

## Introduction:

Theia Ventures is thrilled to announce its investment in **Metastable Materials**, a pioneering deep-tech urban mining startup. Metastable Materials focuses on extracting rare earth materials from end-of-life batteries using a patent-pending chemical-free carbothermal reduction process. This revolutionary technology minimizes capital and operational expenditure while maximizing the residual value of end-of-life batteries for manufacturers and providing extended producer responsibility (EPR) benefits.

## Importance of Battery Recycling:

With electric vehicle (EV) adoption soaring globally—over 10 million units sold in 2022—and the EV market in India projected to grow at a **49% CAGR** by 2030, the recycling and reuse of batteries are becoming critical. India's EV industry alone will require the recycling of an estimated **145,000 tons of lithium-ion batteries** by 2030, as reliance on imports from markets like Taiwan and China continues. Lithium, nickel, and cobalt, the key components in EV batteries, make up **35% of the total battery cost**. The rising demand for these materials, coupled with India's limited domestic supply of lithium, has made recycling essential for a circular economy.

Moreover, battery recycling addresses a critical environmental issue. By using recycled battery materials, India can reduce its carbon footprint and meet its commitments toward sustainable energy, while also supporting **renewable energy grid storage** solutions that store energy during peak production periods.

## Current Problems and Challenges:

1. **Environmental Impact of Battery Waste:**
  - **Battery Waste in Landfills:** Only **10%** of India's 50,000 tonnes of annual lithium-ion battery waste is currently recycled. The rest ends up in landfills, leading to environmental hazards from heavy metals and corrosive substances.
2. **Market and Supply Chain Constraints:**
  - **Dependence on Imports:** India's reliance on imported lithium-ion batteries poses a significant challenge, further exacerbated by a lack of manufacturing capacity for these batteries domestically.
3. **Challenges in Current Recycling Methods:**
  - **Hydrometallurgy and Pyrometallurgy Limitations:** Hydrometallurgy is resource-intensive and complex, while pyrometallurgy requires significant capital and produces suboptimal environmental outcomes due to high-energy consumption.

## Metastable Materials' Value Proposition:

1. **Innovative Recycling Technology:**
  - Metastable's **carbothermal recycling technology** bypasses the traditional, environmentally taxing recycling processes by eliminating the need for chemicals and excessive heat. This process uses minimal water, reduces emissions, and produces battery-grade metals directly usable by manufacturers.
2. **Cost-Effective and Scalable Solution:**
  - The company's process is both **capital-light** and **scalable**, offering significant cost savings to battery manufacturers while reducing environmental impact.
3. **Target Customer Base:**
  - Metastable Materials targets a broad range of customers including **battery manufacturers, recyclers, chemical conglomerates**, and **mining companies**. The company's unique ability to process end-of-life batteries and deliver high-purity outputs makes it an attractive partner for manufacturers seeking to optimize production costs.

## Market Sizing and TAM:

Given the expected increase in electric vehicle adoption, India's battery recycling market is projected to reach **\$300 billion** by 2030. The demand for lithium, nickel, and cobalt is set to skyrocket due to growing reliance on renewable energy storage and battery-dependent technologies.

Globally, the rare earth materials market is expected to grow at a **CAGR of 7.4%** during 2022-2030, driven largely by the shift toward electric mobility and energy storage systems. By recycling rare earth materials, Metastable Materials stands to capitalize on a rapidly expanding market.

#### **Regulatory Tailwinds:**

The Government of India's **Battery Waste Management Rules (2022)**, which enforce the Extended Producer Responsibility (EPR) mandates, are expected to significantly drive demand for Metastable's solutions. The rules require manufacturers to ensure the proper recycling of waste batteries and increase the recycled content in new batteries. This regulatory push, combined with global sustainability targets, positions Metastable at the forefront of the battery recycling revolution.

#### **Timing:**

The timing of investment in Metastable Materials is impeccable. Several converging trends support rapid adoption of battery recycling technologies:

- **Surging EV Adoption:** With India aiming to have **30% electric vehicle penetration by 2030**, the demand for battery recycling is expected to grow exponentially.
- **Supply Chain Constraints:** Rising geopolitical tensions and disruptions in the supply of rare earth materials emphasize the importance of developing domestic battery recycling capacity.
- **Regulatory Push:** The recent **EPR mandates** are compelling manufacturers to adopt recycling processes, creating a ripe market for Metastable's innovative technology.
- **Sustainability Focus:** Global emphasis on **carbon reduction** and **sustainable energy storage** solutions has accelerated demand for clean, cost-efficient battery recycling technologies.

#### **Exit Strategy:**

There are several viable paths for a successful exit:

1. **Strategic Acquisition by EV or Battery Manufacturers:** Given Metastable's cutting-edge technology and alignment with EV and battery manufacturers' goals of reducing reliance on raw materials, an acquisition by a global battery manufacturer or EV giant (e.g., **Tesla**, **CATL**) would be a logical exit.
2. **Acquisition by Sustainability-Focused Corporations:** Corporations looking to bolster their green credentials and ensure a secure supply of battery materials may also see Metastable as a strategic acquisition target.
3. **IPO:** As Metastable scales and establishes its foothold in the global battery recycling market, an **IPO** could be an attractive exit option, particularly given the growing investor interest in sustainable and deep-tech ventures.
4. **Private Equity:** The company's capital-efficient model and revenue generation potential could attract **private equity investors** looking to scale operations further or diversify their portfolios into clean technologies.

#### **Competitive Positioning and Right to Win:**

Metastable Materials differentiates itself by offering a solution that is:

- **More Economical:** The carbothermal process significantly reduces both capital and operational costs compared to existing battery recycling methods.
- **Greener and Safer:** With no chemicals or high-heat processes involved, the solution is environmentally superior to conventional methods like pyrometallurgy.
- **Scalable and Efficient:** Metastable's process uses **minimal water** (2-3 liters per kg), operates at lower temperatures, and is capable of handling large volumes of battery waste.

#### **Risks and Challenges:**

- **Scaling Operations:** Ensuring the smooth scaling of the technology while maintaining cost efficiency will be critical.
- **Customer Acquisition:** Securing large-scale, long-term contracts with battery manufacturers and recyclers will be vital for sustained growth.

- **Technological Risks:** While patent-pending, there remains the risk of competition developing alternative, cheaper technologies.

**Conclusion:**

Metastable Materials is poised to redefine the battery recycling landscape with its cost-effective, scalable, and environmentally friendly technology. With strong regulatory tailwinds, growing demand for EVs, and increased emphasis on sustainable energy storage solutions, this is an opportune moment to invest. Metastable's innovative carbothermal process, combined with an experienced team, positions it well to meet the increasing need for rare earth materials recycling and capitalize on the rapidly expanding market for battery reuse. The robust exit options provide a clear path for significant returns on investment.