NET-ZERO INDUSTRIES
MISSION

Project Title	**Building the Future of E-Waste Recycling to Accelerate Circular Green Metals**
Industry Partner	Mint Innovation, New Zealand
Industry Sector	Cross Sector
Technology Pathway (Primary)	Materials Efficiency and Industrial Symbiosis
NIM Pillar	Technology Demonstration
Source	NIM Awards 2023
Description	Mint Innovation is a clean technology company that has commercialised a proprietary low- carbon, local and circular solution to extract metals and other waste material from printed circuit boards (PCBs) in old electronics. Our pioneering technology uses a combination of natural biomass, smart chemistry and processing expertise, carefully engineered to process PCBs in a low-impact, cost-effective way, returning high value metals to local economies. Our 'city-scale' technology can significantly reduce the reliance on mining and accelerate the circular supply of 'green' metals. At scale, our technology plays a significant role in the decarbonisation of metal recovery from PCBs across the globe, enabling accelerated progress to delivering net-zero. Mint Innovation's unique technology enables: • Low carbon: with the potential to reduce carbon emissions by up to 90% compared to traditional methods. • Circular: return metals essential to enabling the energy transition back into local supply chains. • Local: designed to 'city-scale, our biorefineries are designed to be deployed close to where e-waste is produced. • Secure metal supply: providing metal sovereignty to reduce the supply chain risk to local industries. • Data security: guaranteed absolute destruction of all data and chip design. • Sustainable jobs: keeps expertise and jobs in sustainable industries on shore. • Catalyst for change: Combining our local biorefineries and proactive community engagement and education initiatives, we raise awareness of the benefits of e-waste recycling, driving a shift in behaviour in how we collectively increase the rate of sustainable recycling.
Innovations Employed	Using a hydrometallurgical method and green chemistry, our technology is a significantly lower carbon alternative to traditional mineral recovery due to the nature of our process, which uses a proprietary biomass and common chemicals to extract metals at ambient temperatures. This biomass is a key aspect of our technology because it's selective for specific metals, such as gold and palladium, which are hard to recover. Combined with the advantages of low-cost chemistry to recover other metals such as copper, we have designed this to be economically and environmentally sustainable, capturing value

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	from e-waste near its collection point. We do not use high heat; our processes run typically at room temperature, rather than high temperatures like a smelter. Our technology is world-leading, we have proven our technology at commercial scale and recover a very high proportion of the valuable metals available in PCBs. No other company combines low-impact technology with high metal recovery at commercial scale.
Dimension of Novelty	**Company & Country** It was new to Company, Country and International. World first, leading technology now being scaled in the international markets.
Innovation Collaboration	**In-house** New Zealand **Cooperation with scientific institutions** **External Partners**
Intellectual Properties	Mint Innovation is pioneering the way for better metal recovery and has a secured IP position for our world-leading process through an in-house patent attorney. We have four patent families granted in key jurisdictions worldwide, including Europe, Japan, the United States and Australia. These patents protect the core and unique processing steps of Mint's metal recovery technology. We developed most of the IP in-house leveraging R&D grants, government and research programs.
IP Links	Patent US20190292627 - Process for Recovering Metal Patent NZ742167 - A Process for Recovering Metal from Electronic Waste Patent AU2023901375 - Process for Recovering Metal from Feedstocks
Timetable & Progress	**System proven in operational environment. Technology available for consumers (TRL 9)** We built our commercial biorefinery in Sydney, Australia in 2022, which is now in operation. **Started on 2016** Mint Innovation started at lab scale in 2016 before setting up a demonstration facility in Auckland in 2019. Once the technology was proved, we built our first commercial processing plant in Sydney in 2022.
Financing (Public/ Private)	Funding Public - Yes NZ$350k through a Waste Minimisation fund from the NZ Government and AU$4.2M through the Modern Manufacturing Initiative from the Australian Federal Government.
Finance Links	Waste Minimisation fund from the NZ Government Modern Manufacturing Initiative from the Australian Federal Government
Project Phase TRL	TRL 9

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Problems to be Solved and Risks to be Managed	Existing methods of recycling metals are energy-inefficient and capital-intensive, and all other e-waste that isn't recycled legally ends up in landfills or exported often to developing nations, resulting in documented environmental and humanitarian issues (https://news.un.org/en/story/2021/06/1094052). With natural mineral reserves depleting and decarbonisation driving rapidly decreasing demand for electrification minerals, we must make the most of the metals already above ground. E-waste is the fastest growing waste stream, with predictions it will double by 2050, according to the UN's E-Waste Monitor 2020 report. Fortunately, e-waste has the potential to be a key source of supply to industries like electronics, transportation, clean energy and healthcare technologies, all of which are vital to delivering a survuvable low-carbon future. It has been estimated that there are c.$62 billion of metals in an "urban mine" which includes PCBs, lithium-ion batteries and catalysts; we can currently service PCBs which have an estimated market value of c.$10 billion.
Preliminary or Final Results Achieved	With our biorefinery fully commissioned, we can process about 3,000 tonnes of PCB waste annually, returning nearly half a tonne of gold and up to 1,000 tonnes of copper to Australia, which is approximately $30 million USD in value. Our technology is designed to be rapidly scaled through the construction of a network of biorefineries, each of which is comparatively quick and low risk to build. Our unique, clean technology has the potential to save over 90% of the carbon emitted through traditional mining per kilogram of gold produced. In addition to the carbon savings, our technology uses 95% less energy and water per kilogram of gold than traditional mining and 40% less energy compared to smelting circuit boards.
CO2 Emissions Reduction Potential - Implementation and Future Market	Now that we have secured our Series C funding of $65 million NZD, our team have accelerated our growth ambitions to build similar city-scale biorefineries concurrently, to rapidly achieve impact at scale. We are building our capability to deliver a network of biorefineries. This network supports countries and companies everywhere to reduce their overall carbon footprint by diverting their e-waste to our processing facilities, returning value and securing a supply of circular green metals locally.
Market Positioning	Mint Innovation is building the future of e-waste recycling with ambitions to become the world's leading provider of circular green metals. Success for us is having our unique, clean technology deployed in every urban city in the world--where there are waste streams containing metals, we want to be there extracting them back into the local economy in a way that helps repair and protect the planet. We don't just plan on tackling e-waste; we are doubling down on R&D into other critical waste streams, such as end-of-life lithium-ion batteries, to see how our technology can recover precious metals like lithium, cobalt or manganese from these batteries to be recirculated in a low impact way. And we'll continue to pioneer new technologies to keep turning waste into value.

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Project Location	New Zealand
Project & Technology Links	Renee Jameson Mint Innovation, .pptx - Company overview Mint Innovation_Sydney Biorefinery, pdf - Image of Sydney biorefinery
Technology Links	Mint Innovation