Special Report

Lithium-ion Battery: Recycling Opportunity in India

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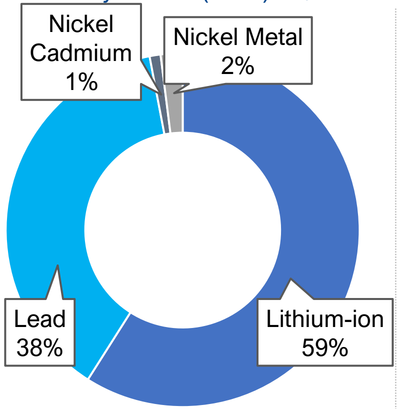
Contents

Global LIB Market Overview

Understanding the Market & Recycling Trends in the LIB Industry

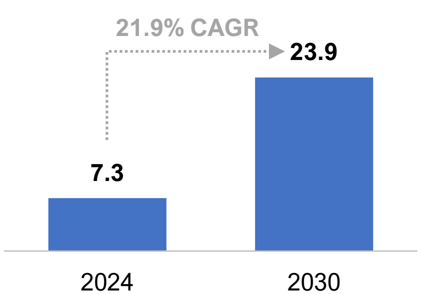
Lithium-ion (Li-ion) dominates growth markets, while lead-acid remains entrenched in low-margin, slow-growth sectors.

Global battery market (2024) is $134.6B [1]



LIBs held the largest market share by **revenue** in 2024. **Lead-acid batteries** still lead by **volume** for low-cost applications but lag in value. Lead-acid batteries are commonly used in automotive starter systems, uninterruptible backup power supplies, and industrial equipment such as forklifts and golf carts. Nickel-metal (NiMH) and nickel-cadmium (NiCd) batteries are niche (<3% combined) and declining in demand due to toxicity and low energy density.

Global Li-ion battery recycling market ($Bn) [2]



From 2024, the **global LIB recycling** market is expected to grow from USD 7.3bn to USD 23.9bn by 2030 at a compound annual growth rate (CAGR) of **21.9%**. China is expected to dominate the global LIB recycling capacity with a 60% market share by 2030.

Lithium-Ion (Lithium Iron Phosphate - LFP & Nickel Manganese Cobalt - NMC) Sets the Benchmark for Battery Performance

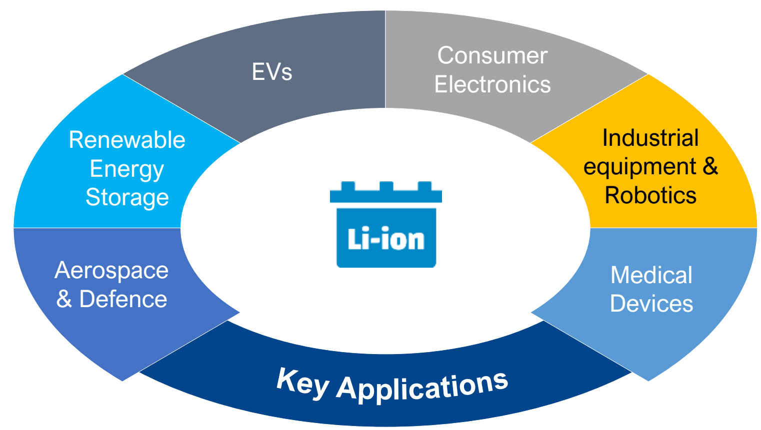
150-250 Wh/kg
High energy density
vs. 30-50 Wh/kg for lead

3,500 cycles
Extended cycle life
vs. 300-500 cycles

2-4 hours
Rapid charging speeds
vs. 8-10 hours

1/3rd
the weight of lead-acid for same capacity

EVs account for ~75% of Li-ion, while consumer electronics and energy storage drive diversification [3]



Source: *1.Grand View Research, Industry Report; 2. GlobeNewsWire, Lithium-Ion Battery Recycling Industry Report 2025; 3.* BloombergNEF (2023) reports

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Global Lithium Supply Constraints

Recycling Can Bridge Global Lithium Shortages and Boost Self-Reliance for Nations Worldwide

