PITT STREET RESEARCH

Metallium Ltd

A new era in metals recycling

Share Price: A$0.815

ASX: MTM

Sector: Resources

22 July 2025

MTM Critical Minerals (ASX:MTM) (to be renamed Metallium Ltd effective as of 22 July 2025) has significantly re-rated in CY2025 as investors observed its rapid progress and realised its potential. Metallium's valuation has surged >3-fold since our last update note 3 months ago in mid-April 2025, & nearly 12-fold since our initiation note published last October.

FJH has strong potential to make a massive difference

Metallium's technology can rapidly create very high temperatures to facilitate targeted metal recovery in a controlled reactor environment. This technology is based on the self-descriptive principles of 'Flash Joule Heating' (FJH), and Metallium's version is licensed from Rice University. Extensive testing has unanimously shown Metallium's FJH works, in that it recovers metals *and* does so with high yields. This is particularly true with critical metals like Gallium and REEs, and the hope is that this can help with 'Westernising' the world's critical minerals supply chains.

2025 has so far been a year of significant progress

In the last 6 months, Metallium has signed multiple collaborations – the first of which came in December 2024 with Indium Corporation – followed by an MOU with Vendata and 2 further e-scrap agreements. The key milestone was to open up a pilot plant in Texas. Earlier this year, MTM finalised the process design and, in recent weeks, has secured an ideal site for the plant in Texas' Chambers County and necessary approvals. Metallium intends to commission the site by the end of 2025 and then roll out into additional states in 2026. The company has also raised A$50m to accelerate its commercial rollout. Moreover, Metallium has added significant strategic capability to its U.S. advisory board through the appointment of Gregory L. Bowman, CSO at Siemens Government Technologies and a recognised expert in national security.

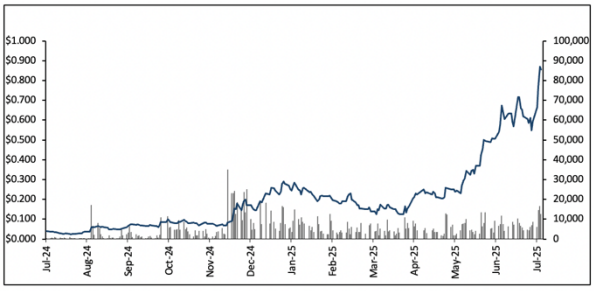
Valuation range increased to $1.50-1.96 per share

Our previous valuation of Metallium was $260.7m, or $0.57 per share. The company has surpassed this, and we now think Metallium can continue to re-rate to $850m or $1.50 per share in our base case or $1,105m/$1.96 per share in our bull case. This represents 50% and 65% of IperionX (ASX:IPX) respectively and is contingent on Metallium starting its pilot plant by the end of this year, on time and on budget. Please see page 11 for more details on our valuation and page 12 for the key risks.

Market cap. (A$ m)	422.6
# shares outstanding (m)	518.5
# shares fully diluted (m)	652.4
Market cap ful. dil. (A$ m)	531.7
Free float	100%
52-week high/low (A$)	0.90 / 0.024
Avg. 12M daily volume ('1000)	5,374.4
Website	www.mtmcriticalmetals.com.au/

Source: Company, Pitt Street Research

Share price (A$) and avg. daily volume (k, r.h.s.)



Source: Refinitiv Eikon, Pitt Street Research

Disclosure: Pitt Street Research directors own shares in Metallium.

