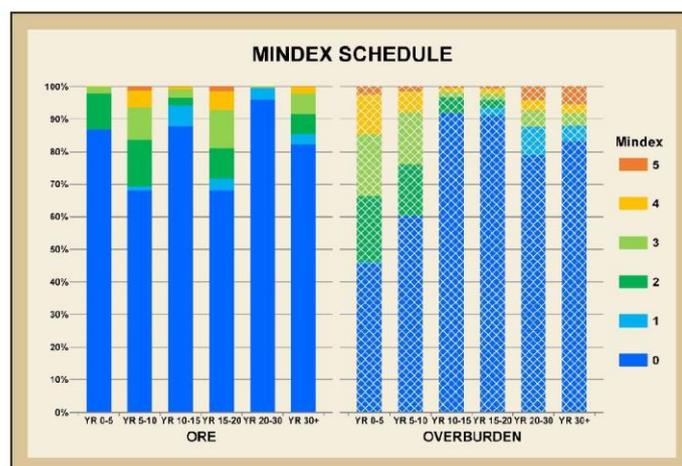


Figure 14-14: MINDEX Schedule

Table 14-8: Description of MINDEX Indicators, and Relative Proportions of Each in the Resource Model

MINDEX Indicator	Excavatability	Mining Oversize Probability	Model Proportions		
			Waste	Ore	All
0	Easy Dig or Push	Very Low	82.3%	83.0%	82.7%
1	Easy Dig or Push	Very Low	4.7%	3.2%	3.8%
2	Hard Dig or Push	Very Low	2.3%	5.9%	4.3%
3	Easy Rip, Dig or Push	Low	4.5%	5.3%	5.0%
4	Easy-Hard Rip, Dig or Push	Moderate	2.9%	2.2%	2.5%
5	Hard Rip, Dig or Push	High	3.3%	0.4%	1.7%

Source Sheffield Resources BFS support documents, March 2017

There is no “coffee rock” as is conventionally recognised in the mineral sands industry. Coffee rock is an extremely indurated iron-bearing pisolitic laterite, typically associated with the weathering of coastal or dune sands. It is often an issue for dredge mining of mineral sand deposits, where the dredge is not configured to deal with hard rock.

At Thunderbird, induration seems to be associated with the local weathering profile where slightly increased iron cementation occurs in the near surface weathered sandstone ore horizon. All materials appear to be amenable to ripping by ‘dozers, and the induration decreases with depth as the ore horizon becomes increasingly weathered. In total under 2% of waste plus ore are “hard rip, dig or push”. And over 80% is “easy dig or push”.

The early years of overburden removal will be the most expensive, with around 15% of the overburden requiring ripping.

We believe the BFS has adequately addressed the indurated overburden issue and built in the additional costs for ripping of indurated material near surface.

✓ ***The metallurgy of Thunderbird appears still to be the largest concern. What are the issues?***

It seems to us that much of the criticism of Thunderbird’s metallurgy is based on a lack of understanding of the proposed metallurgical circuit. We have spent time discussing specific issues with metallurgical consultants. (All discussions were around publicly available information). Those contracted by Hatch and Sheffield are some of the best in the world: Hatch and Robbins are unquestionably ‘best in class’. And given the current malaise in the mining sector, SFX have employed the “A Team” from both groups.

It’s fair to say that Thunderbird is not like the iconic rutile and zircon deposits of the East Coast of Australia. But nothing is anymore. Those reserves have already been mined out. Thunderbird is part of the new generation of mineral sand deposits. Metallurgical issues were identified early in the exploration of the deposit.

The following issues still appear to be worrying investors:

- ***The grain size of the orebody is fine which may cause problems in the wet concentrate plant (WCP). Is this the case?***

IHC Robbins (and Hatch) have been able to select appropriate spiral technology to ensure good performance from the wet concentrating plant. Overall heavy mineral recovery is quoted at 68.3%, with zircon recoveries a remarkable 90.6% and TiO₂ recovery of 83.8%. The established producers never report met recoveries, so it is difficult to compare. But we would be surprised if Thunderbird’s recoveries are much lower than industry average. ***The fine size of Thunderbird’s product has been addressed with appropriate equipment selection.***

- ***Thunderbird has a high proportion of slimes (clay) which could result in tailings disposal issues.***

We had heard that the slimes levels (less than 38 micron) was as moderately high. In fact, the average slimes content in the Ore Reserve is 15.7% which is typical of this style of deposit and much less than some currently being mined (ie Kwale at 26%). Testing of bulk samples has delivered a 7.5% slimes content, with comments that the slimes can be easily thickened, and will therefore be suitable for co-disposal in the mining void. Furthermore the clay proportion of the slimes is relatively low. ***We believe that slimes will not be an issue at Thunderbird.***

- ***50-60% of the heavy minerals assemblage is trash. How does that make Thunderbird a viable project?***

Early in the history of the project it was simply too hard to produce an economic concentrate. Put simply, the heavily weathered nature of the mineral assemblage has liberated a variety of iron oxide minerals which are largely worthless, and are difficult to separate from the valuable heavy mineral assemblage. Zircon could be recovered, but ilmenite at an economic grade could not.

