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ASX RELEASE

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GALLIUM RECOVERED FROM E-SCRAP USING FJH TECHNOLOGY: PLANS FOR COMMERCIAL-SCALE PLANT UNDERWAY

HIGHLIGHTS:

- **Successful Lab-Scale Gallium Recovery:** High-purity gallium recovered from industrial semiconductor scrap using FJH-chlorination process, underscoring the technology's potential.
- **Strategic Importance:** With recent geopolitical developments, the ability to domestically recover gallium represents a transformative step in reducing dependency on Chinese exports.
- **Market Supply Issues:** The global gallium market has been severely impacted by China's export restrictions, leading to a dramatic increase in prices. Gallium is crucial for various applications, including gallium nitride semiconductors, LEDs, solar panels, and defence technologies like next generation missile defence, radar systems, electronic warfare, aerospace and communications equipment (Bloomberg 2024).
- **Broad Commercial Opportunity:** The global demand for gallium is surging, driven by its use in semiconductors, consumer electronics, defence and green technologies. MTM's FJH technology is poised to offer a scalable, efficient solution to meet this growing demand.
- **Prototype Testing:** Following the lab-scale success, MTM will proceed with prototype testing in the FJH reactor in Houston, Texas, moving closer to commercial-scale operations.
- **Commercial-Scale Plans:** Design and planning for a 1-ton per day facility are underway, with operations expected to commence next year, offering a potential solution to the gallium supply crisis.
- **International Collaborations:** MTM is engaging with potential partners for offtake agreements and exploring non-dilutive funding opportunities to support critical mineral onshoring efforts in the US and allied nations.
- **No Acid (Or Strong Base) Required:** The FJH recovery process from e-waste is entirely acid-free, reducing chemical use and associated environmental impacts.

MTM Critical Metals Limited (ASX: MTM) (MTM or the Company) is pleased to announce a significant advancement in the recovery of gallium from semiconductor and LED scrap via Flash Joule Heating (FJH) technology. This lab-scale breakthrough places MTM at the forefront of efforts to resolve the critical supply chain challenges surrounding gallium — a metal that is indispensable to high-tech and defence industries.

The testing was conducted by researchers at Rice University in the USA. MTM holds an exclusive global license from Rice University for the commercialisation of FJH technology, enabling the recovery and processing of all metallic minerals and ores, excluding graphene.

The global supply of gallium (Ga) has been severely disrupted due to escalating geopolitical tensions and China's recent export restrictions, which have caused prices to soar dramatically. With China controlling 98% of the world's Ga supply, the successful demonstration of recovery of this metal is a strategically significant development that offers a potential solution to the escalating supply crisis affecting the USA and its allies.

Why This Breakthrough Matters: FJH technology has proven capable of efficiently recovering gallium from e-scrap, offering a pivotal and timely solution to the global gallium supply crisis. Demonstrating that this critical metal can be sourced outside of China's supply dominance enhances its security and availability for high-tech and defence industries. This also positions MTM to capitalise on significant commercial opportunities, with the potential for near-term, high-margin production.

Commenting on these results MTM Chief Executive Officer, Michael Walshe, said *"The breakthrough in gallium recovery from e-scrap using Flash Joule Heating technology marks a pivotal advancement, with similar potential for germanium. Amid limited Western gallium supply options, escalating geopolitical tensions, and recent price surges, our ability to extract this strategic metal from waste streams offers both significant commercial promise and a strategic solution for the U.S. and its allies. We eagerly anticipate the upcoming bench-scale tests and are optimistic about our potential to transform the gallium supply chain".*

Method for Gallium Recovery using FJH:

Gallium was selectively recovered from electronic scrap in the Rice University lab by heating the mixture to a precise temperature, allowing the gallium compound to vaporise and be separated from other metals and materials present. The process was highly efficient & produced gallium with both high purity and yield (Fig. 1).