Manufacturing Overcapacity ≠ Overproduction: Raw materials are the bottleneck

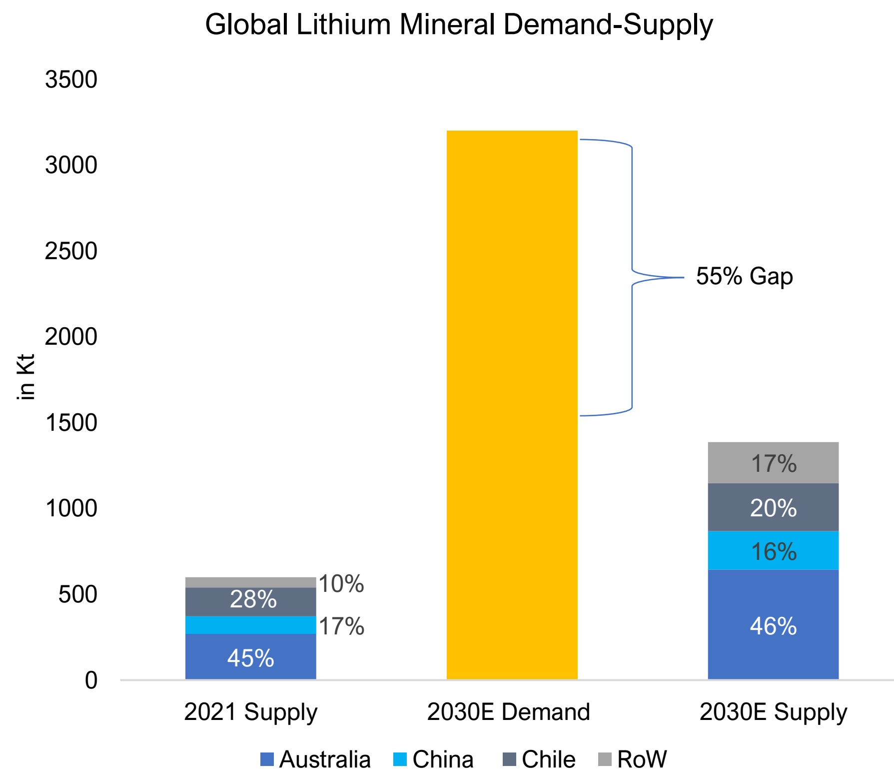
- **Global LIB manufacturing capacity** stands at 3.1 TWh, with China accounting for ~75%. Meanwhile, global demand is 1.2 TWh, creating a 2.5x overcapacity, which could worsen to 5x in the coming years [1]. This is expected to drive lithium battery pack prices down from $115/kWh in 2024 to below $80/kWh by 2030, potentially boosting EVs competitiveness.

- **However, manufacturing overcapacity does not resolve raw material shortages**, as current lithium mining projects are insufficient to meet future demand. Conservative estimates indicate a potential 55% shortfall between lithium supply and demand by 2030. Moreover, with 82% of global lithium supply expected to be dominated by just three countries, nations without domestic mining resources must invest in lithium recycling to mitigate price volatility and enhance supply security.

- **Recycling is expected to bridge 10–12% of this global lithium supply gap** by 2030 and 30–40% by 2040, but projected recycling capacity (1.5M–2M tons/year by 2030) will still fall short of the estimated 2.5M+ tons/year demand for recycled materials. [1]

- **Recycling companies stand to benefit from:**
    - Increased demand due to raw material shortages and reduced mining reliance
    - Growing scrap availability
    - Lower feedstock costs
    - Rising EOL battery volumes in future due to EV adoption
    - Creation of policy-driven demand for recycled content

Lithium could be in extremely short supply if no further mining projects are developed [2]

