MTM CRITICAL METALS

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ASX RELEASE

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Efficient Recovery of Gold from E-Waste with Flash Joule Heating (FJH)

HIGHLIGHTS:

- **FJH technology achieves high gold recovery from E-Waste using no acid:** ~70% yield for Gold (Au) at this unoptimized, proof-of-concept stage.
- **Sustainable & environmentally friendly:** No toxic chemicals or non-selective incineration; simple water wash process minimizes environmental impact.
- **Massive Market Opportunity:** Over 60 million metric tonnes of e-waste generated annually, containing precious and base metals valued at over US$70 billion in potential recoverable content[1].
- **Potential for controlled recovery of toxic heavy metals** such as mercury (Hg) & arsenic (As), effectively preventing toxic effluents and environmental contamination commonly associated with current methods.
- **Scale-Up Potential:** Following successful lab-scale results, prototype testing will follow with plans already underway for a commercial-scale facility.

MTM Critical Metals Limited (ASX: MTM) ("MTM" or "the Company") is pleased to announce initial tests of its proprietary Flash Joule Heating (FJH) technology to recover gold from electronic waste (e-waste) has achieved high recovery yields, demonstrating the potential to change the status quo for the recycling industry.

Proof-of-concept stage testing recovered up to 70% of the contained gold within e-waste **without the use of toxic acids.** The FJH process works by 'flash' heating e-waste in a chlorine gas atmosphere, vaporizing the target metals like gold for efficient separation and collection via metal chlorides.

The process is highly scalable and environmentally friendly, offering a sustainable and energy-efficient alternative to traditional methods of recovering metals from e-waste such as smelting and chemical leaching, which are considered energy-intensive, environmentally harmful, and economically inefficient.

E-waste is one of the fastest-growing components of solid waste with over 60Mt produced annually of which only about 20% is recycled. This vast repository contains precious and critical metals like gold, copper, and palladium, valued at over US$70 billion in potential recoverable content, and presents a significant opportunity for material reclamation that reduces carbon emissions and minimises toxic by-products[2].

MTM Chief Executive Officer, Michael Walshe, said: *"FJH has proven to be an efficient and sustainable solution for recovering gold from low-grade e-waste, with future tests to focus on higher metal content material as it becomes available. As global e-waste levels rise and the demand for greener metal production increases, particularly in the face of an acid shortage, FJH presents a cleaner and more efficient alternative to traditional methods. This technology holds the potential to unlock significant economic value through environmentally responsible metal extraction, delivering lasting benefits for shareholders, the industry, and the environment".*

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[1] Manikandan., Inbakandan & Nachiyar, 2023
[2] Patel 2024

Why This Breakthrough Matters: E-waste, which includes discarded electronic devices, contains a rich concentration of precious metals. For example, printed circuit boards (PCBs) can contain up **400 g/t of gold** and **6 kg/t of silver**, concentrations far higher than in natural ores. However, recovering these metals through traditional methods is energy-intensive, environmentally damaging, and expensive[3]. It is primarily done in smelters/incinerators across China, India, Nigeria, & SE Asia, often using crude, unregulated and methods[4].

The **FJH technology** offers a sustainable and efficient solution – by applying direct electrical energy under a chlorine gas atmosphere, FJH can vaporize metals from e-waste and recover them in a single step without using toxic acids or non-selective incineration. FJH has demonstrated recovery yields of almost 70% for gold.