Material Preparation: Gallium was recovered from synthesised LED manufacturing waste which consisted of a mixture of metals and their derivatives, including GaN (gallium nitride), Ag (silver), SiO_2 (silicon dioxide), and Au (gold).

FJH Chlorination: The process involves rapid heating in a controlled chlorine atmosphere. The temperature was carefully controlled through voltage input to selectively chlorinate the GaN to form $GaCl_3$, which has a lower boiling point than the other metals within the feedstock.

Selective Evaporation: Due to the difference in boiling points, $GaCl_3$ could be evaporated and separated from the remaining materials. This step was crucial in ensuring that the gallium could be recovered with high purity.

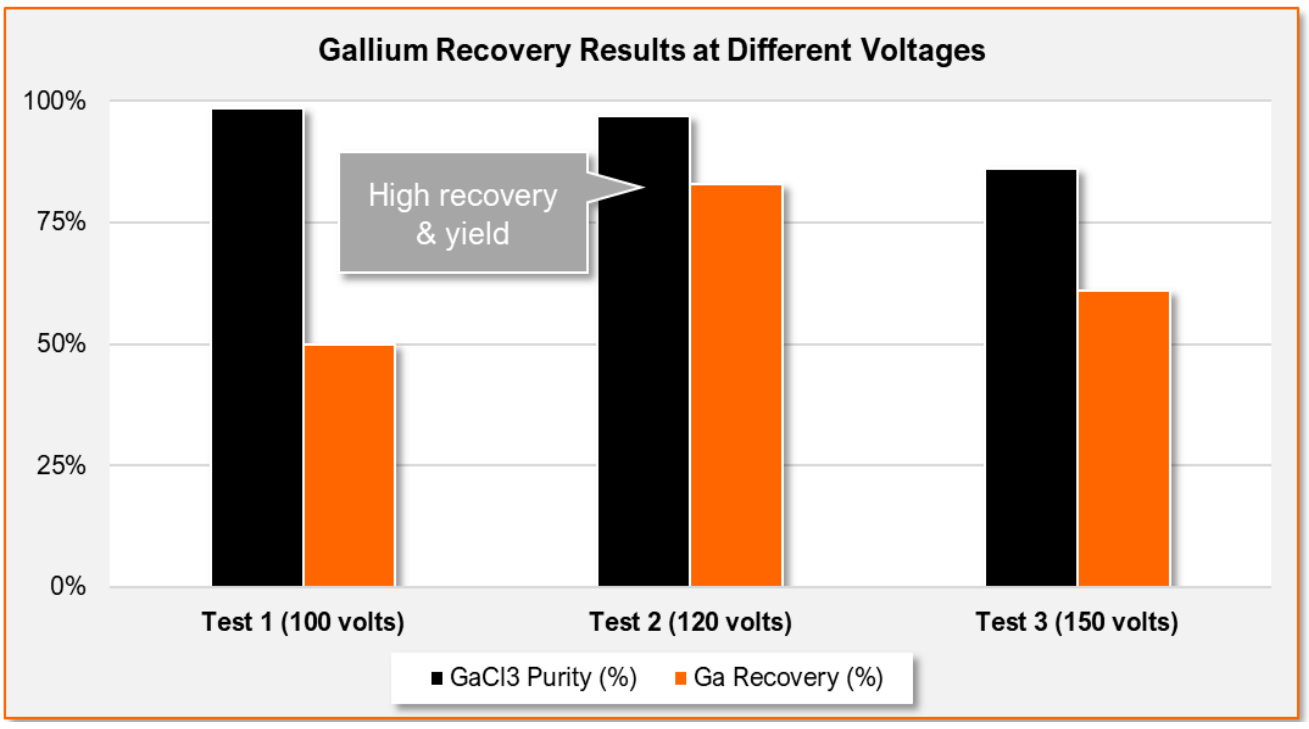

Figure 1: Lab-scale results ($GaCl_3$ purity & Recovery (Yield)) for Ga recovery from LED wafer scrap using FJH in a chlorinated environment at different supply voltages. Source: Rice University.