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The investment case for Metallium (ASX:MTM)

1) **Metallium's FJH represents a new and superior way to recycle methods.** Conventional methods have many problems including cost and energy-intensity. But FJH overcomes many of these problems through its quicker operations and higher yields. This is borne out in the extensive testing done to date.
2) **By investing in Metallium, investors can have exposure to critical metals without vulnerability to fluctuating commodity prices**. As 'critical' as metals like lithium and REEs are, most opportunities for investors are junior explorers or developers that are vulnerable to commodity prices. But Metallium has done exceptionally well for investors even with struggling commodity prices. This is not just because Metallium has made progress but it is applicable for less volatile metals like gold.
3) **FJH has a major market opportunity.** There is demand for critical metals, particularly for critical metals from western sources. But recycling metals is a more convenient way to acquire them than discovering new mines and bringing them into production. Some jurisdictions, like the EU, are even mandating the use of metals recycling. FJH would ensure the process of recycling could be not just sped up, but more effective (in producing higher yields of metals) and less costly.
4) **Metallium's has made significant progress and has major milestones in the near-term.** In the last 12 months, the company has signed multiple agreements with collaborative partners to facilitate future commercialisation including with:
   - **i)** Critical metals supplier **Indium**, to create a US-based processing solution to recover metals,
   - **ii)** Global metals conglomerate **Vedanta** (worth US$20bn) for Vedanta to supply bauxite residue to Metallium so Metallium can apply FJH to extract metals,
   - **iii)** Major E-waste recycling company **Dynamic Lifecycle Innovations (DLI)** for a long-term e-waste supply agreement. This is only an MoU at this stage but the principal terms for a binding deal have been agreed on including for a target volume of 700t per year,
   - **iv)** E-scrap supplier **Plastic Recycling** to provide 400/t per year, and
   - **v)** **Meteoric Resources (ASX:MEI)** whereby Mixed Rare Earth Carbonate will be processed to remove impurities and enrich magnet rare earths for downstream separation.

   Metallium's key goal has been to start a pilot plant by the end of CY25. It has made significant progress to this end including settling on the design and securing an ideal site in Texas for the plant. Subject to successful revenue generation, the company plans to roll out into further US states in 2026.Metalliumrecently raised $50m in a strongly supported placement to bankroll its future commercial plans.
5) **Metallium's exploration assets represent further upside.** Although in the short-term, the company's focus is on the FJH technology, it still owns multiple exploration assets with significant potential – particularly its West Arunta projects are immediately adjacent to tenements held by WA1 Resources (ASX: WA1) and Encounter Resources (ASX: ENR).
6) **We believe Metallium has further room for growth** at its current market value. Our latest valuation of the company is $1.50 per share base case and $1.96 per share optimistic case using a peer-weighted approach. We

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intend to model the company using a DCF approach in a further report in the near future.

Why Flash Joule Heating has potential

Flash Joule Heating is essentially joule heating at a 'flash pace', with joule heating being the creation of thermal energy through colliding electrons in a conductor at a rapid pace.

Flash Joule Heating is essentially joule heating at a 'flash pace', with joule heating being the creation of thermal energy through colliding electrons in a conductor at a rapid pace. Metallium has licensed a version of this technology developed at Rice University that can create 3,000 degrees Celcius of heat in just a fraction of a second. This extreme heat generated in the process allows for either the direct volatilisation of metals or makes them more easily extractable using conventional acid leaching techniques. The thermal shock renders refractory minerals 'unrefractory', and using controlled reagents like chlorine, metals can be selectively recovered from a bulk mass. FJH overcomes many of the problems associated with conventional metal recoveries including cost (time and money), the high amount of reagent typically required for the re-action and non-selectivity[1].

Metallium's FJH works - don't just take our word for it

Studies and testing conducted with this kind of FJH have unanimously shown strong results. It all began with a key 2022 paper in the journal *Science Advances* which showed that Metallium's FJH (then belonging to Rice University outright) reduced the concentration of hydrochloric acid required from 15-molars to 0.1-molars, but still getting a higher yield[2].

Results of testing in May 2024, done at 50 times the scale of Rice University's original proof of concept, was 50% higher in 2022. FJH improves the acid leachability of REEs by over 50% and other critical metals by 50-514% when compared to conventional acid leach methods. In September 2024, Metallium announced that it had successfully used FJH to recover gold from e-waste and achieved yields of up to 70%. In February 2025, Metallium demonstrated ~90% and ~80% recovery rates for Gallium and Germanium respectively from semiconductor metal refining waste.