Met consultant Robbins and its associates, who had been working on Thunderbird's metallurgy, were quick to deliver an outcome. Interestingly the solution was simple, and was actually beneficial to the mineral assemblage.

The use of low temperature roasting (LTR) is a means by which the iron oxides can be separated from the valuable heavy minerals. This enables the production of a high TiO₂ ilmenite, which has excellent acid solubility characteristics, and may command a price premium from sulphate pigment producers. Moreover, the iron oxides are converted by the LTR process to a saleable product (titanomagnetite). More comments on both issues are in the section on Markets which follows.

All this comes with additional capital for the roaster, and operating cost, but this is partly offset by the delivery of more marketable products earlier in the project's life.

In summary, we believe the issue of high levels of trash have been comprehensively addressed in the BFS and the LTR circuit enables the production of ilmenite with highly suitable characteristics for the sulphate pigment producers.

Not all ilmenites are the same. *The sulphate pigment producers have a particular requirement of a high iron II to iron III ratio which increases the reactivity of the ilmenite in sulphuric acid, which in turn encourages the solubility if the contained titanium. The higher the titanium content the better. Low temperature roasting of Thunderbird ilmenite produces just such a product. Furthermore the levels of impurities such as Cr and Al are well within quality guidelines. As well Ca and Mg contents are low, which could make Thunderbird ilmenite suitable for the chloride pigment route. Thorium levels are higher than competing slag products, but they fall within limits for transportation.*

- **What about the hard ironstone in the plant?** It has been established that the coarse ironstone can be effectively screened at 2mm while delivering recoveries of over 98% of both ZrO₂ and TiO₂.
- ✓ **Capex, it's \$53m higher than the revised PFS number. Why?** Perhaps disappointingly the capex is significantly higher than the revised PFS estimates. The bulk of the A\$53m increase is attributed to the wet concentrate plant (\$8m) and low temperature roaster (\$25m). If there were to be any surprises it will have been the plant. **It should be noted that the roaster has been designed to incorporate volumes from Phase 2.**
 - ✓ **What are the key environmental issues?** The project's PEA was lodged later than we expected and was opened up for public comment in January 2017. Since then 52 submissions have been lodged, and are overwhelmingly positive. The sole issue of any significance is to do with the Greater Bilby, a potentially at risk marsupial species, for which management plans will be put in place. Environmental approvals are now expected in 3Q17, a couple of months later than we expected. **We see no reason to see delays to the granting of a mining licence over Thunderbird.**
 - ✓ **We haven't heard much about Native Title. Is this now on the critical path?** Sheffield have been under a confidentiality cloud on this issue since day 1, so management has been very careful about public statements. A heritage clearance survey was completed in 2016 and no issues were found. Subsequently SFX commenced negotiations with the Native Title party but an agreement could not be reached. This has since been referred to the Native Title Tribunal which is expected to provide recommended terms for the agreement in the current quarter. **We do not see Native Title issues as a show stopper and are expecting an announcement on its resolution soon.**
 - ✓ **Timing of the project? What's the risk of delay?** As we understand it Sheffield are very keen to start site works before the start of the wet (November) so will want to commence roadworks prior to that. Assuming grant of the ML and other miscellaneous in say August, this will allow ample time to complete an all-weather road, and perhaps commence civils.
 - ✓ **Is the market ready for a new, large mineral sands project?** Below is a discussion of the outlook for zircon and ilmenite. Suffice to say here that we are greatly comforted that it is now proposed to ramp up Thunderbird's production more slowly than it was proposed in the PFS. **This ramp-up will allow a progressive entry into the 1-1.2mtpa global zircon market, without disrupting supply (and therefore pricing) too much.**

Sheffield announces three non-binding off-take agreements for zircon.