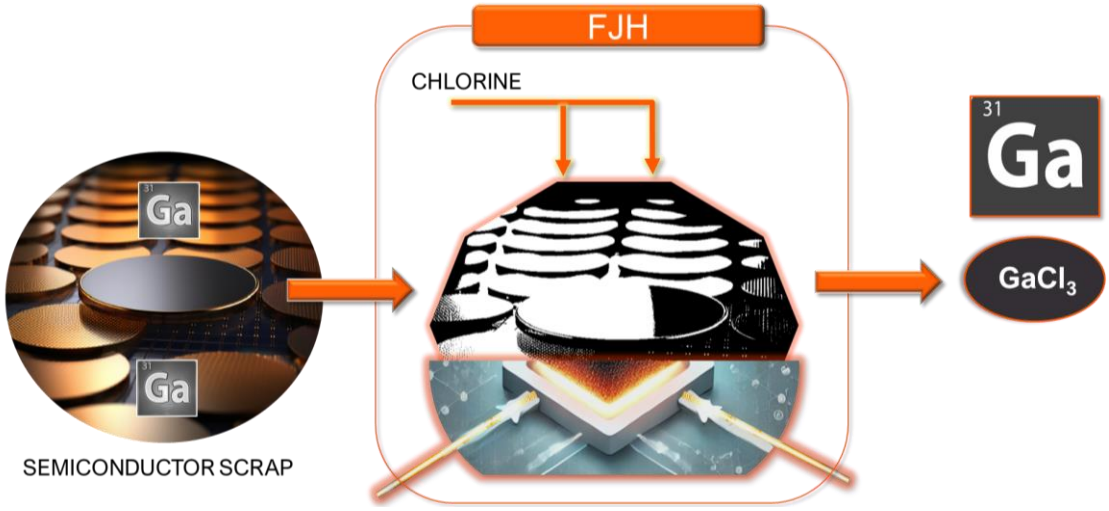

Figure 2: Schematic representation of Ga recovery from semiconductor scrap using FJH in a chlorinated atmosphere.

Impact of Chinese Export Controls on Global Germanium and Gallium Supply Chains

Chinese Export Controls: On August 1, 2023, China imposed new export controls on critical minerals, including germanium and gallium, significantly impacting the global supply chain (S&P Global 2024).

USA Reliance on Imports: US is 100% reliant on imports of germanium and gallium, particularly from China, which is the dominant global producer. Current domestic US Ga stockpiles are non-existent (USGS 2024).

Chinese Production Dominance & Global Supply Concerns: China produces >95% of the world's gallium with no domestic production noted in the USA (Bloomberg 2024).

Price Surge: Following China's export controls in Aug. 2023, gallium prices surged by 27% within a week, with continued increases seen in the following months. By December 2023, global prices had increased by 68% since July 2023 with the upward trend ongoing (S&P Global 2024).