Metallium's most recent testing results were revealed to shareholders in early April 2025, conducted on Printed Circuit Board Feedstock (from end-of-life electronics), and depicted over 95% recovery for gold & titanium and over 90% for silver, tin and zinc (Figure 1). These not only show that FJH technology works, but also that e-Waste is an ideal opportunity to source recycled metals.

And most recently, the company revealed in June 2025 that it could achieve a 98% recovery of high-grade antimony from American e-waste with a grade of over 3%. Conventional technologies struggle to surpass 1% grade antimony with most coming below that – even using antimony from some of the world's largest known deposits.

[1] Conventional methods can sometimes remove the metal of interest in addition to other metals, but Metallium's FJH reduces this problem.

[2] Deng et. al., *Rare earth elements from waste*, Science Advances, 9 February 2022.

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Figure 1: Metallium's testing results with e-waste

Element	Feedstock Grade	Recovery to Chloride (%)
Gold (Au)	551 g/t	100%
Silver (Ag)	2,804 g/t	97%
Copper (Cu)	41.60%	91%
Tin (Sn)	13.20%	97%
Aluminium (Al)	5.20%	91%
Zinc (Zn)	1.30%	99%
Nickel (Ni)	1.40%	81%
Titanium (Ti)	0.20%	100%

Source: Company

What's the opportunity for Metallium's FJH?

Metallium's FJH can help 'westernise' critical metals supply chains, helping customers save time and money, and bypass tariffs.

Metallium's FJH can help 'westernise' critical metals supply chains. China is responsible for a large proportion of many of the world's critical metals including lithium, graphite, zinc, lithium, REEs, gallium and germanium. In some instances (most particularly germanium), China is responsible for virtually all of the world's supply. The Trump administration's tariffs have only magnified this need for Western supply chains, as American companies with local supply chains will bypass the tariffs. But again, it is easier said than done to just 'build new mines' because there may not be these metals in America; and even when they are, it can take significant time and money to bring mining projects into production. The ideal compromise is metals recycling and Metallium's FJH is a solution because it overcomes the drawbacks of conventional methods.

Beyond being a tariff hedge for customers, Metallium could also be a target for government procurement and incentives including Department of Defence (DoD) and Department of Energy (DoE) grants. Metallium has already initiated engagement with the DoD and DoE to seek non-dilutive funding support for scaling FJH. These efforts align with U.S. policy objectives to reshore critical mineral processing and support technologies that enhance national supply chain resilience.

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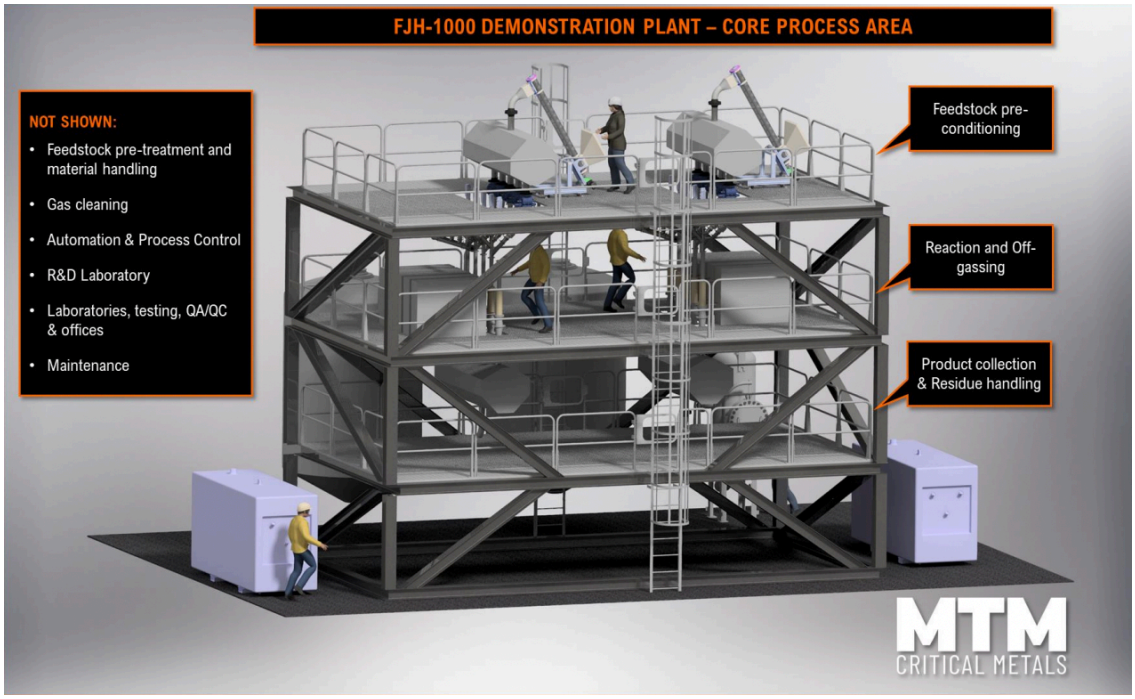
2025 is the year of the pilot plant