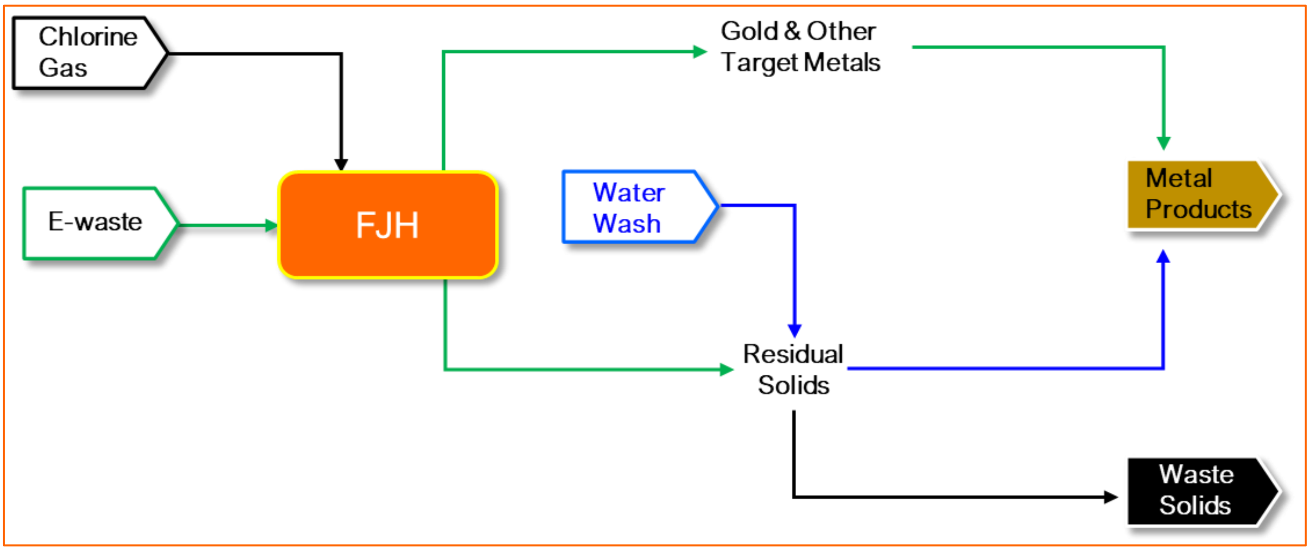

Figure 1: Schematical overview of FJH recovery of metals from e-waste

Globally, the small percentage of electronics that are collected for recycling are typically sent to about a dozen smelting facilities located in Asia, Canada, and Europe, with a significant portion going to unregulated plants in developing nations. These facilities, which are highly costly to build and operate, break down the e-waste and either melt it at extremely high temperatures or use strong acids to extract the valuable metals. Any leftover plastic is often incinerated and used as fuel to power the smelters. While this process is effective at metal recovery, it comes at the cost of significant carbon emissions and the production of harmful toxic by-products and emissions[5].

The motivation for testing FJH technology stems from the urgent need for more efficient and sustainable methods to recycle e-waste.

Summary of Method & Results

OVERVIEW: Initial FJH tests demonstrated significant gold (Au) recovery from PCB e-waste, attributed to gold's low chlorination temperature and broad temperature range for reaction.

- The purpose of the test was 'proof-of-concept' for the extraction of gold from e-waste using MTM's prototype following up on previous works undertaken by Rice University[6]. Rice previously demonstrated that FJH enables the recovery of valuable metals in e-waste with high yields.

[3] Manikandan et.al 2023
[4] Li, et.al 2022
[5] Forti et.al 2024
[6] Deng et.al 2021

- Previous work also demonstrated FJH's ability control the **recovery of toxic heavy metals** such as mercury (Hg) & arsenic (As), effectively preventing toxic effluents and environmental contamination commonly associated with current methods[6]. MTM will follow-up on these efforts in subsequent tests.
- **Single Flash Test**: The initial, unoptimized flash test was conducted using samples of shredded 'low gold grade' (Au sub 100 ppm) e-waste. The metals were flashed in a chlorinated atmosphere to facilitate the formation of metal chlorides.
- **Water Washing**: After the flashing process, water washes were conducted to remove metal chlorides from the residual solids. Inductively Coupled Plasma Mass Spectrometry (ICP-MS) was used to quantify the metals in both the solid residues and the water wash solutions.
- **Results**: **High Gold Recovery from E-Waste using no acid:** 69% yield for Gold (Au) at this unoptimized, proof-of-concept stage with plans to enhance the recovery efficiency for a range of additional valuable metals like copper, silver and palladium in subsequent tests.

Table 1: Summary of Initial FJH recovery of metals from e-waste - Gold concentration & recovery

METAL	Gold (Au)
E-waste feedstock metal content (g/t)	49.0
Product metal content (g/t)	33.8
Recovery (%)	**69%**

While gold has been the primary focus of initial testing, recovery rates for other valuable metals like copper, silver, and palladium were lower due to the present sole focus on proof-of-concept conditions for gold extraction. MTM is developing a dual-stage flash process such that all metals including copper, palladium and silver, can be efficiently recovered while maintaining the strong gold recovery results, with further testing planned in the next phase.

See also *Table 2* in the appendix for other metal results.

Market Opportunity

In 2022, it was estimated that **62Mt of e-waste was generated globally**, with only 20% being formally collected and recycled, and this forecast to grow to over **75Mt by 2030**[7]. The economic value of the metals in this waste is estimated at > USD70 billion, including USD15 billion from gold and USD19 billion from copper[7]. However, most of this value is lost due to incineration, landfilling, or substandard treatment. Improved recycling systems could unlock the recovery of these valuable materials[8].