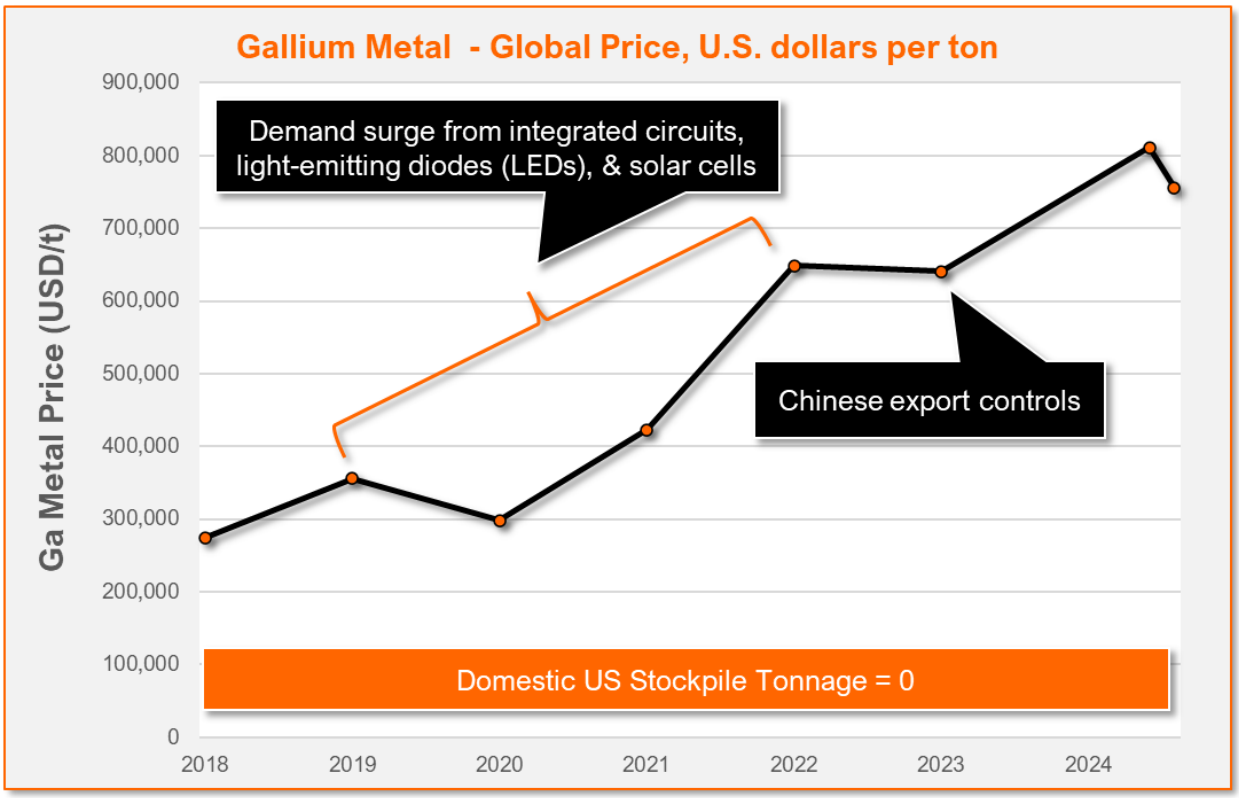

Figure 3: Global Gallium Metal Price Trend since 2018. Source: Statista (2024), USGS (2024)

Importance of Germanium and Gallium: Both minerals are vital for the production of semiconductors, solar panels, electric vehicles, and various high-tech and defence applications (Bloomberg 2024).

Supply Chain Disruptions: significant risks are posed to critical defence, electronics, computer, and automotive industries amongst others, potentially reducing the output of omnipresent semiconductor-dependent devices.

Germanium Stockpiles in the US: The US govt. holds stockpiles of Ge in the National Defence Stockpile, including wafers, intrinsic metal, and scrap (USGS 2024).

Lack of Gallium Stockpile: Unlike germanium, there is currently no known strategic stockpile of gallium in the United States (USGS 2024).

Supply Chain Disruptions & Risk for Western Nations: The semiconductor and mining industries are expected to face disruptions, leading to potential shortages and significant price increases for gallium-dependent technologies. **Several western nations are 100% reliant on gallium imports from China.**