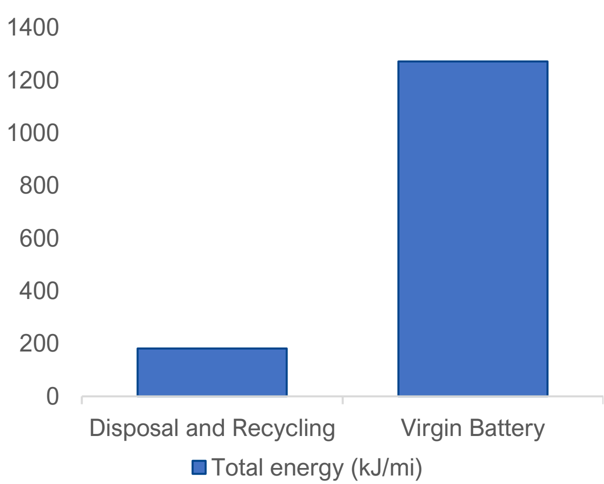


Source: *1. BloombergNEF Articles, 2024; 2.McKinsey & Company 2023 article; 3. ET EnergyWorld, 2024; 4. NITI Aayog*

Benefits of Lithium Recycling

An Energy-Efficient, Cost-Effective, and Profitable Solution for Waste Management and Manufacturing

Energy Consumed for Mfg. LIB for Tesla Model 3 - recycling vs. virgin battery [1]

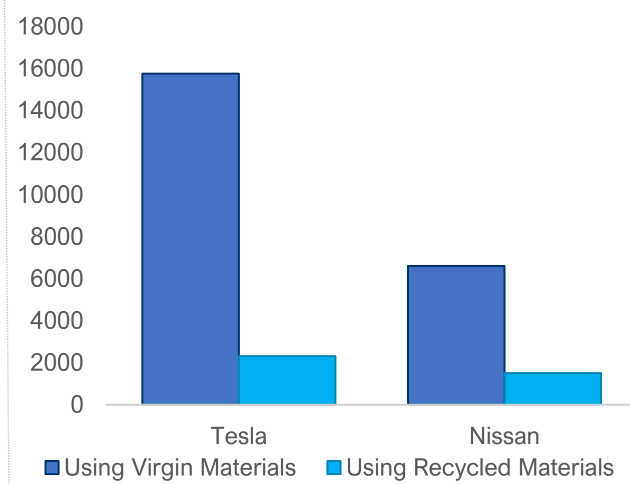


Energy Efficient

Manufacturing virgin Tesla Model 3 batteries consumes 8x more energy than using recycled materials.

Recycling reduces CO_2 emissions by 75% vs. mining and prevents toxic leakage [2], yielding 18–30 kg of lithium per ton of batteries compared to 2–7 kg from ore [3]. Expanding recycling facilities is crucial for energy savings and lower environmental impact, especially in energy-deficient regions.

Cost of Manufacturing one LIB using Virgin Materials vs. Recycled Materials (in USD) [1]

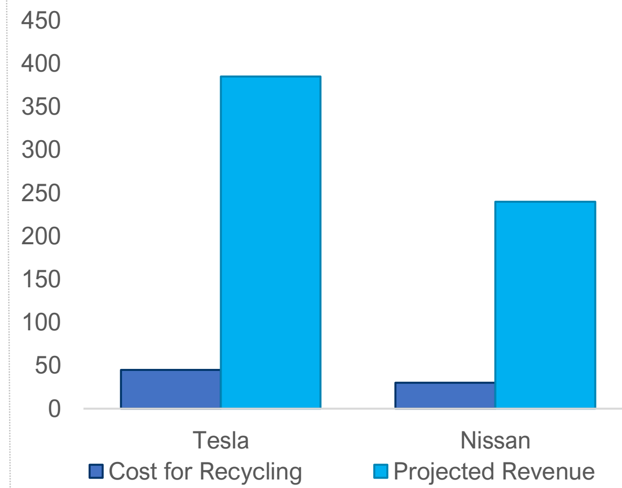


Cost-Effective

Life Cycle Cost Analysis (LCCA) evaluates the total cost of EV battery recycling, ensuring economic feasibility and sustainability.

Through LCCA, it is found that the cost to produce a Tesla battery using recycled materials is 6x cheaper and for a Nissan Leaf battery it is 4x cheaper than virgin materials. This makes these batteries economical choices for new battery production.