Metallium key focus for 2025 has been its proposed demonstration plant.

Metallium's key focus for 2025 has been its proposed demonstration plant. Around the time of our last update note on Metallium in mid-April 2025, the company told investors it had finalised the process design (Figure 2) including the key process parameters (flow rates, material balances and operating conditions), final equipment selection and regulatory readiness. The plant and its engineering has been designed by renowned engineering firm KnightHawk that was so confident in theMetalliumand its prospects that it took equity in lieu of fees.

Figure 2: The core process area of the demonstration plant



Source: Company

Metallium has secured a site to operate the pilot plant and to serve as a base for future commercial operations and R&D activities.

Next, Metallium found a site on the eastern outskirts of Houston (in the Chambers County) (Figure 3, Figure 4 and Figure 5). Metallium has found a pre-permitted 5-hectare industrial site that will host the pilot plant, but also serve as the base for future commercial operations and R&D activities as part of a New Technology Campus.

Its proximity to the Interstate 10 highway and the Houston Ship Channel will provide efficient access to global logistics, industrial suppliers and downstream customers. The site has substantial infrastructure including sealed access roads, onsite power, wastewater management, security fencing and office/warehouse facilities. The location also offers access to low-cost industrial electricity and proximity to Houston skilled industrial workforce.

Most importantly, the property already has industrial waste processing permits, so Metallium will be able to begin without length environmental approvals. The facility will have a focus on high-value critical metals from industrial waste and electronic scrap, including gallium, germanium, indium and gold. Down the track, it'll be able to scale up capacity and could co-locate allied processing activities or shared infrastructure.