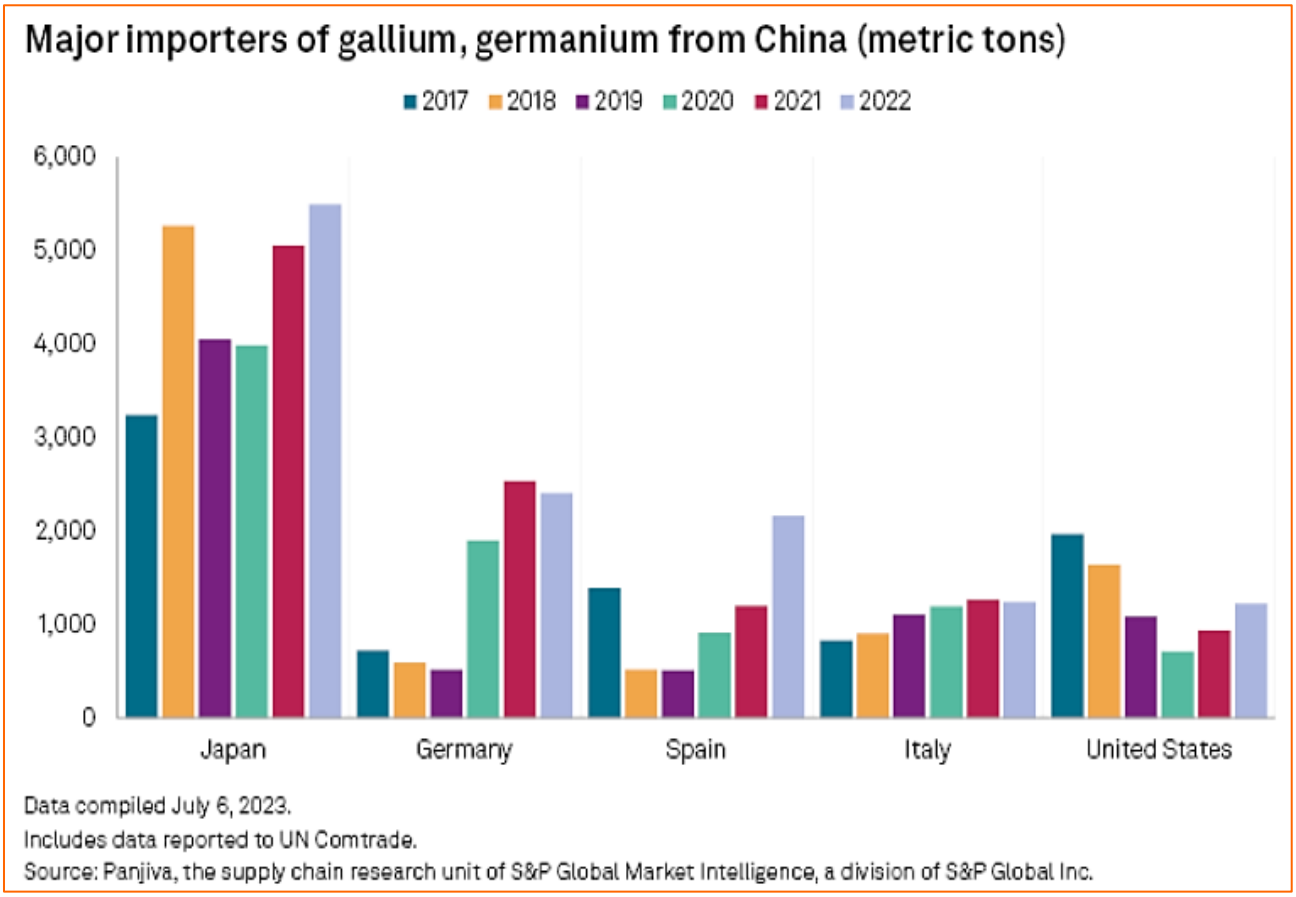

Figure 4: Major Gallium & Germanium Importers. Source: S&P Global (2023)

Recent Chinese Export Data: Following the implementation of supply controls in Aug 2023, China's exports of germanium and gallium plummeted, with none recorded between Aug. & Sept. 2023, and only minimal quantities in Oct. 2023. Although exports have resumed since then, volumes remain significantly lower (Bloomberg 2024).

DATA SOURCES: Source: Statista (2024), USGS (2024), S&P Capital IQ (2024); Bloomberg (2024)

Commercial Potential:

Importance of Domestic Supply: The announcement underscores the strategic need for developing domestic gallium recovery and processing capabilities, highlighting the opportunity for MTM's gallium recovery efforts from U.S.-sourced scrap.