Recycling cost vs. projected revenue for one metric ton of batteries (in USD) [1]



Profitable Venture

The above graph assumes the same level of purity and regardless of the source, the materials will be sold at market value.

Processing one metric ton of LIB yields black mass (mixture of nickel, manganese, cobalt oxides, and carbon). Additionally, metallic components such as copper and aluminum are recovered, which can be resold for various industrial applications.

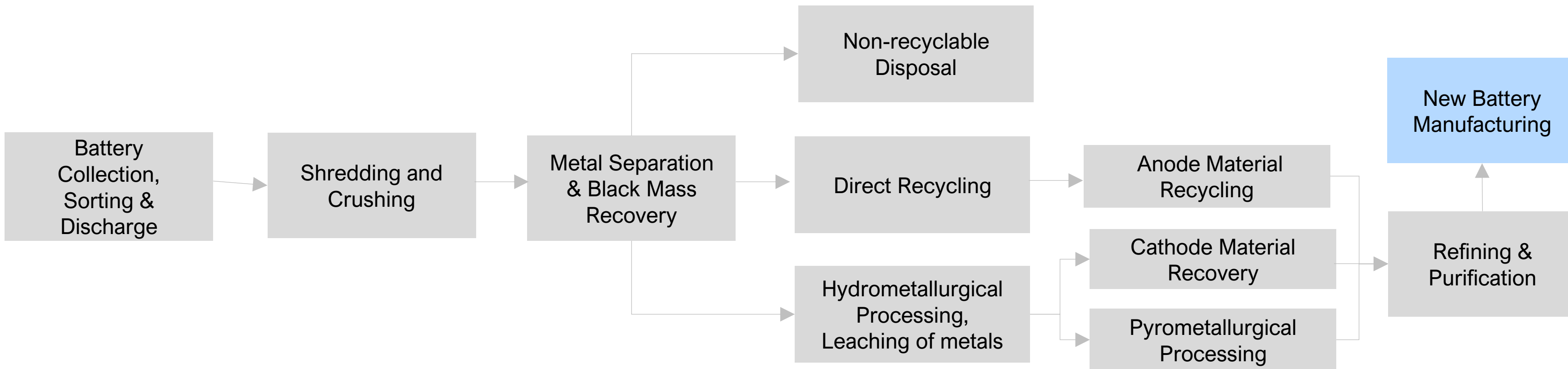
Source: *1. MDPI Article: Sustainable Management of Rechargeable Batteries Used in Electric Vehicles, May'24; 2. International Energy Agency; 3. Tata Chemicals Corporate Insights, 2024*

Engineering Circularity

Early Investment in Lithium Recycling Ensures a Strategic Edge in the Future Battery Supply Chain

Recycling Process Diagram

LIB recycling is challenging due to diverse chemistries, lack of standardization, safety risks such as potential explosions, and the early-stage infrastructure needed for efficient processing, favoring early investors and established players.



LIB recycling architecture: Recycling LIB is a complex process that encompasses disassembly, chemistry-based sorting, and various extraction methods. These methods include mechanical processes, hydrometallurgical techniques (solvent-based extraction), and pyrometallurgical approaches (high-temperature smelting). Among these, hydrometallurgy is the most widely utilized method.

Evolving changes: This sub-sector is still developing, facing challenges in standardization, material complexity, and safety. Even experienced lead or nickel battery recyclers face entry barriers. Viable operations require significant capital, proprietary technology, or strategic partnerships, given the low spent battery collection rates currently. However, early investment and capacity building offer a first-mover advantage as EOL battery volumes grow.

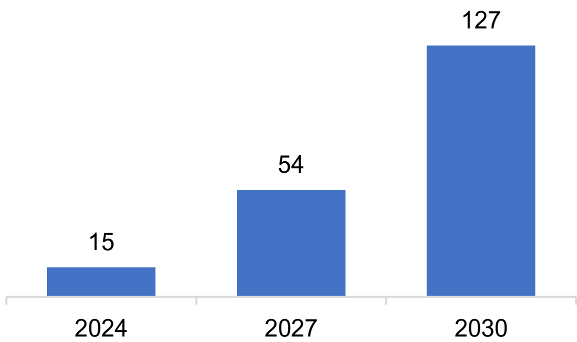
End uses of recycled materials: Lithium, cobalt, and nickel are used in battery cathodes for EVs, electronics, and grid storage. Manganese strengthens steel, while copper is essential for wiring, battery connectors, and renewable energy systems. Plastic casings are turned into new plastic products.