Since the publication of the Thunderbird BFS, Sheffield have announced three non-binding off-take agreements with zircon customers representing roughly 40% of Phase 1 production. Two are large ceramic companies in India (Ruby Ceramics and Sukaso Ceracolors), one is Spanish (CFM Minerales)

Sheffield are of the view that these agreements will progressively become binding volume agreements, and will provide the basis for security for project debt for Thunderbird.

Our forecasts and valuation

Our valuation is based on capital, cost and production profiles provided in the BFS. The first 10 years can be summarised as follows:

Thunderbird summary (100% basis)		2017	2018	2019	2020	2021	2022	2023	2024	2025
Commodity/FX assumptions										
Zircon, premium	US\$/t, FOB	-	-	1250	1250	1250	1250	1250	1250	1250
Zircon, in cons (1)	US\$/t, FOB	-	-	625	625	625	625	625	625	625
LTR ilmenite	US\$/t, FOB	-	-	220	220	220	220	220	220	220
Leucoxene/HiTi	US\$/t, FOB	-	-	850	850	850	850	850	850	850
Titanomagnetite	US\$/t, FOB	-	-	48	48	48	48	48	48	48
AUD/USD		-	-	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Production										
Project stage				Phase 1					Phase 2	
MUP throughput	Mt	-	-	2.0	7.4	8.4	8.7	11.3	18.0	18.0
Zircon, premium	Kt	-	-	8	40	55	58	70	100	110
Zircon, in concentrate (1)	Kt	-	-	11	45	50	50	66	95	100
LTR ilmenite	Kt	-	-	46	230	280	290	350	570	570
Leucoxene/HiTi	Kt	-	-	2	10	15	17	23	26	21
Titanomagnetite	Kt	-	-	27	136	165	170	210	335	340
Total	Kt	-	-	94	461	565	585	719	1126	1141
Revenue/tonne VHM	A\$/t (2)	-	-	404.1	395.0	408.6	411.7	414.7	391.4	399.2
Cash costs/tonne VHM	A\$/t (2)	-	-	327.7	232.8	206.7	171.0	168.2	171.0	168.8
Revenue/cost ratio		-	-	1.23	1.70	1.98	2.41	2.47	2.29	2.36
Capital (3)	A\$m	-100.0	-250.0	-10.0	-10.0	-1.0	-100.0	-60.0	-2.0	-2.0
Gross cashflow		-	-	7.2	74.8	114.1	140.8	177.2	248.1	262.9
EBIT		-	-	-12.8	54.8	94.1	120.8	157.2	228.1	242.9
NPAT (4)		-	-	-12.8	54.8	94.1	157.1	204.4	296.6	315.7
Notes										
1. Zircon in concentrate priced at US\$10/%.										
2. Revenue and costs per tonne of valuable heavy mineral.										
3. Estimates in 2019 and 2020 include allowance for build up in working capital and Phase 2 capex in 2022.										
4. Earnings sheltered by prior losses and accelerated depreciation for 2019-2021.										

Our valuation is premised on the following assumptions, flat in real terms going forward:

Zircon US\$1250/t

ZIC US\$650/t

Ilmenite US\$220/t, \$10/t higher than our earlier report, recognising the recent price increases and the emerging tightness of supply

HiTi US\$650/t

Titanomagnetite US\$48/t

FX 0.75

This generates the following project-level NPVs and IRRs.

Pre tax		
NPV10	A\$m	\$794
NPV8	A\$m	\$1,132
NPV5	A\$m	\$2,007
NPV0	A\$m	\$6,282
IRR	%	26.3%
Post tax		
NPV10	A\$m	\$503
NPV8	A\$m	\$746
NPV5	A\$m	\$1,381
NPV0	A\$m	\$4,499
IRR	%	21.6%

Translating that to a valuation requires further assumptions. The following is a conceptual valuation, assuming a sell-down of 20% of the project at a 50% discount to NAV (raising ca. \$110m and relieving SFX of 20% of the capex). This model assumes 50% debt to equity and a \$120m raise at an assumed \$0.60/share. This we suggest is a very conservative outcome.

Clearly this scenario is just one of many which could be considered.