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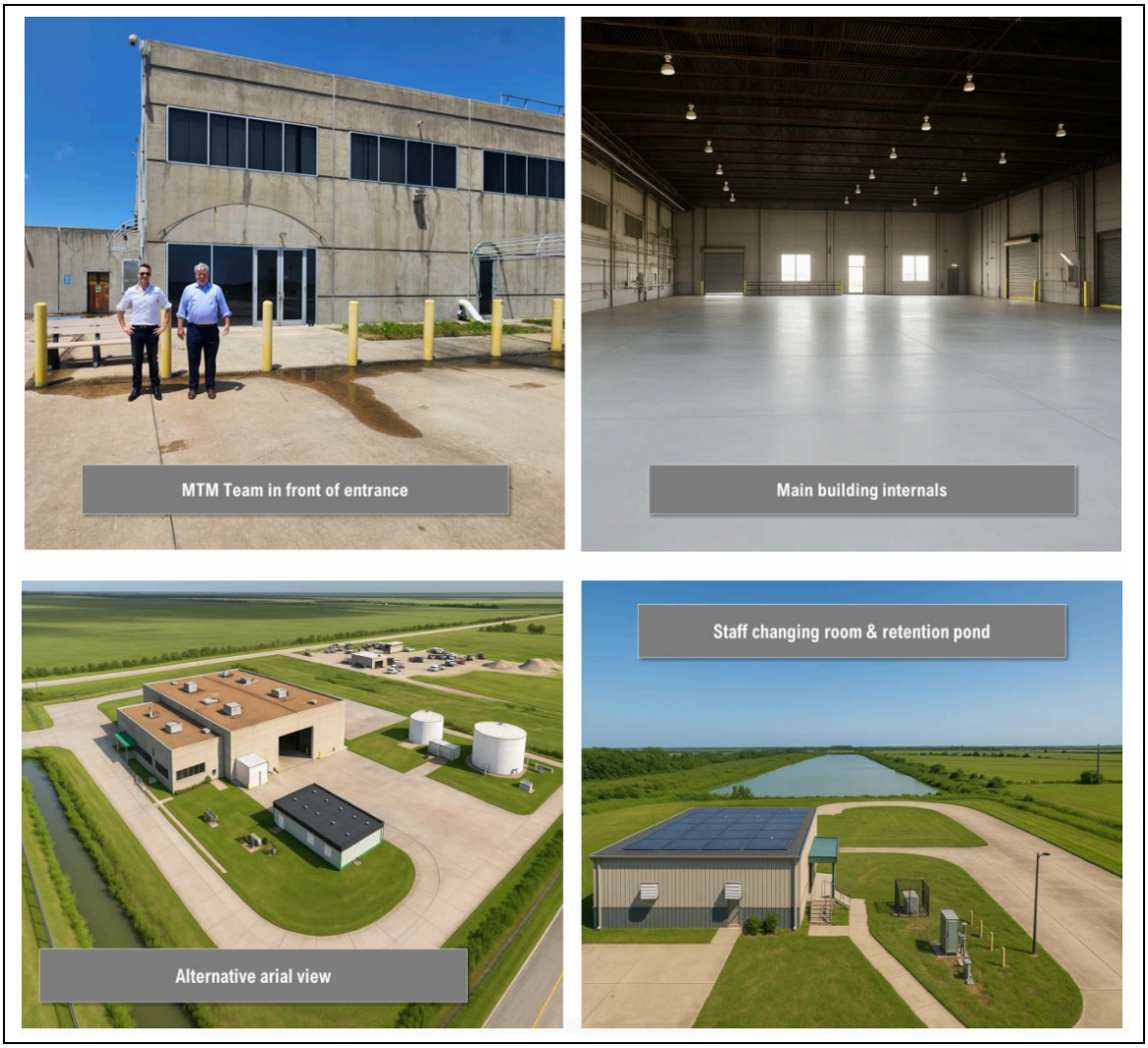
Figure 3: A view of the site for the demonstration plant

Source: Company

Figure 4: A view of the site for the demonstration plant

Source: Company

Figure 5: Further images of the demonstration plant



Source: Company

Metallium hopes to finalise the lease and begin on-site works in Q3 of 2025 and to commission the 1tpd demonstration plant in December 2025.

The site has been secured under a long-term lease agreement (15 years plus 2 5-year options) with an option to purchase the site in year 6. The lease completion remains conditional on the vendor closing its acquisition of the site. They contain standard conditions customary for industrial sites in the US and give flexibility for Metallium to exit under defined conditions. Metallium hopes to finalise the lease and begin on-site works in Q3 of 2025 and to commission the 1tpd demonstration plant in December 2025. Following this, Metallium will initiate staged operations and product qualification with early offtake partners.

Beyond the securing of the site, the company has also announced that it validated its production-scale reaction chamber (crucible) to confirm that the company will be ready once construction is complete (Figure 6). Once concern investors may have had was whether what Metallium had shown on a smaller scale would still hold on a larger scale, but these results have put those fears to bed, at least for now. Moreover, they even suggest that the plant could deliver significantly higher throughput than originally planned.