India's Push for Lithium Recycling

With Strong Policy Backing, India Aims to Replace its Heavy Lithium Imports with Domestic Recycling

With supply gaps and import reliance, battery recycling is vital for India's energy security, economic resilience, and sustainability

India's Li-ion Battery Demand (GWh)



- **India's LIB demand is projected to reach 127 GWh by 2030** [3], with the government aiming for self-reliance as 75% of imports come from China. To meet this demand, the government and private sector are expanding battery manufacturing capacity. However, limited access to raw materials, particularly lithium, is a challenge.
- **India lacks major operational lithium and cobalt mines**, relying almost entirely on imports, which cost approximately $2.5 billion annually. Global lithium production is dominated by Australia (47%), Chile (30%), China (15%), and Argentina (5%). Recycling could address 30–40% of India's lithium demand by 2030 [4], reducing import dependence and strengthening price and supply security.
- **India's 500 GW renewable target by 2030 will require ~150 GWh of battery energy storage systems (BESS)**. While some may use alternative chemistries (e.g., sodium-ion, flow batteries), Li-ion will dominate. Recycling can supply 20–30% of storage demand.

The Indian government is creating a roadmap for battery recycling, focusing on collection centers, tech, and stakeholder collaboration

Battery Waste Management Rules (BWMR) 2022

Implements extended producer responsibility (EPR), making battery manufacturers responsible for collecting and recycling used batteries.

Objectives:

Ensure safe disposal of LIBs. Recover valuable materials.

Promote a formalized recycling industry in India.

Battery Waste Management Rules 2023 Amendment

Mandatory Recycling Targets for LIBs:

Objective:

70% recovery by FY25

80% recovery by FY26

90% recovery by FY27

Customs Duty Exemptions (Union Budget 2025)

Full customs duty exemption on LIB waste and 12 critical minerals, including cobalt powder, battery scrap, lead, zinc, and nickel.

Objective:

Reduce India's dependency on raw material imports

Support domestic LIB manufacturing

Lower battery production costs, making EVs and storage solutions more affordable.

Key Drivers of LIB Growth in India

India's LIB Market Growth Will Accelerate and Strengthen the Recycling Sector in the Years Ahead

Key market catalysts of Lithium Batteries Fueling the Rise of Lithium Recycling

Increasing LIB Demand

India's current LIB demand is 15 GWh, which is met almost entirely through imports, is set to reach 54 GWh by FY27 and 127 GWh by FY30, with import dependency falling to 20% by FY27 as local capacity grows.

Domestic Manufacturing For Advance Chemistry Cells

Backed by the Rs 18,100Cr PLI scheme, India targets 150–200 GWh capacity by 2030, with projects completing by 2027. Major players such as Reliance (30 GWh), Tata Group (20 GWh), and Ola Electric (20 GWh Gigafactory) are investing ₹1.2+ lakh crore.

Faster EV Adoption

An 80% drop in LIB prices (projected below $100/kWh by 2025), along with exponentially increasing charging networks and high fuel costs (~₹100 per liter), makes EVs 5–6x cheaper per kilometer. Recycling can make raw materials cheaper.

Government Policies

The Rs 18,100 Cr PLI scheme targets 50 GWh battery capacity. The Faster Adoption and Manufacturing of Electric Vehicles (FAME) scheme aims for 30% EV penetration by 2030 (current 2%). The 2025-26 budget removed duties on LIB waste and minerals.

Renewable Energy Integration

India's push for 500 GW renewable energy by 2030, net-zero by 2070 and smart city expansion is driving Li-ion battery demand. Li-ion adoption is further boosted by urban infrastructure projects, grid-scale storage, and public transport electrification..

