PITT STREET RESEARCH

MTM Critical Metals

Poised for a breakthrough year in 2025

Share Price: A$0.25

MTM Critical Metals (ASX: MTM) enters 2025 with cutting-edge technology, strategic partnerships, and robust financial support, capping off an exceptional 2024. The company's Flash Joule Heating (FJH) technology revolutionises metal recovery with faster, more efficient, & higher-yield processes, significantly reducing acid use and environmental impact.

MTM entered its first commercial collaboration, with one of the world's leading technology metal suppliers, Indium Corporation. MTM will process ultra-high-value scrap from Indium containing strategic metals like gallium and germanium. This validates MTM's technology and positions it as a key player in creating a US-centred supply chain.

ASX: MTM

Sector: Resources

15 January 2024

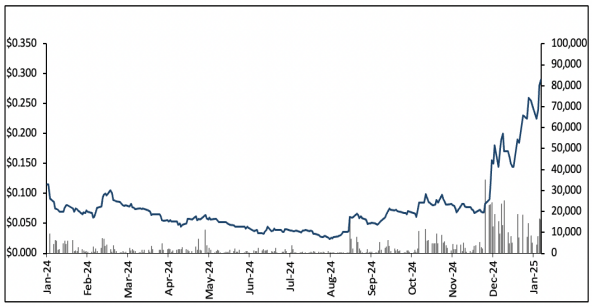
Market cap. (A$ m)	114.6
# shares outstanding (m)	458.3
# shares fully diluted (m)	612.2
Market cap ful. dil. (A$ m)	153.1
Free float	100%
52-week high/low (A$)	0.28 / 0.024
Avg. 12M daily volume ('1000)	3,341.3
Website	mtmcriticalmetals.com.au

Source: Company, Pitt Street Research

A strong summer

Since our last report in early December, the company has unveiled further testing results that have been the best to date, including for highly valuable 'magnet REEs', such as Nd, where it achieved a 93% average conversion of REEs (Rare Earth Elements) to chlorides. MTM also completed a $7.5m placement just before Christmas, which it completed at a zero percent discount, and saw a significant broadening of its institutional investor base with Pengana Capital joining the register and Terra Capital topping up its holding.

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



Source: Refinitiv Eikon, Pitt Street Research

Plenty of catalysts await in 2025

MTM investors will have several catalysts to look forward to, beginning with the design completion of the FJH demonstration plant design by February with procurement and construction to begin thereafter. At the same time, the company will continue testing FJH across multiple critical metal feedstocks and will also seek further strategic partnerships and non-dilutive funding.

New valuation of $260.7m or $0.57 per share

In our initiation report, we suggested MTM could trade at ~$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). With the company now more than double that, it is time to update our valuation. We have continued to use a peer-weighted approach and believe MTM could trade at $260.7m, or $0.57 per share subject to meeting the milestones it has set for 2024. Please see p.9 for more details on our valuation rationale and p.10 for the key risks.

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Disclosure: Pitt Street Research directors own shares in MTM.

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The Investment Case for MTM Critical Metals

1) **MTM's FJH technology represents a better way to recycle metals**. Conventional metals recycling is expensive, time-consuming, energy-intensive, contingent on a high proportion of reagents being added to the process and may not distinguish metals of interest and other metals. Certain commodities, particularly lithium and REEs, have their own vulnerabilities to conventional methods. But FJH overcomes all of them because it is fast, requires far less energy and can ensure that only valuable metals are recovered.
2) **FJH has proven to be effective**. Repeated testing has shown not just that MTM's FJH is effective, but that it has become increasingly so due to the development work over the last couple of years. Testing conducted in mid-2024 depicted that FJH's recovery of REE and critical metals was 50% higher than just two years prior. The most recent testing with REEs achieved an average 93% conversion of REEs to chlorides as well as a 95% reduction in key impurities.
3) **FJH has a substantial market opportunity that is expected to continue to grow in the years ahead**. Metals recycling will become increasingly important as the costs of discovering new deposits for critical metals and bringing them into production as operating mines keeps increasing, but also regulations in some jurisdictions (most notably the EU) mandate the use of recycling as part of the critical metals supply chain. 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) **2025 will be a year of solid newsflow.** The company's next major milestone is the completion of the FJH demonstration plant design which is expected in February, followed by procurement, construction and commissioning phases. Other potential newsflow will include ongoing testing, commercial partnerships as well as funding.
5) **FJH has significant upside to be realised.** Even though the company has significantly re-rated in the past 3 months due to its collaboration with Indium and the latest FJH testing results, the company and its technology remain at an early stage. We see scope for further re-rating if it can hit the milestones it has set itself for 2025, particularly the finalisation of the design and subsequent construction and commencement of a pilot-scale plant. Further commercial deals and test results could prove to be further catalysts. With the company having doubled our previous valuation, we have updated it to $260.7m or $0.57 per share.