[7] Global E-waste Monitor 2024
[8] Forti 2024

Figure 2: **Breakdown by weight and value of some of the metals contained in the 62 million tonnes of e-waste generated globally in 2022. Source: Forti et.al 2024; Patel,2024.**

E-waste is particularly rich in precious metals, often surpassing traditional ore bodies in metal content and is a growing waste source in most countries. For example, **printed circuit boards (PCBs)** can contain up to **400g of gold** and **6kg of silver** per ton, while **TV boards** have **280g of silver**, **20g of gold**, and **10g of palladium** per ton. **Computers** also contain significant amounts, with up to **600g/t of gold** and **2000g/t of silver**[9].

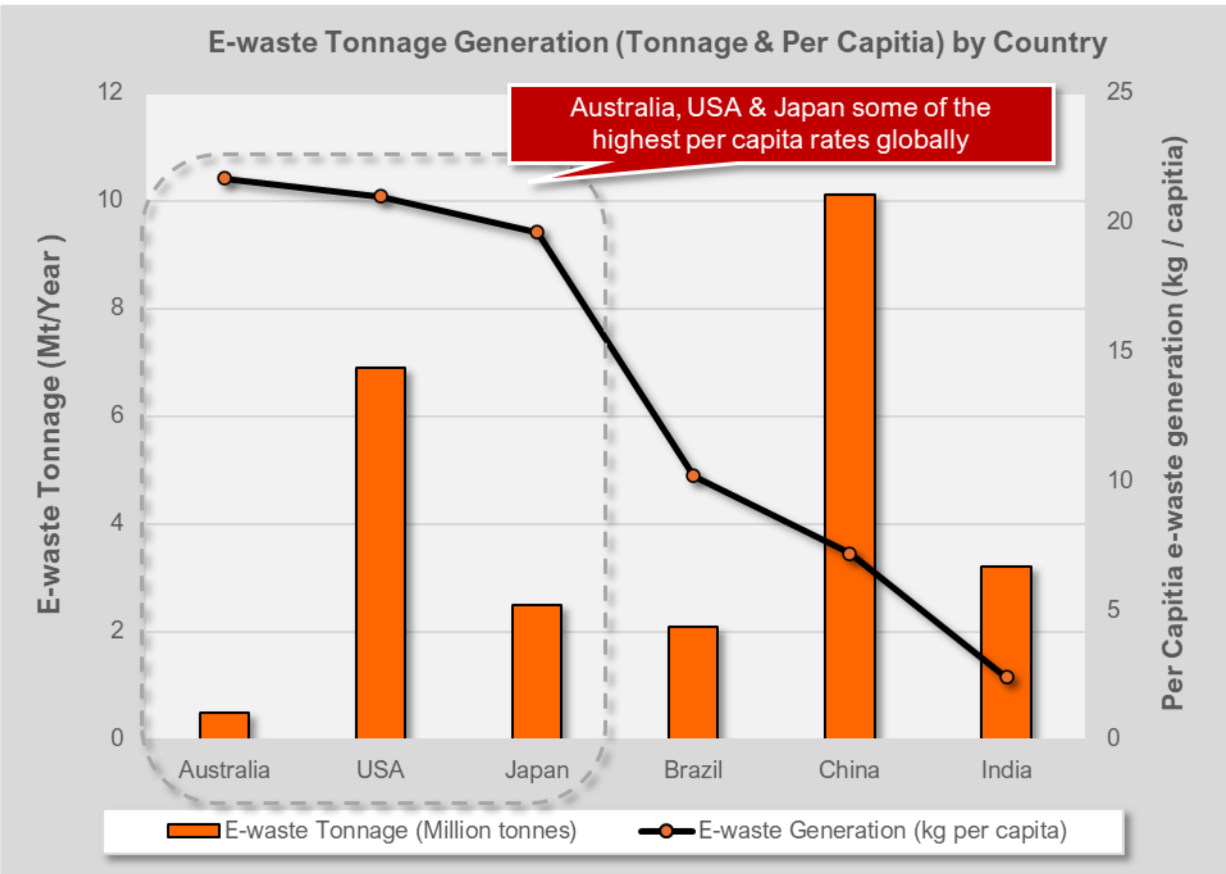

Figure 3: **E-Waste generation by tonnage & per capita various countries in 2023 (Source: Mairizal et.al 2023)**

[9] Yazici& Deveci 2013

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The E-Waste Problem for the Electronics Industry

A small percentage of electronics collected for recycling are typically sent to a limited number of smelting facilities located in Asia, Canada, and Europe. These facilities, which are capital intensive and have high operating costs, extract valuable metals by either melting the e-waste at extremely high temperatures or using strong acids for chemical leaching. Any leftover plastic is often incinerated to fuel the smelters. While these processes recover metals effectively, they generate significant carbon emissions and harmful toxic by-products.