Analyzing the EOL LIB in India

India's Recycling May Face Underutilization Initially, but EOL Batteries Will Drive Growth Post-2030

Fig 1. EV + Hybrid Growth and Penetration in India [1]

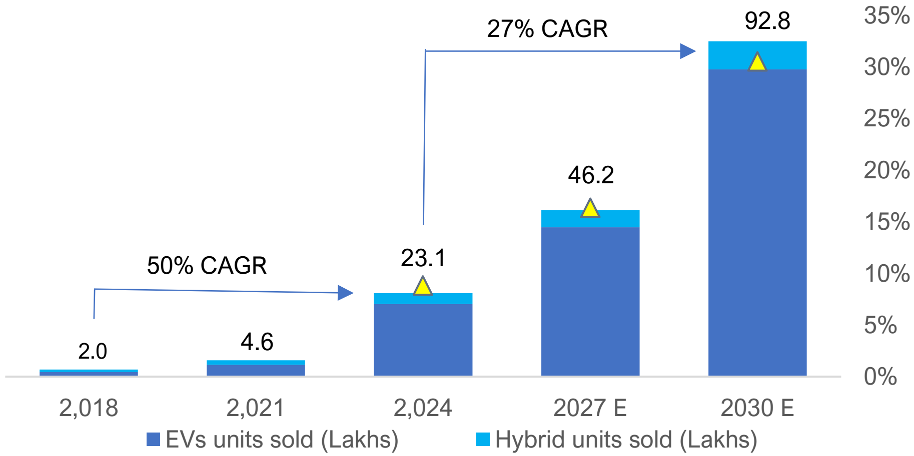
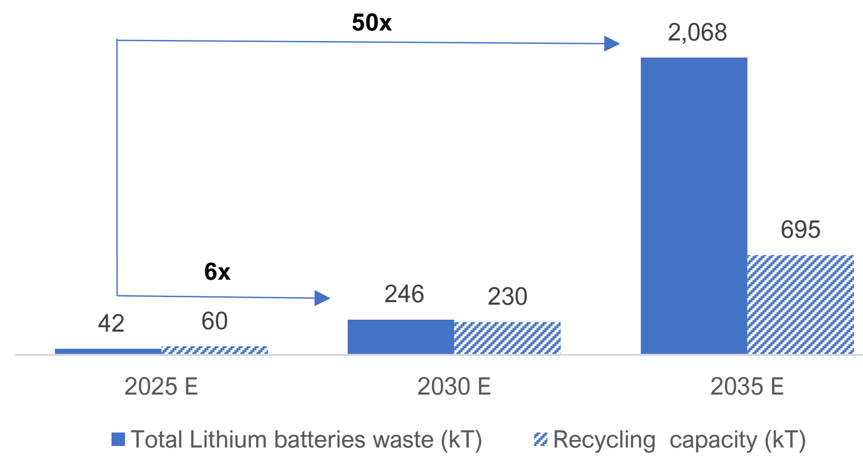


Fig 2. Drastic Expansion needed for Upcoming EOL LIB 1



Understanding the Numbers: Insights from the Analysis

- To estimate EOL LIB volumes, forecasting EV and hybrid vehicles growth is crucial, as both rely on lithium batteries. India estimates 30% EV + hybrid penetration by 2030.
- **As seen in Fig. 1**, EV and hybrid sales registered a 50% CAGR (2018–2024) and are expected to record 27% CAGR (2024–2030). With an 8–10 years battery lifespan, EVs and hybrids will contribute 45% of EOL LIB waste by 2030 and 70% by 2040, up from 15% in 2023.
- **As seen in Fig. 2**, LIB waste will rise 6x by 2030 and 50x by 2035 (vs. 2025), requiring significant recycling capacity. India's current recycling facilities, though underutilized, are insufficient for future demand. By 2035, India's estimated recycling capacity (0.695 million tons) will fall short of the projected 2 million tons of LIB waste, highlighting the need for urgent capacity expansion.