Reintroduction to MTM's FJH Technology

Flash Joule Heating involves the creation of thermal energy because of the collision of electrons in a conductor…done at a 'flash pace'.

Flash Joule Heating (FJH) is a general method of metal recovery, and MTM has commercialised a form of FJH that has been licensed from Rice University. FJH causes rapid and intense heating, as high as 3,000 degrees Celsius in less than a second. FJH is essentially Joule Heating conducted at a 'flash pace'. This is achieved through the collision of electrons in a conductor, a process that produces thermal energy. It is named after the English physicist James Prescott Joule (1818-1889) who outlined this theory in a paper to the Royal Society in 1840.

The Flash Joule Heating which MTM is commercialising originated from work at the Rice University to make 'flash graphene', graphene being a valuable and highly versatile carbon derivative[1]. Realising that carbon's high conductivity enabled ultrafast heating, the Rice lab then started using carbon black[2] as a conductive additive to non-conductive feedstocks. Tests undertaken in reactor vessels made of quartz with graphite electrodes at each end, and applying electrical pulses, generated 3,000 degrees Celsius of heat in just a fraction of a second[3].

The benefits of FJH

FJH is high-yielding, which is to say that it recovers a high proportion of the metals.

When this process is used for the purposed metals recycling – as opposed to standard methods such as smelting, incineration, combustion or processes involving the use of industrial sludges – the outcome for all stakeholders is better. Most notably because FJH is higher yielding, in other words it recovers a high proportion of the metals. Results have included an average of 50% improvement with Rare Earth Elements (Figure 1) as well as lithium. In respect of other metals, it has shown even higher changes, with the most being 514% with titanium. Moreover, the performance continually improves with further testing and refinement of the process.

On 8 January 2025, the company unveiled testing results with respect to a monazite-rich REE concentrate accompanied by a water wash. In the process, a single carbo-chlorination flash converted 93% of REEs into high-purity, water-soluble chlorides (Figure 2). All 17 REEs were chlorinated, underscoring the robustness of the process. A final high-purity REE-chloride product was produced. Furthermore, it also demonstrated very high impurity removal rates of key deleterious elements including iron (92%) and aluminium (96%).

Other benefits include that FJH is:

