Lithium Universe Ltd: Acquires Breakthrough Gold and Copper Extraction from E-Waste Technology

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Perth, Australia - Lithium Universe Ltd. (ASX:LU7) (OTCMKTS:LUVSF) (FRA:KU00) is pleased to announce that it has secured an exclusive global licence from the University of Edinburgh for a breakthrough process to recover gold and copper from waste computers, phones, and circuit boards (e-waste). E-waste generation is estimated to be about 93.5 Mt by 2030 of which 80% ends up in landfill.

Highlights

- Acquired global rights to University of Edinburgh's gold and copper extraction hydro-met technology (Gold Copper Diamide Extraction GCDE process)

- GCDE Technology selectively extracts gold and copper from electronic waste

- Uses simple, recyclable organic compounds to selectively extract gold and copper

- Ability to selectively extract gold and copper with minimal impurities

- Advantages over conventional high temperature smelting

- Devices, phones, laptops and printed circuit boards

- E-waste generation estimated at 93.5 Mt by 2030 of which 80% ends up in landfill

- Approx 200-350 grams of gold in one metric tonne of e-waste

- Amount of gold in e-waste is 100 times higher than in natural gold ore

- Gold content is worth US$46,320 pt e-waste (300g/t @ US$4,800 /oz)

- Copper in e-waste ranges from 50-270 kg per tonne

- Copper content is worth US$2,064 pt e-waste (160 kg/t @ US$12,900 /t)

- Complements LU7's silver extraction technology from PV recycling

Developed by the University of Edinburgh's School of Chemistry, supported by Edinburgh Innovations, the patented process exploits a simple, reusable organic diamide to selectively capture and precipitate gold from complex acidic solutions generated from circuit boards and electronic waste.

Following gold recovery, copper is extracted using a dedicated copper-precipitating agent (pyrazine-2,3-dicarboxylic acid, PDCA), enabling the recovery of high-quality copper from the remaining acidic solution. Together, these two steps allow for the selective recovery of the two most valuable metals in e-waste without the need for high-temperature treatment or energy-intensive processes typically required in conventional smelting or pyrolysis methods. The technology is known as the Gold Copper Diamide Extraction (GCDE) process.

While the sustainable recycling of these materials is complex and often uses environmentally unsustainable methods, the development of new hydrometallurgical processes for e-waste recycling has received recent attention because of the potential reduction in environmental impact, suitability for small scale applications, and low capital cost. In this context, highly selective, reusable precipitation methods are becoming popular as they offer advantages over traditional, single-use precipitants and avoid the use of organic solvents required in solvent extraction technologies.

Currently, 93.5 million tonnes of e-waste are generated globally each year, with waste printed circuit boards (PCBs) accounting for approximately 50 million tonnes. E-waste is a concentrated source of base metals such as iron, nickel, copper, tin, and zinc as well as many high value noble metals that include silver, gold, platinum, and palladium. In particular, the Cu content of waste PCBs is 20% by weight, while the Au content of waste mobile phones is up to 1200 g/t; these concentrations are far higher than those found in natural Cu- and Au- containing minerals.

Electronic waste represents a high-grade "urban ore". Gold is applied to PCB edge connectors ("gold fingers"), contact pads, switch contacts, thin protective board coatings, and the fine bonding wires linking chips to their packages. Although present in small quantities, gold is essential because of its excellent conductivity, resistance to corrosion, and long-term connection reliability.

Copper, by contrast, forms the backbone of the circuitry. It is used extensively in internal wiring and PCB layers, charging ports and connectors, battery terminals, inductors and small coils, and in some designs as heat spreaders to manage power and thermal loads. Copper content is significant, typically ranging from 50-270 kg per tonne of circuit boards, making e-waste an attractive and valuable source of metal recovery.

PRICE OF GOLD AND COPPER

The price of gold reached a record high in late 2025 and is currently trading at US$4,800 /oz. There is approximate 200-350 grams of gold in one metric tonne of E-waste. The content of gold in printed circuit boards can be as high as 900 grams per tonne of electronic waste. At the average gold content of 300 grams per tonne and the current trading price the gold content in a single tonne of E-waste is worth US$46,320 per tonne for just the gold content without factoring in recoveries.

Copper in E-waste ranges widely between 50 kg and 270 kg per tonne. The current LME price of copper is trading at around US$12,900 per tonne and assuming at average content of 160 kg /t the copper content is worth US$2,064 per tonne.

THE SCALE OF THE E-WASTE PROBLEM

Driven by rapid technological turnover and consumer demand, e-waste has become the fastest-growing hazardous solid-waste stream globally. E-waste generation is on track to rise from 62 Mt in 2022 to about 82 Mt by 2030 - a ~32 % increase. However, only about 20% of e-waste is formally recycled using environmentally sound practices, while the remainder is dumped or sent to developing countries for crude processing that releases toxic pollutants.