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Figure 6: The commercial-scale crucible

Source: Company

Beyond preparation for the pilot plant, the company will continue its R&D work, particularly with respect to antimony in light of the company's discovery earlier in June that its FJH could aid with the recovery of antimony. It will engage with US government agencies, industrial end-users and critical metals stakeholders focusing on securing domestic sources of strategic metals. The company has told investors it is in discussions with >10 additional companies across the mining, recycling and processing sectors. Even though it may be a few months until the pilot plant is underway, this shows there will be constant news flow for investors to digest in the coming months.

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2026 will be the year of commercial-scale operations

Metallium will have 2 core business units: Urban Mining and Mineral Processing.

Metallium plans to build a commercial-scale business based around the operating model of the Pilot Plant. It will have 2 core business units.

The first will be Urban Mining which will consist of recycling technology metals and electronic waste from partners such as Indium and Dynamic. Metallium will purchase feedstock, own and operate the processing facility and retain full economic interest in the recovered metals. Metallium has estimated that it has a US$60bn market (US$20bn in Technology Metals and US$40bn in Electronic waste).

The second will be Mineral Processing where it will partner with miners or mineral processing plant owners by supplying equipment and services and monetising technology via licensing fees and production royalties. In this segment, Metallium is developing partnerships with Vedanta and Meteoric Resources and plans on further partnerships in the REE, Lithium, Antimony and Red Mud Spaces. It estimates a US$13bn market for REEs and a US$15bn with Red Mud (Figure 7).

Metallium will focus on high-value waste streams that will enable profitability even with an operation of just 1-10 tonnes per day.

Metallium will focus on high-value waste streams that will enable profitability even with an operation of just 1-10 tonnes per day. Specifically, it will target gallium, germanium and indium rich waste, as well as gold/copper-rich electronic waste (particularly Printed Circuit Boards).

Figure 7: Metallium's future Business Model

Source: Company

Once the pilot plant has been proven, it will seek to build up to a commercial scale, and to establish sites in further US states. It has short-listed Louisiana, Florida, Nevada, Ohio and Virginia as shortlisted states for future sites. Future sites will be close to major e-waste aggregators and strategic partners and will have logistical access to regional industrial corridors. There will have some fixed infrastructure at the sites, but the company will also possess mobile modular units for regional flexibility.

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Our updated valuation of Metallium: $1.50-1.96 per share

We once again update our valuation of Metallium. When we initiated coverage last October, the company was $0.08 per share, or $32.3m and we suggested it could re-rate to $63.9m or A$0.16 per share in a base case and ~$83.0m or A$0.21 per share in an optimistic (or bull case). This was using a peer-weighted approach and line with peers then at a similar stage to it. At that time, we noted one peer as IperionX (ASX:IPX). IPX was just about to commercialise its technology but stated it was too early to think it could reach its then valuation of over A$600m. The company quickly surpassed our initial valuation and, in an update note in January 2025, we updated it to $260.7m, or $0.57 per share, in line with its peers.

We now value Metallium at $850m or $1.50 per share in our base case or $1,105m or $1.96 in our bull case.

We now value Metallium at $850m or $1.50 per share in our base case or $1,105m or $1.96 in our bull case (Figure 8). These figures are 50% and 65% respectively of IPX which we think Metallium is now worth consideration to be compared to. It is still too early to ascribe a 100% valuation (which would be $1.7bn or $3.01 per share), but with a pilot plant only months away, and commercial operations 12-18 months away we think Metallium can now be compared to similar companies in the commercialisation phase rather than companies at the R&D phase, hence our 50-65% valuation of Metallium now. At the point of commercial operations, then it would be reasonable to ascribe a 100% valuation.