Thunderbird (NPV10), post tax	A\$m	\$ 502.8	
Add back capex	A\$m	\$ 348.0	
Less working capital	A\$m	-\$ 20.0	
Thunderbird (NPV10)	A\$m	\$ 830.8	Unfunded NPV
Mine site exploration	A\$m	\$ 10.0	Notional
Equity NPV	A\$m	\$ 840.8	
Project debt	A\$m	-\$ 174.0	50% debt/equity
NPV less debt	A\$m	\$ 666.8	
Ownership by SFX	A\$m	80%	Sell down equity in project
Implied SFX equity	A\$m	\$ 533.4	
Cash	A\$m	\$ 11.0	Current
PV of corporate costs	A\$m	-\$ 80.0	Estimate
Other exploration	A\$m	\$ 10.0	Notional
Corporate NAV, post debt, pre equity funding	A\$m	\$ 474.4	
Number of shares	m	180.5	
New equity, say	A\$m	\$ 120.0	Estimate
Issue price	A\$	\$ 0.60	Future price
Number of new shares	m	200.0	
Total number of shares	m	380.5	
NAV adding new cash	A\$m	\$ 594.4	
NAV/share	A\$	\$ 1.56	

Sensitivities

The following are project NPV sensitivities quoted by SFX for Thunderbird.

10% increase in...	Change in pre-tax NPV(10)
All product prices (A\$)	38.0%
Plant recoveries, all products	33.4%
Ore VHM grades	33.4%
Zircon + ZIC price (A\$)	23.5%
LTR ilmenite price	11.2%
Site operating costs	-11.2%
Capital costs	-7.0%

Source Sheffield Resources BFS support documents, March 2017

No surprise that the project is quite sensitive to revenue, whether that is derived from pricing, grade or plant recoveries.

What is surprising is the very low leverage to capex, driven by relatively low capital intensity, strong cashflows and by the project's long mine life. Relatively low sensitivity to opex reflects the projects high margins.

Update on supply and demand issues for zircon and ilmenite

Ilmenite

There have been several developments since our last report on ilmenite supply and demand. Importantly we are continuing to see a rebound in both prices, with **sulphate ilmenite** leading the way. A specialist report from Industrial Minerals (31 March 2017) observes as follows:

- Supply of sulphate-quality has been constrained by production interruptions at the Chinese magnetite mines (where ilmenite is a by-product) and in India, where the Tamil Nadu producers are under significant environmental and licencing pressures.
- Reports of spot pricing out of Australia are quoted at US\$170-210/tonne, and US\$195 to 230/t CIF for Chinese supply.

SFX's excellent disclosure of BFS support material also extended to supply demand data from the normally secretive TZMI consultants. In one of the charts we see TZMI's forecasts of global sulphate ilmenite supply and demand, which they have currently in deficit, explaining dramatic recent price moves. Remember just 12 months ago ilmenite prices were sub-US\$100/t as Kenmare and Base battled it out for market share.

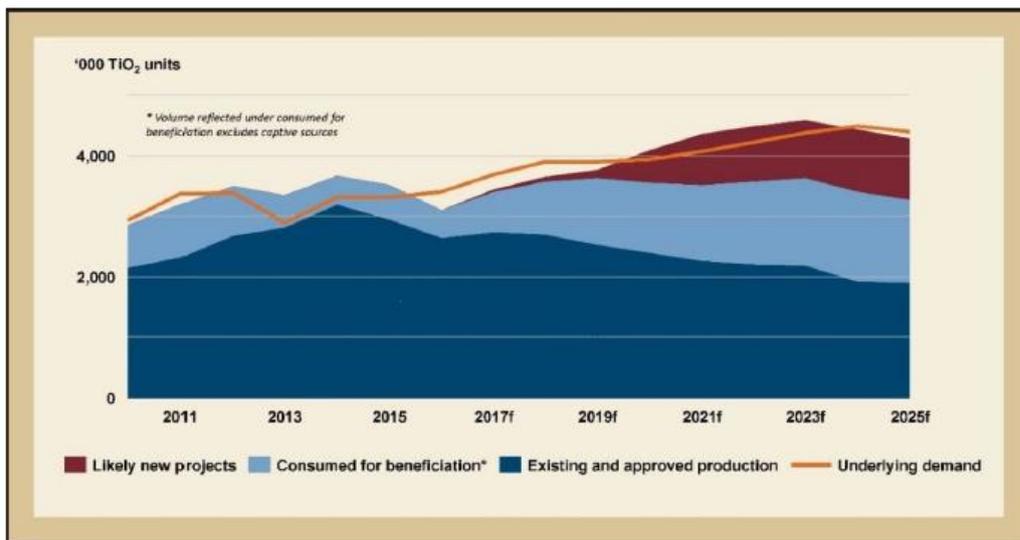


Figure 26-2: Global Sulfate Ilmenite Supply/Demand Balance and Outlook to 2025 *

* Source TZMI.

