Closing the Loop: Strengthening India's Battery Recycling Supply Chains

The robustness and resilience of India's clean energy supply chains depend heavily on how efficiently the country can recover and reintegrate critical minerals from end-of-life (EOL) batteries. As the adoption of electric vehicles (EVs) and stationary storage accelerates, domestic access to secondary sources of lithium, cobalt, nickel, manganese, and graphite becomes increasingly strategic for securing raw material supply and reducing import dependency.

A sound battery recycling industry forms a domestic, secondary source of strategic minerals, potentially reducing India's reliance on volatile and geopolitically sensitive international mining supply chains. It enables localized, circular supply loops where recovered materials are reintegrated into battery or material production, reducing the pressure on primary extraction. At present, however, India's battery recycling sector remains nascent and structurally disconnected from its larger battery manufacturing ecosystem. While global lithium prices have softened and commodity markets show signs of temporary oversupply, long-term supply security remains uncertain. In this context, a robust domestic recycling value chain can serve as a critical buffer against future supply disruptions and price volatility.

Domestic Policies and Industry Efforts

India's 2022 Batteries (Management and Handling) Rules,[1] require producers and importers to register and implement collection/recycling frameworks. However, the effectiveness of these regulations is directly tied to the structure and scale of reverse logistics — the process of collecting, transporting, and processing spent batteries along the supply chain.EOL lithium-ion batteries are typically mechanically discharged and shredded, then treated with hydrometallurgical or pyrometallurgical processes to extract key critical minerals, such as lithium, manganese, cobalt, nickel and graphite.

Approximately 70% of used batteries still flow through informal scrap channels, which undermines traceability, mineral recovery efficiency, and environmental standards. This fragments the supply chain and diminishes the quality and reliability of recycled feedstock for domestic manufacturers. High GST on recycled batteries and lack of reverse-logistics hubs[2] favor the informal sector. State agencies have struggled to monitor compliance and crack down on sham recyclers. Funding itself presents another challenge, with recyclers reporting difficulty in securing capital, and the promised EPR recycling fees and incentives (viability-gap funding) have been delayed.

India's domestic policy framework centers on Extended Producer Responsibility (EPR) under the Battery Waste Management Regulations, which aim to require producers to meet annual recycling/collection quotas and use recycled materials until 2031. The government has additionally launched incentives to boost EV and battery manufacturing, such as PLI schemes for Advanced Chemistry Cell batteries[3], though no dedicated PLI exists yet for recycling.

A dozen or more companies[4], such as Attero, Exigo Recycling, Tata Chemicals, BatX

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[1] International Energy Agency. 'Battery Waster Management Rules 2022

[2] Conference Proceeding summary. 'Battery circularity in India.' WRI

[3] Srivastav, Udisha. 'Waste to Wealth: India's Battery Recycling Boom.' Fairplanet.

[4] Gupta, Uma. Challenges and opportunities for lithium-ion battery recycling in India. PV Magazine

Energies, are testing and attempting to scale up the battery recycling process. Projections by NITI Aayog and industry analysts foresee rapid sector growth with battery storage capacity reaching ~600 GWh by 2030[5], particularly driven by EVs, grid storage and electronics.

Pioneering projects are underway, such as BatX Energies lithium-ion battery recycling plant[6] in Uttar Pradesh that utilises hydrometallurgy to extract Li, Co, Ni, Mn and other metals. The facility, following a successful pilot, claims zero-waste and low-energy operation consistent with current environmental regulations. Domestic firm Attero Recycling, based in Roorkee, is further scaling up operations[7] from recycling ~15,000 t/yr to 200-300,000 t/yr in the coming years. Atterro's patented process recovers >98% of battery-grade cobalt, lithium, graphite, nickel and manganese, displaying technical promise.

Policy experts in India recommend stronger oversight and coordination by establishing a single nodal agency through the Ministry of Heavy Industries for all battery circularity. An alternate solution could also be raising EPR penalty rates, and further creating recycling clusters or 'recycling parks.' Proposed measures include extending PLI-style incentives to recycling which would offer viability-gap grants for low-value chemistries such as Lithium Iron Phosphate (LFP), and funding demonstration pilots. The recycling sector in India could potentially call for modular 'hub-and-spoke' collection systems and market-based financing to replicate global best practices. While there are domestic companies such as Lohum Cleantech and other startups partnering with OEMs to collect and process batteries, to scale up pilot projects, there is a need for clearer scrap collection channels and guaranteed offtake for recycled feedstock.

Global Comparison

Leading recyclers internationally operate at a much larger scale with significant policy support. Redwood Materials (USA) uses an integrated approach, with its Nevada plant recycling spent batteries via pyrometallurgy and refining to make cathode and anode materials. Redwood has additionally secured a $2 billion DOE loan to finance[8] a giant battery materials 'campus.' Similarly, Umicore (Belgium) employs a proprietary smelting plus hydrometallurgy process to convert scrap into high-purity Ni, Co, Cu and Li products. Umicore is expanding to a 150,000-tonne/yr European plant by 2026[9] and received a 350 million euro[10] low-cost loan from the European Investment Bank for battery R&D, reflecting EU industrial policy support.

Li-Cycle (Canada-USA) utilises all-hydrometallurgical recycling to produce lithium carbonate and nickel-cobalt-manganese hydroxide from 'black mass.' Its Rochester facility is touted as North America's first commercial-scale hydrometallurgical battery recycler; Li-Cycle closed a $475 million DOE Advanced Technology Vehicles Manufacturing loan[11] to compete in construction. Ascend Elements (USA) applies a novel 'Hydro-to-Cathode' process, converting black mass directly into battery precursors. For funding, Ascend in

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[5] NITI AAYOG Report, 'Advanced Chemistry Cell Battery Reuse and Recycling Market in India.'
[6] PIB. Ministry of Science & Technology.
[7] India's Attero to expand lithium-ion recycling capacity. Argus
[8] Redwood materials. Press Brief
[9] Umicore. Press Brief
[10] European Investment Bank Group. Publication
[11] Voloschuk, Chris. Recycling Today

building the first large-scale precursor plant[12] from recycled feedstock with $480 million in DOE grants and a $320 million in Polish government grant. The DOE loans to Redwood and Li-Cycle are milestone-based concessional financing- a model India is yet to offer. The EU now mandates minimum recycled content in new batteries (6% of lithium and nickel from recyclate by 2031[13]).

Strategic Direction

To strengthen India's battery recycling supply chain, a multipronged approach is essential. First, investments must be directed toward expanding reverse-logistics infrastructure and developing formal recycling hubs to shift collection away from the informal sector and into certified, traceable systems. Second, incentive structures should be extended to cover recycling activities, including viability-gap funding to support the processing of all battery chemistries—particularly low-value types—and the introduction of mandates requiring minimum recycled content in new batteries. Finally, establishing a dedicated national agency to oversee battery circularity and supply chain integration can ensure better coordination, streamlined regulation, and the seamless incorporation of recovered minerals into domestic battery manufacturing pipelines.

[12] Ascend Elements. Press brief.

[13] IEA. EU Sustainable Batteries Regulation. Policy Brief