Moreover, a large portion of e-waste is offshored to poorer nations, such as Ghana in Africa (*Fig. 4*), where mountains of discarded electronics accumulate in landfills. These informal recycling sites, such as Agbogbloshie, are notorious for improper disposal methods that allow e-waste to rot and leach toxic substances, such as lead, mercury, and cadmium, into the environment. This leads to severe health risks for local communities and widespread ecological damage.

Countries like Australia and the USA, with some of the highest per capita e-waste generation (*Fig. 3*), have a unique opportunity to address this issue by adopting more sustainable, efficient technologies like FJH. By processing e-waste domestically, they can reduce the harmful environmental impact of offshoring and turn the growing e-waste problem into an economic opportunity while safeguarding both human health and the planet.

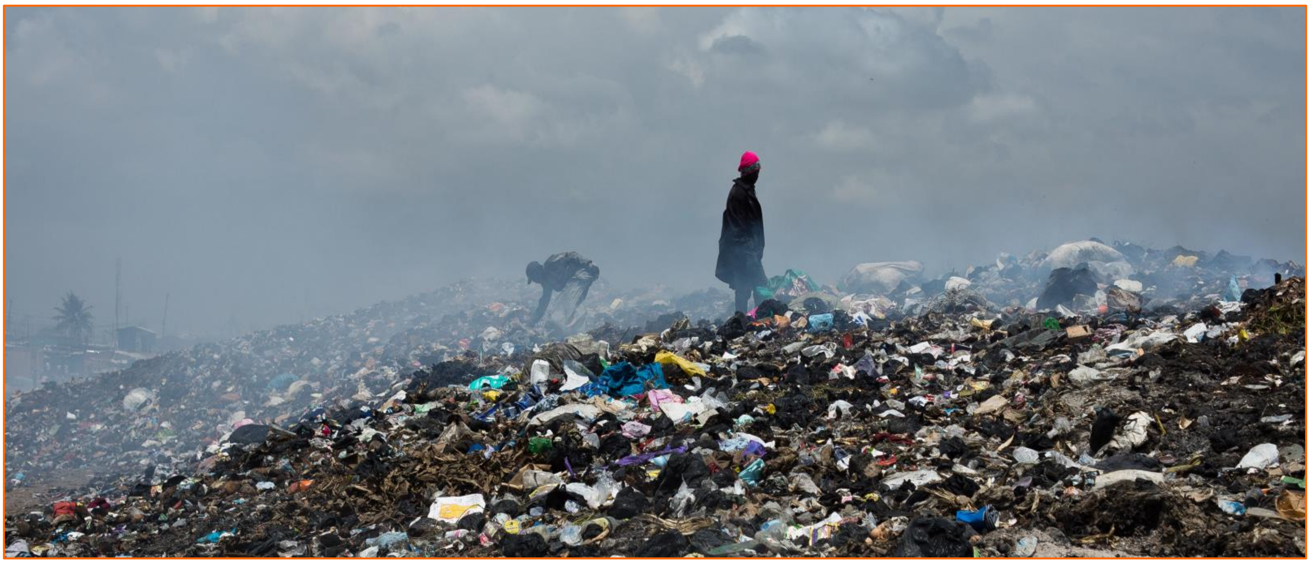

Figure 4: Example of enormous e-waste dump in Agbogbloshie Ghana, Africa. Source: Hakkens 2016.

By capturing the economic value of precious metals in e-waste and offering a more sustainable recycling method, MTM is positioned to capitalize on this significant market opportunity while addressing a pressing global environmental issue.

Next Steps:

- **Prototype Testing:** Continue optimisation of 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 **critical metal (Li, Co etc) recovery** from spent lithium-ion batteries ('black mass').

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 8: Knighthawk Engineering, FJH Team, Houston Texas

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APPENDIX:

Table 2: Summary of Initial FJH recovery of metals from e-waste - concentration & recovery by all metals analysed

METAL	Gold (Au)	Silver (Ag)	Copper (Cu)	Palladium (Pd)
E-waste feedstock metal content (g/t)	49.0	530.0	120,000.0	17.0
Product metal content (g/t)	33.8	82.7	5,422.2	1.0
Recovery (%)	69%	16%	5%	6%