Source TZMI data in Sheffield Resources BFS support documents, March 2017

As with most commodities, we could easily see the ilmenite price response overshoot. And at the moment it's hard to see where that incremental supply will come. Kenmare at its Moma operations in Mozambique is already producing at or around its 1mtpa capacity. We doubt Base Minerals can ramp up quickly, even if they take a decision to expand production.. So to see a price in the mid-\$200's per tonne could easily emerge.

We are not bullish on iron ore price, which drives the economics of the Chinese/Panzihua hard rock operations.

As we've seen from the pigment producers where pricing pressures are also on the upside, the focus is very much on declining inventories, and recognition that raw material supply is tight (ref Tronox 4th quarter report). Increased discipline in the pigment industry as the Tronox/Cristal merger delivers further consolidation.

So whether our forecast of US\$220/t for sulphate ilmenite proves to be conservative remains to be seen. But we can see prices in the mid-200's as definitely possible.

Zircon

We are continuing to see a recovery in **zircon** pricing from sub \$900/tonne lows. Spot prices for premium zircon are now reported at around US\$1050/tonne (CIF). Iluka now appears to control the market as it unwinds its substantial inventory in a disciplined way. The historic tussle between Iluka and Richards Bay appears to have passed, in response to improving zircon demand and pricing.

We have attempted to put together a supply/demand model for zircon to establish that there is indeed demand for a new source of supply. In the BFS support documentation, SFX released some useful information from consultants TZMI, highlighting the parlous state of the Australian zircon supply. (Australia currently produces around 60-70% of global supply).

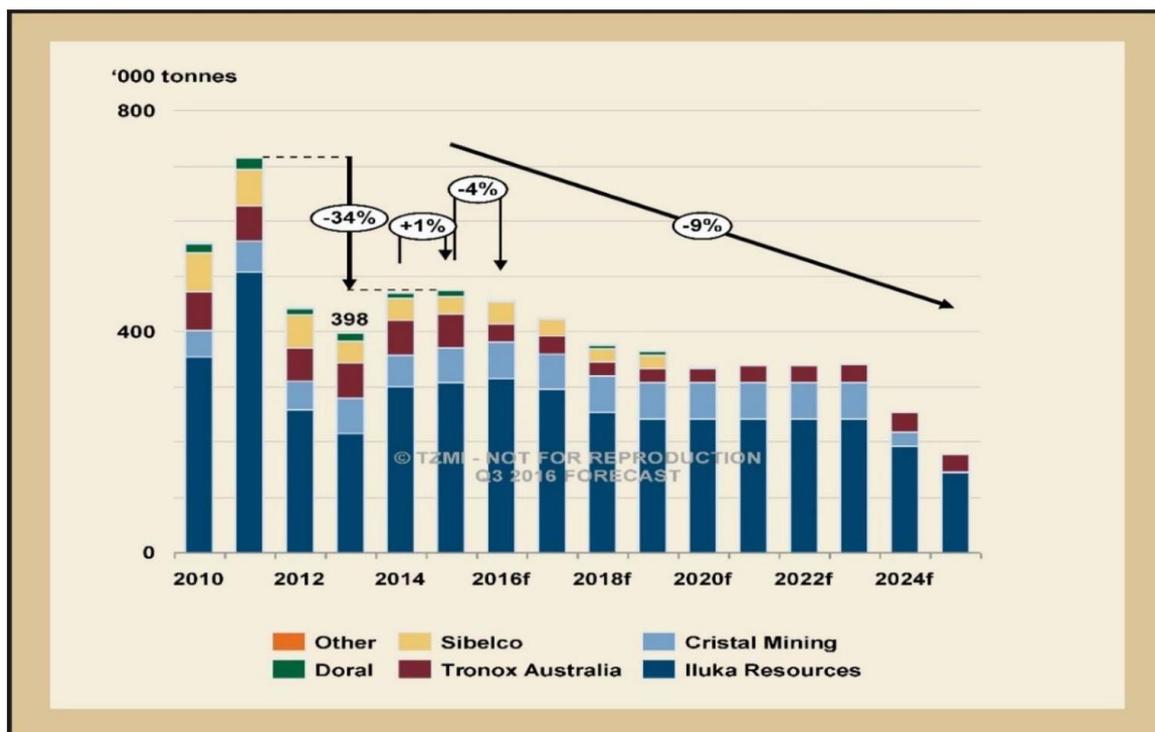


Figure 26-6: Australian Zircon Supply From Existing Operations to 2025 (Without Likely New Products) *

Source TZMI data in Sheffield Resources BFS support documents, March 2017

TZMI sees current production levels as unsustainable and forecasts Australian supply of 400-500ktpa declining to 300-400ktpa after 2018 and then to under 200ktpa as Iluka's Jacynth-Ambrosia deposit moves into progressively lower grades.