The low recycling rate stems from the complex mixture of metals and polymers in e-waste, which makes separation difficult and costly. The conventional method of extracting gold from e-waste (especially printed circuit boards) is based on high-temperature smelting or chemical leaching, both of which are energy-intensive and chemically aggressive. Shredded e-waste is smelted in a 1,200-1,400degC furnace, where plastics burn off and base metals melt. Copper acts as a collector metal, dissolving gold and other precious metals into a molten alloy. The copper is then electrolytically refined, with gold concentrating in the anode slime, which is subsequently processed to recover pure gold.

GCDE technology which comprises selective organic ligand extraction represents a fundamental shift away from bulk smelting and toward targeted, low-energy molecular chemistry. GCDE uses a specially designed organic ligand (diamide) that selectively binds gold ions at low (often room) temperature. The process targets gold specifically, leaving base metals such as iron, aluminium and other impurities largely untouched, resulting in high selectivity and minimal co-precipitation of unwanted metals.

GCDE TECHNOLOGY

The University of Edinburgh's innovation centres on a class of organic molecules known as tertiary diamide ligand; small, reusable compounds that act like selective "magnets" for valuable metals such as gold. When electronic waste (for example, old circuit boards) is dissolved in a mild acid, the result is a solution containing many metal ions; gold, copper, tin, iron, and others. Separating these metals has traditionally required multiple chemical steps involving harsh reagents and toxic waste.

STAGE 1 - GOLD EXTRACTION

The electronic circuit board feedstock is produced using conventional, off-the-shelf e-waste recycling equipment, with multiple established suppliers available globally. In a typical process, mixed electronic waste is shredded, ground and mechanically separated into various material streams. One of the key output fractions is a concentrated printed circuit board (PCB) stream, from which plastics, insulated cables, ferrous metals and other non-ferrous materials have been removed. See Figure 3*.

In the GCDE process, electronic circuit boards are halide leached at room temperature to dissolve the metals, with gold and copper converting into soluble chloride complexes such as $HAuCl_4$ and $CuCl_2$ in solution.

In the University of Edinburgh process, the specially designed diamide molecule functions as a smart, reusable precipitator for gold dissolved in acidic solutions derived from e-waste. When electronic scrap is leached with HCI acid, gold enters solution as the tetrachloroauric acid, $HAuCl_4$.The diamide ligand contains two amide groups with nitrogen and oxygen donor atoms (See Figures 6,7*) that are protonated to selectively recognise the gold ion. When the diamide is added to the leach solution, Au forms a complex with diamide, which is insoluble and rapidly precipitates as a distinct yellow solid, while base metals such as copper, iron and nickel remaining dissolved in solution. The gold complex can then be washed with water to form a pure $HAuCl_4$ solution which is further refined to produce metallic gold, and the diamide reagent recovered for reuse multiple times (See Figure 4 and 5*). This high level of selectivity arises from a favourable "soft-soft" bonding interaction between the goldion and the cationic receptor. Operating under mild conditions and avoiding toxic reagents such as cyanide, mercury, and organic solvent, the process offers an environmentally responsible and energy-efficient method for recovering gold from e-waste.

The Edinburgh process uses a diamide compound that selectively interacts to gold ions, while ignoring other impurity metals such as copper, iron, or nickel. This precise molecular recognition causes only the target metals to form insoluble complexes, leaving impurities dissolved in the leach solution. As a result, it enables the direct separation of high-purity gold under mild, environmentally safe conditions without further purification steps.

DIAMIDE LIGAND - HOW DOES IT WORK?

A diamide is a compound with two amide groups (see Figure 6) whose oxygen atoms are protonated under the acidic conditions to form a cationic ribbon polymer that interacts preferentially with the tetrachloroaurate anions over other metals (see Figure 7*).

STAGE 2 - COPPER EXTRACTION

After the gold has been selectively removed from the acidic e-waste leach solution, the remaining liquor typically contains high concentrations of dissolved copper (as Cu^{2+}), along with smaller amounts of iron, aluminium and other base metals. At this stage, 2,3-PDCA (pyrazine-2,3-dicarboxylic acid) is introduced as a selective copper chelating agent. 2,3-PDCA contains two carboxylic acid groups and a nitrogen-containing aromatic ring. In acidic solution, it coordinates strongly with Cu^{2+} ions, forming a stable copper-ligand complex. The molecular geometry and electron-donating sites of 2,3-PDCA favour copper binding over many competing metal ions, providing useful selectivity in mixed-metal systems typical of PCB leachates.