India's LIB Recycling Market is set for Exponential Growth

- LIB waste in India is set to grow 6x by 2030 and 50x by 2035.
- Underdeveloped recycling capacity creates an untapped investment opportunity. India currently lacks the infrastructure to process the surge in LIB waste, with most used batteries still exported for recycling.
- The lack of established large-scale recyclers means that investors backing early-stage technology and capacity expansion can secure dominant market positioning. Strategic partnerships with OEMs and EV manufacturers can ensure steady feedstock supply and long-term revenue visibility.
- Investing early in scalable domestic recycling facilities presents a long-term growth runway with high-margin potential.

Source: *1. Aranca Analysis*

India's Lithium Recyclers

Driving a Circular Economy through Expansion, Sustainable Margins, and High Investment Potential

GRAVITA (Operational** : 2026)

Capacity: India's largest non-ferrous metal and batteries recycler. Lead – 148,500 MT, aluminum – 10,800 MT, plastics – 8,500 MT, tire oil.
Expansion Plan: Setting up a Li-ion recycling pilot and a rubber recycling plant in Mundra (operational H1 FY26), aiming 5+ lakh MT total capacity by FY27.
Tech: Leveraging existing metal recycling expertise with partnerships.
Listed: India
Revenue: Rs 3161Cr (FY24). Target: 25%+ volume CAGR, 35%+ profit growth. 30%+ non-lead share.

TATA CHEMICALS (Operational** : 2019)

Capacity: 500 t/yr LIBs
Tech: Partial recycler focusing on chemical extraction and refining.
Collaborations: With Agratas (battery manufacturing, energy storage) and Tata brands, ensuring battery supply, advanced recycling and closed-loop ecosystem.
Listed: India
Products*: Battery-grade metals and materials used in glass, ceramics, and catalysts for sodium bicarbonate and agri-chemicals.

ATTERO (Operational** : 2020)

Capacity: India's largest 15,000 t/yr LIB recycler, 144,000 t/yr e-waste.
Expansion Plan: 300,000 t/yr Li-ion, 1mn t/yr e-waste in 5 years (India, Poland, Ohio - USA).
Patents & Tech: 46 global patents, among the few recycling LFP batteries (end-to-end recycler).
Extraction efficiency: 98%
IPO Plans: 24-36 months in India.
Products*: Battery-grade metals and materials.
Revenue: Rs 285Cr (FY23) → Rs 440Cr (FY24) → Rs 1,000Cr (FY25E) → Rs 16,500Cr (FY27E)

LOHUM (Operational** : 2018)

Capacity: 10,000 t/yr LIBs
Expansion plans: Plans to raise more $200M+ investment to 5X capacity after raising $100M.
Patents & Tech: Patented chemistry-agnostic NEETM recycling (end-to-end). **Efficiency:** 95%
IPO Plans: 2027
Products*: First-life LIB packs for 2W & 3W, second-life packs for stationary storage. Lohum's DETX battery price index.
Revenue: Rs 308Cr (FY23) → Rs 530Cr (FY24) → Rs 1,000Cr (FY25E) → Rs 5000Cr (FY28E)

RECYCLEKARO.COM (Operational** : 2020)

Capacity: 10,000 t/yr Li-ion battery, 24,000 t/yr e-waste
Expansion plans: Plans to process 50,000 metric tons of batteries by 2025-26
Tech: Proprietary Technology but not patented yet (end-to-end)
Extraction efficiency: 90-95%
Products*: Battery-grade metals and materials
Revenue: Rs 100 Cr (March 2023) → Rs 150-180Cr (March 2024)

EXIGO (Operational** : 2022)

ETHICAL | TRANSPARENT | RECYCLING

Capacity: 10,000 t/yr all batteries, majorly Li-ion
Tech: In-house chemistry-agnostic technology but no information on patents (end-to-end)
Extraction efficiency: 96%
Products*: Battery-grade metals and materials.
Revenue: Rs 69.7Cr (March 2023) → Rs 71.8Cr (March 2024)

** - Refers to products sold related to Li-ion battery recycling, not the full portfolio; ** - Commencement Year for Li-Ion Recycling Operations*

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Global clients

500+
Strong, professional team across multi-disciplinary domains

120+
Sectors and sub-sectors researched by our analysis

80+
Countries where we have delivered projects

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