Zircon production is in global decline, largely as the Iluka and other Australian operations shut down. We are in accord with TZMI's view, that there is ample room for new capacity in global zircon supply.

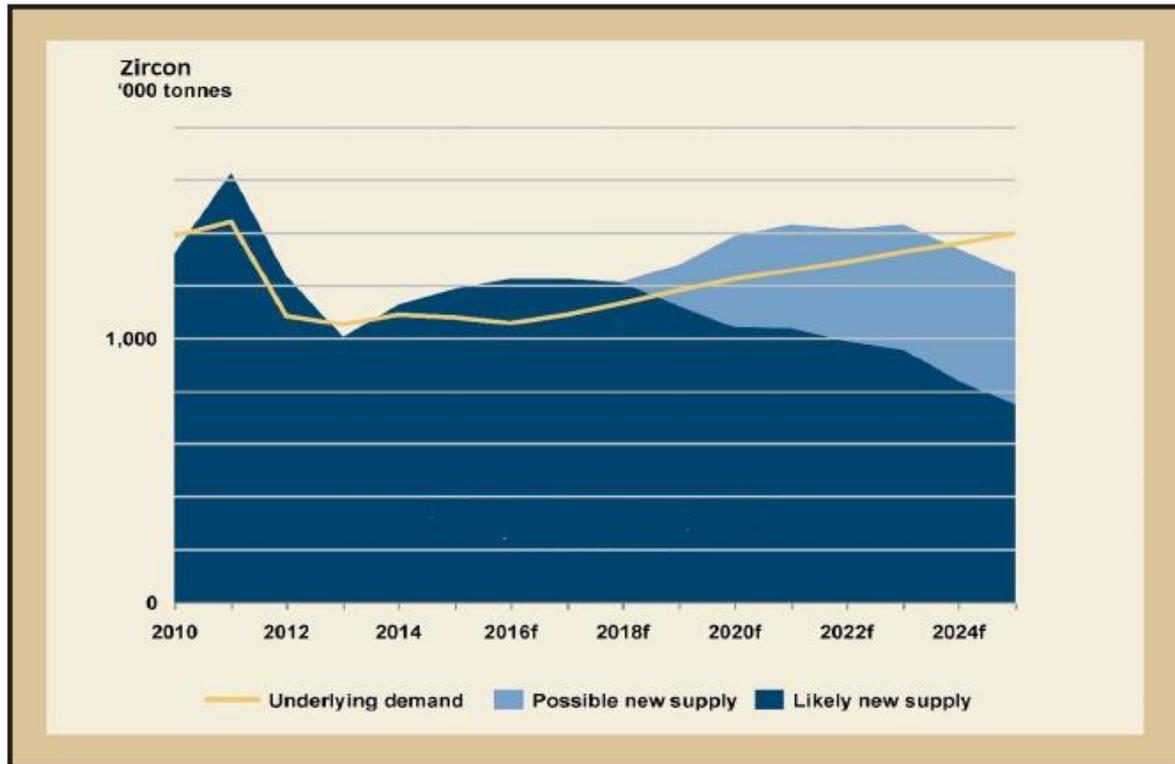


Figure 26-4: Global Zircon Supply/Demand Balance and Outlook to 2025 *

* Source TZMI.

Source TZMI data in Sheffield Resources BFS support documents, March 2017

TZMI do not disclose the detail behind these charts. We have endeavoured to build a supply/demand model in an attempt to replicate the chart above. This is a very opaque industry and there are a number of underlying assumptions in the following table. This table includes the top producers of zircon (>50ktpa in 2020e), together with our interpretation of ILU's inventory position, which we forecast to disappear during the course of 2017.

These numbers suggest the market is currently in balance (with ILU's inventory position the swing supplier), but moving into 8-9% deficit in 2018. Even with the start-up of Sheffield's Thunderbird and Kalbar's Fingerboards mines from 2019 or 2020, the market struggles to balance.