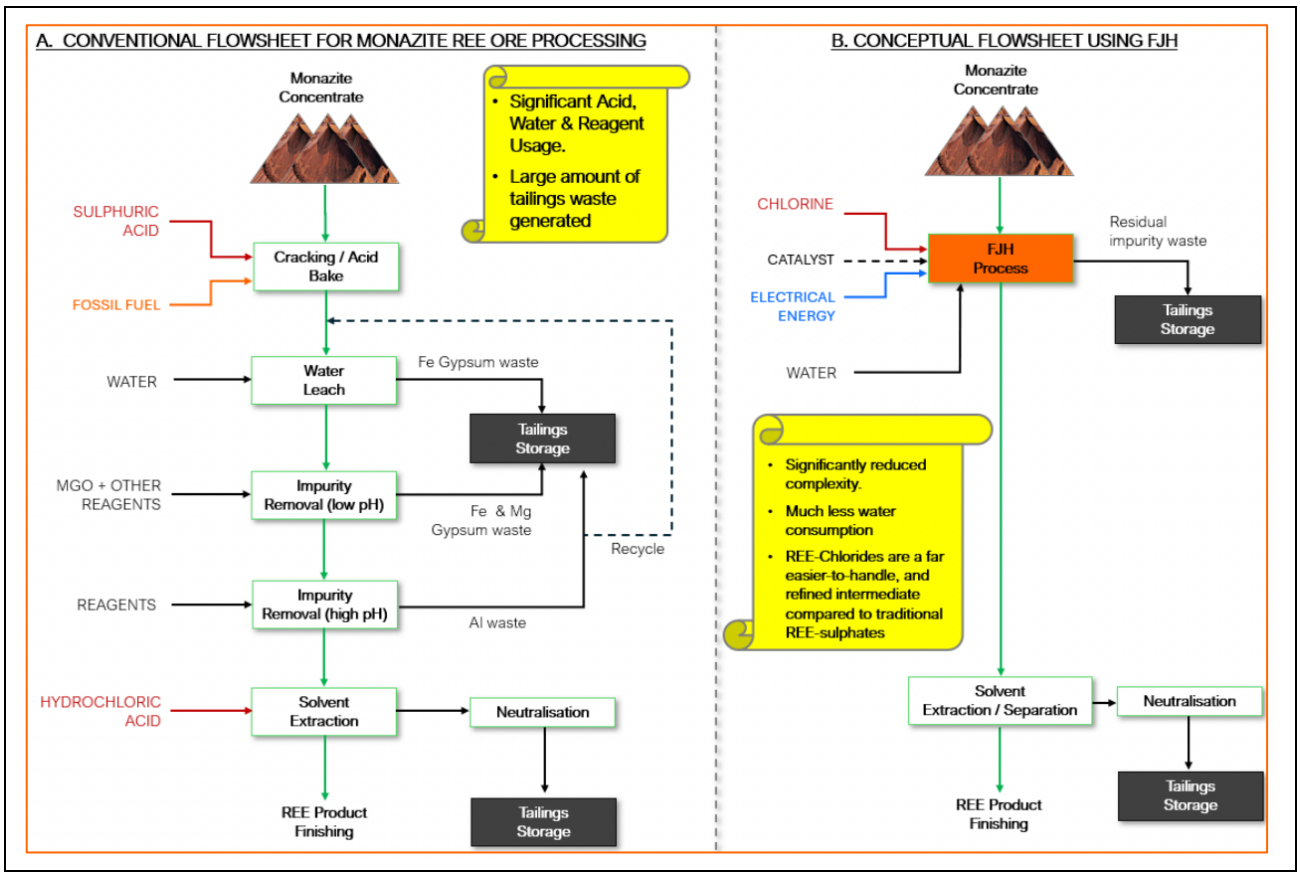
- **Less time-consuming** as the heating takes less than a second as opposed to hours,
- **Less energy-intensive,**
- **Selective** in only removing the metal of interest while not 'mixing' other metals,
- **Less reagent-contingent** which means less reagents (compounds added to cause the necessary chemical reactions) are required,
- **Less expensive** for all of the reasons above.

[1] See WO/2020/051000, priority date 19 August 2019. A company called Universal Matter is producing graphene using the Flash Joule Heating technology and has already scaled to more than 1 tonne per day and is moving towards 3 tonnes per day. See universalmatter.com.

[2] A material commonly used as a pigment and reinforcing phase in car tyres.

[3] See *Ultrafast flash joule heating synthesis methods and systems for performing same*, WO/2022/067093, priority date 24 September 2020. Invented by James Tour and Bing Deng.

Figure 1: The effect of FJH



Source: Company

Figure 2: REE-Chloride conversion yields for the key REE elements of interest

REE Element	Nd	PR	Dy	TB	Ce	La	Eu	Gd	Y	Sm
% Conversion to Chloride	90%	100%	77%	89%	90%	93%	100%	100%	79%	96%

Source: ASX announcement 9 January 2025, Pitt Street Research

Where MTM came into the picture

MTM has exclusive worldwide licensing rights to license Rice's FJH.

MTM had been an minerals explorer since its 2021 ASX listing, but in 2023 acquired Flash Metals which had REE-prospective territory adjacent to WA1 Resources (ASX: WA1) along an option to license the FJH technology from Rice University. This option was formally exercised in March 2024 and MTM obtained exclusive licensing rights from Rice. Since them, the company has made significant progress and this has been reflected in the company's re-rating. In particular, the company demonstrated results even more spectacular than had previously been demonstrated.

Most importantly, the company unveiled a strategic collaboration with Indium Corporation (Indium), which is one of the Western world's leading suppliers of refined gallium, germanium, indium and other specialty technology metals. MTM will process scrap materials rich in gallium, germanium, indium and tin provided by Indium. By 'rich', this means metal containing up to 20% (200,000 ppm) indium, 15% (150,000 ppm) gallium and 18% germanium (180,000 ppm). Although it is only a non-binding Memorandum of Understanding (MoU) at this stage, it will be the first external partnership MTM has secured, thus marking a major valuation of the company's work to date and the potential of its technology.

The aim of this collaboration is to create a US-based processing solution using MTM's FJH to recover the aforementioned metals from scrap sources. This initiative aligns with US efforts to establish a secure domestic supply of critical materials – efforts which we expect to intensify once the new Trump administration takes charge. Gallium, germanium, indium are all critical metals that are used in electronics, high-tech applications and advanced military technologies.