Figure 8: Our valuation of Metallium

Valuation (A$m)	Base Case	Bull case
IPX market capitalisation	1,700	1,700
% attributable to Metallium	50%	65%
Implied Market Cap	**850.0**	**1,105.0**
Diluted shares outstanding	518.5	599.9
Implied price (A$)	**1.50**	**1.96**
Current price (A$)	0.815	0.815
Upside (%)	84.8%	140.5%

Source: Pitt Street Research

We foresee the stock being re-rated to our valuation range driven by the following factors:

- Commencement of the Pilot Plant on schedule (the end of 2025) and within budget,
- Continued validation of Metalluim's FJH through further testing results,
- Continued geopolitical tension between the United States and its traditional critical metal suppliers, raising awareness of the need for solutions like Metallium's FJH,
- The securing of future commercial partners.

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Risks

We see the following key risks to our investment thesis:

- **Development risk**: The road to a viable commercial product is very long. Much development and engineering work remains which brings with it a risk of technical failures, or at the very minimum, extended development periods.
- **Facility risk**: There is the risk that Metallium may not be able to 'close' the deal on its facility or that it may encounter supply chain issues that will mean it will fail to reach its goal of a 1tpd pilot plant by the end of 2025.
- **Funding risk**: Metallium will continue to require external funding to support its development plans for the foreseeable future. Raising funds on favourable terms (both debt and equity) along with timeliness may be a challenge for the company. If it secures equity funding, this would dilute shareholder value. Any debt financing would not have this effect, but could present challenges dependant on the terms secured and the progress made by the company.
- **Commercial risk:** Even if and when Metallium's technology is commercialised, it will be a challenge in and of itself to find commercial partners for its technology. Lower than anticipated adoption rates may hamper future growth.
- **Licensee risk:** Metallium's ability to commercialise the FJH technology is from its licensing of the technology from Rice University. A withdrawal of the license or change in conditions could be catastrophic for the company. Alternatively, existing propositions in the agreement may have the potential to hinder FJH's development and commercialisation.
- **Key personnel risk**: There is the risk the company could lose key personnel and be unable to replace them and/or their contribution to the business.

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Appendix I – Capital Structure

Security Class	Number	%
Ordinary shares	518,508,537	79.5%
Options	70,900,000	10.9%
Performance Rights	63,000,000	9.7%
Total	**652,408,537**	

Source: Company

Appendix II – Analysts' Qualifications

Stuart Roberts, lead analyst on this report, has been an equities analyst since 2002.

- Stuart obtained a Master of Applied Finance and Investment from the Securities Institute of Australia in 2002. Previously, from the Securities Institute of Australia, he obtained a Certificate of Financial Markets (1994) and a Graduate Diploma in Finance and Investment (1999).
- Stuart joined Southern Cross Equities as an equities analyst in April 2001. From February 2002 to July 2013, his research speciality at Southern Cross Equities and its acquirer, Bell Potter Securities, was Healthcare and Biotechnology. During this time, he covered a variety of established healthcare companies, such as CSL, Cochlear and Resmed, as well as numerous emerging companies. Stuart was a Healthcare and Biotechnology analyst at Baillieu Holst from October 2013 to January 2015.
- After 15 months over 2015–2016 doing Investor Relations for two ASX-listed cancer drug developers, Stuart founded NDF Research in May 2016 to provide issuer-sponsored equity research on ASX-listed Life Sciences companies.
- In July 2016, with Marc Kennis, Stuart co-founded Pitt Street Research Pty Ltd, which provides issuer-sponsored research on ASX-listed companies across the entire market, including Life Sciences companies.
- Since 2018, Stuart has led Pitt Street Research's Resources Sector franchise, spearheading research on both mining and energy companies.

Nick Sundich is an equities research analyst at Pitt Street Research.

- Nick obtained a Bachelor of Commerce/Bachelor of Arts from the University of Sydney in 2018 and the designation of Financial Modelling & Valuation Analyst by the Corporate Finance Institute. He has also completed the CFA Investment Foundations program.
- He joined Pitt Street Research in January 2022. Previously he worked for over three years as a financial journalist at Stockhead.
- While at university, he worked for a handful of corporate advisory firms

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