Zircon forecast supply			2016e	2017e	2018e	2019e	2020e
Country	Location	Company					
Australia	Eucla Basin	Iluka	0	0	100	140	140
Australia	Perth Basin	Iluka	130	75	50	50	50
S.Africa	Namakwa	Tronox	120	120	120	120	120
S.Africa	Richards Bay	Rio Tinto	105	125	113	101	91
Madagascar	Port Dauphin	QMM	50	50	50	50	50
Mozambique	Mozambique	Kenmare Resources	52	80	80	80	80
Australia	Thunderbird	Sheffield	0	0	0	25	70
Senegal	Grande Cote	TIZir (Eramet/MDM JV)	50	60	70	70	70
USA	Florida	Chemours	65	65	65	65	65
Australia	Western/Eastern Aust.	Cristal Mining	60	60	60	60	60
S.Africa	Fairbreeze	Tronox	30	40	40	50	55
Australia	Fingerboards	Kalbar	0	0	0	5	50
Australia	JA inventory	Iluka	300	120	0	0	0
		Total	1,330	1,097	1,028	1,083	1,148
		Growth in supply	15.0%	-17.5%	-6.3%	5.4%	6.0%
		Growth in demand		3.0%	3.0%	3.0%	3.0%
		Surplus/deficit		9	-93	-71	-40

Source: Company data, Author estimates

The following points are also relevant:

- With the closure of Iluka's Hamilton plant (in Victoria) the company's total zircon production capacity is now around 300ktpa, down from 600ktpa. We have assumed ILU's zircon capacity will be around 200-220ktpa when J-A is restarted, possibly in 2018.
- The Stradbroke Island operations of Sibelco will cease at the end of 2018.
- The real wild card is what happens at Rio Tinto's RBM operations in Africa. We do know that grades at the existing operations are in decline, so we have superimposed a 10% decline in zircon production going forward. RBM have in the past produced over 10% of world zircon supply.

What is happening at the Rio Tinto/Richards Bay Minerals/Zulti South expansion?

RIO is remarkably quiet on this expansion, which was due to be in production last year. There was no mention of it at RIO's annual talkfest in December 2016. It is still classified as an 'evaluation project' in RIO reports, even though we believe a BFS has been completed and the project is viable.

We know that one of 4 of the titanium slag furnaces at RBM have been idled, and 2 of 9 in Quebec are shut, in response to flat demand from the chloride pigment producers. It might be that RIO cannot see light at the end of that tunnel yet.

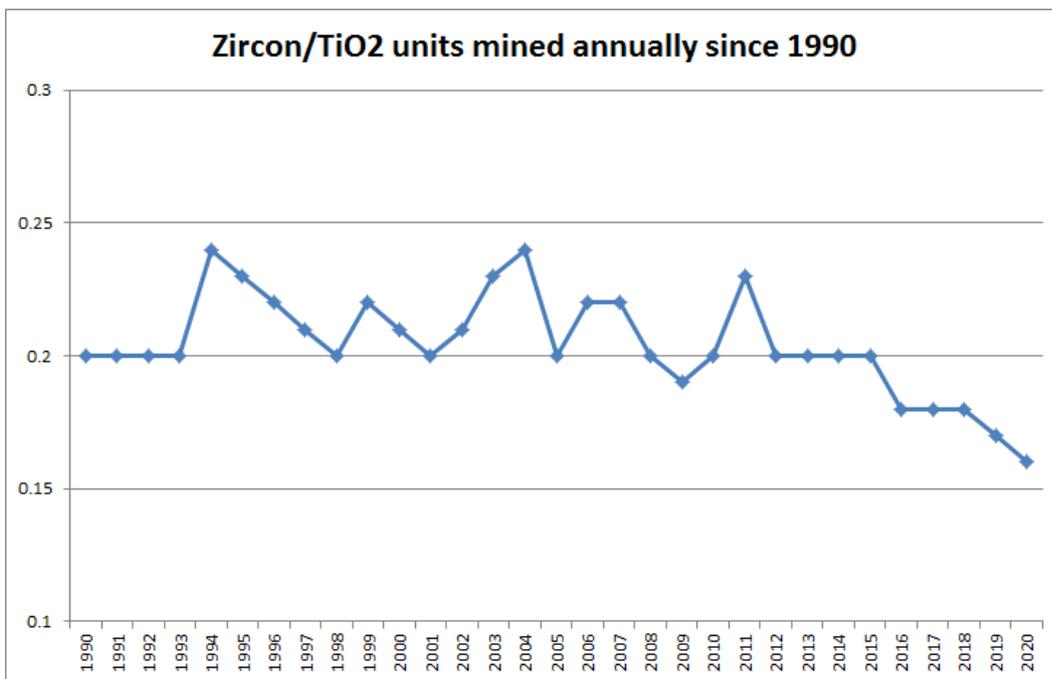
Recent news out of South Africa (Fin24 City Press, 2 April 2017) suggests that construction of Zulti South will commence shortly and that "the first tonne of ore will be delivered to the smelter in November next year". We also note that the respected RBM Managing Director resigned at short notice in March 2017 to "spend more time with his family". Hmm.