MTM's commercial plan

FJH has 3 target commodities: Lithium, REEs (Rare Earth Elements) and Galluim.

MTM has three target commodities: Lithium, REEs and Gallium. In respect of each of these, demand is expected to grow exponentially in the years ahead, and metals recycling can play a key role in ensuring demand can be met. Moreover, beyond the general benefits of FJH we mentioned above, it has specific benefits to certain commodities. For lithium, FJH can improve the energy-intensive 'calcination' step in lithium extraction[4]. For rare earths, FJH could potentially improve the processing by removing the need for the 'acid bake/roasting' step where rare earth phosphates are converted to rare earth sulphates. Gallium is arguably the commodity where MTM could make the most difference because China dominates the supply chain even moreso than with rare earths and also because gallium mining is rare given it is rarely found in sufficient volumes to make mining operations viable. Please see our initiation report from last October for further details on how FJH can help those specific commodities.

FJH has also demonstrated potential against other commodities with the most prominent being gold, which is a very common metal in E-waste. Gold processing is typically done in smelters and incinerators using methods that are expensive, time-consuming, crude to the environment through direct emissions and toxic by-products, and often unregulated. FJH's technology applies direct electrical energy under a chlorine gas atmosphere, thus vaporising metals from e-waste and recovering them in a single step without using toxic acids or non-selective incineration

MTM has estimated a global market for metal recovery from industrial waste in the order of US$400bn, while another US$600bn market exists for improved processing options for refractory minerals.

MTM has estimated a global market for metal recovery from industrial waste in the order of US$400bn, while another US$600bn market exists for improved processing options for refractory minerals. It has identified 4 specific verticals: Lithium battery waste, E-waste, Bauxite residue and Coal fly Ash (REE can be present in all of these).

MTM's options for longer-term commercialisation

Although MTM is a few years away from commercial-scale operations, it is not unrealistic to ponder how MTM could eventually make money from this technology. Although MTM has not disclosed its thoughts publicly, we see the following as some of the options available:

- **Licensing or Sub-Licensing** to companies such as those in the critical metals industry, allowing them to integrate it into their operations. MTM would get a licence fee, plus a processing fee, plus ideally a share of the profits to incentivise high recovery;
- **An Owner/Operator Arrangement**; in other words, establishing and operating facilities of MTM's own – potentially with a project partner who would acquire equity at the project level,
- **Contract Operations**: Operating plants on behalf of third parties, leveraging MTM's expertise in deploying the technology and getting fees based on tonnage processed and a share of the profits; and,
- **Collaborative Ventures**: Forming JV or partnerships with major industry players to integrate FJH into their processes while sharing the financial and operational commitments.

[4] See the MTM announcement dated 9 July 2024 headlined '*Positive lithium extraction results from Flash Joule Heating*'

What 2025 holds for MTM

Commercial production is a few years away, but the company should continue to take important steps towards that goal.

2025 promises to be a spectacular year for MTM if all goes to plan. It may be at least a few years before we realistically see FJH deployed on a wide-spread commercial scale (i.e. beyond one or two major clients), but the company should continue to take important steps towards that goal.

MTM is pursuing a 3-pronged strategy to commercialisation involving optimisation of the technology, scaling up testing (towards pilot-scale trials) and pursuing collaborations with industry stakeholders. Testing programs to further validate FJH will continue, particularly across rare earths, lithium and e-waste. And finally, the company will continue to pursue partnerships – we expect the Indium collaboration to be the tip of the iceberg. We expect interest from metal suppliers, future offtake partners as well as from potential sources of non-dilutive funding.

MTM is looking to undertake a listing in the US via over-the-counter (OTC) markets, a move that will expose the company to a broader range of investors. Although it has not given a specific time frame, this is expected to occur in 2025.

A Texas-based demonstration plant is coming

MTM is working on a demonstration plant in Texas. The design will be complete in February, and procurement, construction and commissioning will follow.

But the most important milestone facing the company is work on a demonstration plant which will be based in Texas. MTM has promised shareholders that it is on track for design completion in February. Thereafter, procurement, construction and commissioning will follow.

REEs are strategically important for defence, electronics and renewable energy and the US is prioritising the onshoring of rare earth processing and supply so the country can become self-sufficient rather than relying on China. Initiatives demonstrating this have included Department of Defence (DoD) awards to MP Materials for US$35m and Rare Earth Salts for US$4m, for rare earth oxide processing and terbium oxide production respectively. The very reason the US has historically not had its own supply chain is because traditional methods have proven complex, costly, and environmentally taxing. But FJH offers a promising solution that could help with the US's objectives.