Next Steps:

- **Bench-Scale Testing:** Initiate testing on the FJH prototype reactor to scale up the recovery process.
- **Commercial-Scale Facility:** Finalise the design and operational plans for the 1-ton per day facility, targeting full-scale production in the next year.
- **Strategic Partnerships:** Continue discussions with international partners and pursue funding opportunities to support the development and commercialisation of this technology.

The Company will continue its test work to demonstrate the scalability and effectiveness of the FJH & chlorination-enhanced FJH technology with a focus on maximising lithium & other critical metal recovery and minimising energy consumption. Discussions with industry partners, academia and government agencies are ongoing to support the development and commercial deployment of this revolutionary technology.

Additionally, test work is completed, underway or planned on a range of additional sample streams including: **refractory minerals** such as spodumene (lithium), monazite (rare earths), & pyrochlore (niobium); **precious metal recovery** from e-waste; and **alumina & titanium recycling** from 'red mud'.

This announcement has been authorised for release by the Board of Directors.

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About MTM Critical Metals Limited

MTM Critical Metals Limited is a dynamic company with a dual focus on mineral exploration and metal recovery technology development. We hold exploration assets prospective for niobium (Nb), rare earth elements (REE), and gold, strategically located in Western Australia and Québec. Additionally, we possess exclusive licensing rights to the innovative Flash Joule Heating technology, a cutting-edge metal recovery and mineral processing method developed by esteemed researchers at Rice University, USA.

Flash Joule Heating (FJH) is an advanced electrothermal process that enhances metal recovery and mineral processing compared to traditional methods. By rapidly heating materials in a controlled atmosphere, FJH efficiently extracts metals like lithium from spodumene, gallium from scrap, and gold from e-waste, among others. This technology has the potential to revolutionise metal recovery by reducing energy consumption, reagent use, and waste, offering a more economical and environmentally friendly alternative.

MTM's West Arunta Nb-REE exploration assets are situated in one of Australia's premier exploration hotspots, where over $60 million has been invested by ASX-listed companies such as WA1 Resources, Encounter Resources, Rio Tinto (in JV with Tali Resources), and IGO Limited. MTM also holds tenements in other key mineral regions across Western Australia, including the Mukinbudin Nb-REE Project, East Laverton Gold & Base Metals Project, and Mt Monger Gold Project. In Québec, the Pomme Project is a highly promising carbonatite intrusion rich in REE and niobium, located near the world-class Montviel deposit.

ABOUT KNIGHTHAWK ENGINEERING

KnightHawk was founded in 1991 and specializes in identifying high technology solutions in a short timeframe. They have executed projects throughout the United States, Europe, and Asia. Their clients range from individual entrepreneurs to the large industrial organisations such as Shell, Exxon Mobil, Chevron and NASA. They have a depth of experience and expertise and are leaders in design, failure analysis and troubleshooting across a range of engineering disciplines. KnightHawk was selected for its expertise across a wide range of disciplines and their focus on ensuring outcomes in a timely manner.

Figure 5: Knighthawk Engineering, FJH Team, Houston Texas

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REFERENCES

- **Bloomberg 2024,** 'Gallium Has More Than Doubled in Price on China Export Curbs', https://www.bloomberg.com/news/articles/2024-04-03/critical-metal-hit-by-china-curbs-has-more-than-doubled-in-price?embedded-checkout=true.
- **S&P Capital IQ 2024,** 'Uncertainties abound around China's gallium, germanium export controls', Commodity Insights – Gallium.
- **Statista 2024,** Gallium price worldwide from January 2018 to January 2024, https://www.statista.com/statistics/1443942/gallium-global-price/
- **United States Geological Survey (USGS) 2024**, Gallium Mineral Commodity Summaries 2024, https://pubs.usgs.gov/periodicals/mcs2024/mcs2024-gallium.pdf