We remain of the view that RBM is being mined for cash, and that RIO is reluctant to put any further capital into Southern Africa.

- We have not included the deposits of Astron (WIM150, Donald, Avonbank) as we believe that they will not be financeable for another 4-5 years. But they do represent a real supply opportunity.

It should be remembered that zircon production is largely driven by the production of TiO₂ feedstock. Typically it is a by-product of ilmenite and rutile mining. Since the zircon-rich Jacinth-Ambrosia (J-A) mine has moved into decline, so has zircon supply. And most subsequent developments (Kenmare and Moma) are relatively low in zircon.

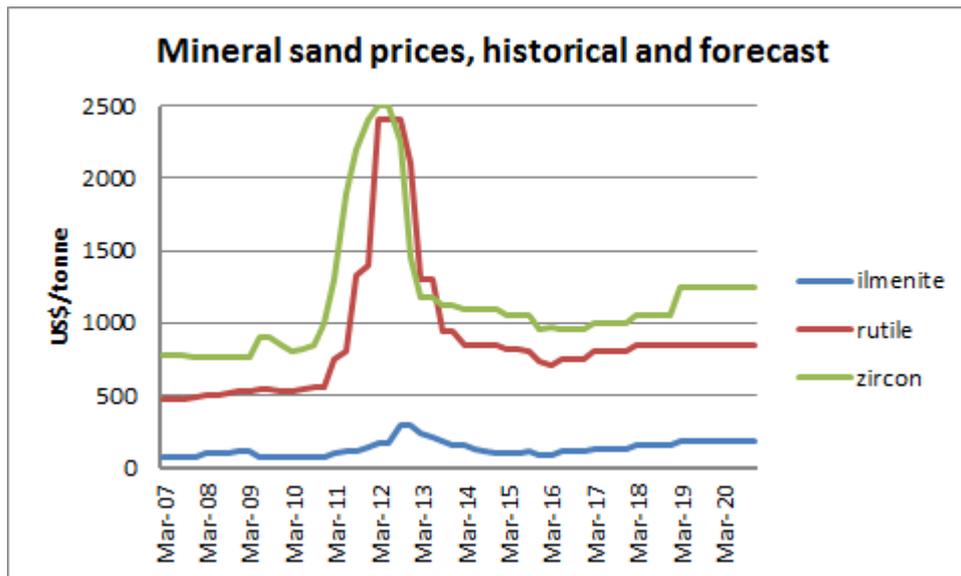
To illustrate this, we have used data reported by Iluka in 2009 and extended the time series with our own, and TZMI's data. Until recently the ratio of zircon mined to total TiO₂ units remained typically in a range of 0.2 to 0.25. That is the global mining industry tended to produce 1 tonne of zircon for every 4 or 5 tonnes of TiO₂ feedstock units (expressed on a 100% TiO₂ basis). The following chart infers that with the declining grades at ILU's operation in the Perth Basin, at J-A (if and when it restarts) and at RBM, there could be a >20% supply deficit by 2020.



We see that there could be a risk of a supply squeeze if we have overestimated supply from Iluka. We do not know the size of its remaining inventory position, nor do we know when it plans to restart J-A. Given Iluka is the market at the moment, we'd like to think they have it all in hand.

Given zircon's reliable pricing history over the past 30 or more years, expect the price to rally as the inventory is depleted and as it moves into a supply deficit.

Our forecast for premium zircon going forward remains US\$1250/tonne.



Source: Author 2016, industry sources.

In conclusion:

- **We believe Thunderbird is a Tier 1 asset**, on the following grounds:
 - One of the largest deposits found in the last 30 years. 3-4 times larger than the Jacinth-Ambrosia discovery of Iluka in 2004 for similar in situ value.
 - Long mine life of 42 years.
 - High grade. Significantly higher grades than most of its peers.
 - Low cash costs helped by a low strip ratio and relatively high grades.
 - Located in Western Australia, the world's most attractive mining jurisdiction. Most of the world's mineral sand ore reserves are now in geopolitically risky areas.
 - Good access to existing port infrastructure.

- **Critical issues** going forward now are:
 - Permitting. There seem to be few impediments to the grant of a mining lease during 3Q17.
 - Native title issues. This is nearing completion.
 - Offtake. Both products, ilmenite and zircon, are of high quality and should be easily marketed. The company now has 40% of future supply from Phase 1 of premium zircon under non-binding MOU's.
 - Financing.

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