The ditopic nature of 2,3-PDCA means that its copper complex selectively precipitates from solution, allowing for straightforward isolation. The copper can be released from the ligand electrochemically or through chemical stripping.

Because this step operates at relatively low temperature and moderate acidity, it avoids the high-energy inputs of pyrometallurgical smelting. Importantly, copper is recovered after gold in a staged hydrometallurgical sequence, improving metal purity and reducing cross-contamination. The approach enables production of high-quality copper from complex acidic e-waste streams while lowering energy consumption and reagent intensity compared with conventional furnace-based methods.

EDINGBURGH UNIVERSITY TEAM

The inventors of the GCDE technology from the Edinburgh University School of Chemistry are Professor Jason Love and Professor Carole Morrison. The inventors have extensive interest in metal extraction and recycling processes and experience of studying the chemistry that underpins all aspects of metal recovery processes including base and precious metals. Their focus and interest targeted the extraction of precious metals from e-waste and in 2021, published a paper entitled "Gold extraction and recycling by selective precipitation" in the Nature Communications. In 2022, they applied for a patent that covered Europe and USA. Professors Love and Morrison were winners of the Anders Gustav Ekeberg Prize in 2020. Lithium Universe is fortunate to be able to secure the licence and rights to commercialise this unique technology.

LICENCE AGREEMENT

Lithium Universe entered into an exclusive worldwide licensing agreement with the University of Edinburgh to commercialise its patented gold/copper extraction technology (GCDE), with patent applications pending in Europe and the United States. Under the agreement, Lithium Universe has the exclusive rights to use, commercialise and sub licence the technology. In return, the University is entitled to a commercial royalty of between 2-3% on revenues generated from the extraction of metals by the technology.

The licence term continues for the shorter of the remaining life of the last patent or 20 years from the Commencement Date. Financial consideration includes an upfront payment of GBP20,000, reimbursement of approximately GBP25,000 in patent registration costs (payable 6 months from Commencement Date), and an annual licence fee of GBP15,000 due on first anniversary of agreement signing.

Lithium Universe will pay a 3% royalty to Edinburgh University on its annual gross revenue derived from metal products produced using the technology. Any approved sublicensees will pay 20% of any royalty fees to the Edinburgh University and 80% to Lithium Universe Limited.

In addition, milestone payments of GBP100,000 are payable upon Final Investment Decision (FID) for a pilot plant, GBP100,000 upon commissioning and start-up, and GBP100,000 upon first commercial sale.

EXECUTIVE CHAIRMAN COMMENT

"Our strategy is built around two complementary divisions, each addressing critical gaps in the global energy transition. The first is our core lithium refining business, where we are focused on closing the lithium conversion gap in North America through the development of merchant lithium carbonate refineries. This remains our primary focus, underpinned by strong market fundamentals and a clear pathway to commercialisation.

Alongside this, we have established a Precious Metals Recovery Division targeting high-value metals from photovoltaic (PV) solar panels and electronic waste. This division is driven by a simple rationale: the energy transition is not only about producing new materials, but also recovering valuable metals already in circulation. With growing volumes of end-of-life solar panels and e-waste, there is a clear opportunity to apply advanced, low-impact technologies to extract silver and other metals efficiently and sustainably. Importantly, this initiative does not detract from our lithium strategy. It is being advanced in parallel using a disciplined, modular approach with limited capital intensity at the early stage. If successful, it provides significant upside optionality-either as an integrated business within the Company or as a standalone entity that could be spun out to unlock shareholder value".

PROFESSOR JASON LOVE COMMENT

"We are delighted to partner with and license our gold and copper extraction technology to Lithium Universe. The Company brings significant experience in scaling innovative processing technologies from laboratory development through to commercial deployment. There are clear synergies with Lithium Universe's existing silver extraction technology and its strong chemical engineering and project delivery expertise.

We will work closely with the Company to advance the development of a pilot plant and accelerate the pathway to commercialisation. We look forward to bringing this technology to market together."

*To view the release including tables and figures, please visit:
https://investorhub.lithiumuniverse.com/announcements/7554953

About Lithium Universe Ltd:

Lithium Universe Ltd (ASX:LU7) (FRA:KU00) (OTCMKTS:LUVSF) is a forward-thinking company on a mission to close the "Lithium Conversion Gap" in North America and revolutionize the photovoltaic (PV) solar panel recycling sector. The company is dedicated to securing the future of green energy by addressing two major strategic initiatives: the development of a green, battery-grade lithium carbonate refinery in Quebec, Canada, and pioneering the recycling of valuable metals, including silver, from discarded solar panels.

Source:
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