Our updated valuation of MTM

We formerly valued MTM at A$63.9m (or $0.16 per share) in our base case or A$83m ($0.21 per share) in our bull case.

In our initiation report, we outlined a view that MTM could trade at a market cap of ~A$63.9m (which was $0.16 per share under the number of shares on issue at the time but $0.139 per share now) and $83m in our bull case ($0.205 per share at the time of our report but $0.181 with the current number of shares on issue). This was in line with peers Zeotech (ASX:ZEO) and Neometals (ASX:NMT)), two companies that were not MTM's only peers but were the closest comparable considering the stage of development. Our valuation was contingent on MTM passing pilot-scale testing and has secured a licensing deal. But the news of the MoU with Indium and the latest REE testing results were enough to send MTM's valuation well above and beyond our earlier figure, well ahead of NMT and ZEO, although still well behind other peers which were capitalised at ~$600m earlier in 2024, but are all now above $1bn (Figure 3).

Figure 3: MTM's peers (market capitalisations correct as of 8 January 2025)

Company	Code	Market Cap (A$m)	Location	Website
ASX-Listed				
Alpha HPA	ASX.A4N	1042.6	Sydney, Australia	https://alphahpa.com.au
Silex Systems	ASX.SLX	1379.8	Sydney, Australia	https://www.silex.com.au
Neo Metals	ASX.NMT	63.1	Perth, Western Australia	https://www.neometals.com.au/en/
IperiorX	ASX.IPX	1642.4	Charlotte, North Carolina	https://iperionx.com/
ZeoTech	ASX.ZEO	81.6	Brisbane, Queensland	https://zeotech.com.au/
Iondrive	ASX.ION	25.9	Adelaide, South Australia	https://iondrive.com.au/

Source: Pitt Street Research

We now ascribe a valuation of 25% of Alpha HPA (ASX:A4N) which is $260.7m or $0.57 per share.

We feel it is time to update our valuation and we ascribe a valuation of 25% of Alpha HPA (ASX:A4N), a company we now think is MTM's closest peer from a metal recovery technology perspective although is far more advanced. Alpha HPA is currently $1,042m and 25% of that is is $260.7m or $0.57 per share. We also model a bull case of 33% of Alpha HPA (ASX:A4N) which is $344.1m or $0.75 per share (Figure 4).

Figure 4: Our Updated Valuation of MTM

Valuation	BASE	BULL
Equity of Alpha H4A (A$m)	**1,042.6**	**1,042.6**
% Market Cap	25%	33%
Implied Equity of MTM (A$m)	**260.8**	**344.1**
Shares outstanding	458.3	458.3
Implied price (A$ cents)	**0.570**	**0.751**
Current price (A$ cents)	0.250	0.250
Upside (%)	128.0%	200.4%

Source: Pitt Street Research

Alpha HPA (ASX:A4N) is commercialising high purity aluminium metals using low carbon HPA refining technology. The company is in Stage 1 of production and is currently building 'Stage 2' which would represent full commercial scale – at 10,4370tpa, making it the largest single-site production of high purity aluminium materials globally. An annual, steady state project EBITDA of

A$255-403m is anticipated. MTM has is still some way from commercial production, but is within weeks of starting construction of a pilot plant which is a step towards a commercial-scale plant. We therefore think 25-33% is an appropriate range for now.

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

- Completion of the pilot plant's design followed by the commencement of construction,
- Continued testing results which continue to depict FJH's effectiveness.
- Partnerships or collaborations with potential strategic customers and joint-venture partners – both chemical companies and owners of difficult-to-process mineral deposits.
- Securing government grants or other sources of non-dilutive funding in various jurisdictions.
- Further optimisation of the FJH approach.

Further re-rating?

We think that once MTM has a formal Feasibility Study and has demonstrated a Pilot Plant successfully, it could then trade at 50% of A4N. We do not think a valuation of 100% of A4N (or any valuation above A$600m) would be appropriate until FJH is in commercial-scale production – i.e. at least multiple thousand tonnes per annum.

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.
- **Funding risk**: MTM 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 MTM'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:** MTM'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.

Appendix I – Updated Capital Structure

Capital	Number	% of share capital
Total Ordinary Shares	**458.3**	**84%**
Existing Listed Options (expire Nov-24)	66.5	12%
Performance Rights	23.1	4%
Fully diluted shares	**547.9**	**100%**

Source: Pitt Street Research

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. 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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