



Critical Minerals at Scale: Securing Supply and Closing Loops

Post Event Report from the Official Side Event of
World Circular Economy Forum (WCEF)

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About TERI

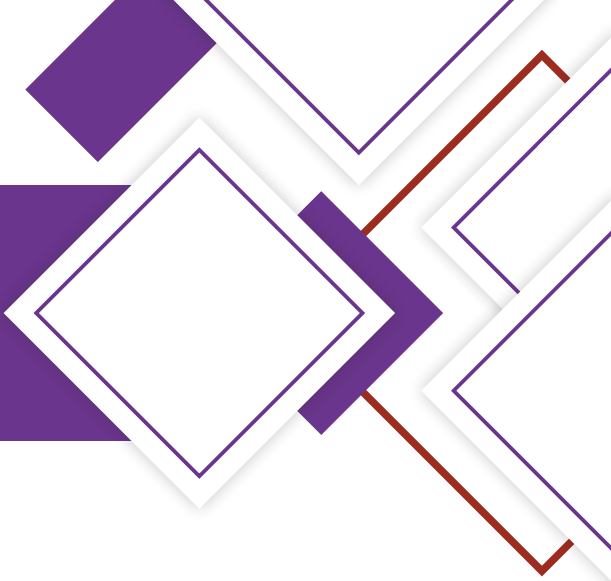
The Energy and Resources Institute (TERI) is an independent, not-for-profit research organization advancing innovative solutions in energy, environment, climate change, and sustainable development. Headquartered in New Delhi, with regional centres in Gurugram, Bengaluru, Guwahati, Mumbai, Panaji, Nainital, and Hyderabad, TERI is powered by a 1,000+ strong multidisciplinary team of scientists, engineers, economists, and sociologists engaged in action-oriented research and implementation.

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From L-R: Shri Anshoo Pandey, Director, Ministry of Mines; Smt. Leena Nandan, IAS (Retd.); Shri Kaushal Mahan, Managing Principal, Chase Advisors



Foreword

India's journey towards becoming a clean energy powerhouse and a globally competitive manufacturing economy is intrinsically linked to its ability to secure access to critical minerals. These minerals underpin the technologies that will define the future, from electric mobility, renewable energy systems, energy storage, digital infrastructure to advanced manufacturing. As demand accelerates, the challenge before us is not merely one of resource access, but of building resilient, sustainable, and future-ready value chains.

In this context, circular economy principles offer a powerful and often underappreciated pathway. Recycling, resource recovery, urban mining, product life extension, and sustainable consumption must no longer be viewed solely through an environmental lens. They are increasingly becoming strategic imperatives for economic resilience, resource security, and industrial competitiveness. The transition towards circularity presents India with a unique opportunity to reduce import dependence, unlock value from end-of-life products, create green jobs, and strengthen domestic capabilities across the critical minerals value chain.

It is therefore encouraging to see critical minerals and circularity emerging as converging priorities within India's policy and industrial landscape. The discussions captured in this report reflect a growing recognition that achieving mineral security requires a holistic approach - one that integrates responsible mining, technological innovation, recycling infrastructure, market development, product design, and stakeholder collaboration.

The World Circular Economy Forum (WCEF) side event, *"Critical Minerals at Scale: Securing Supply and Closing Loops,"* provided a valuable platform to bring together policymakers, industry leaders, researchers, recyclers, investors, and sustainability practitioners to deliberate on these issues. The dialogue moved beyond identifying challenges and focused on practical pathways for scaling circular solutions, strengthening secondary material markets, supporting technological innovation, and creating the enabling ecosystem required for implementation.

A key message that emerged from the discussions is that circularity cannot succeed in isolation. Effective collection systems, robust recycling infrastructure, credible standards, market incentives, financing mechanisms, and strong partnerships must work together to create a vibrant and resilient ecosystem. Equally important is the need to view waste not as a liability, but as a resource one that can contribute meaningfully to India's long-term resource security and economic growth.

The opportunity before India is significant. By embracing circularity as a strategic pillar of our development journey, we will not only be able to strengthen resource security but succeed in positioning India as a global leader in sustainable and responsible growth.

Leena Nandan, IAS (Retd.)
Distinguished Fellow, TERI



Participants at the Official Side Event of WCEF on "Critical Minerals at Scale: Securing Supply and Closing Loops"

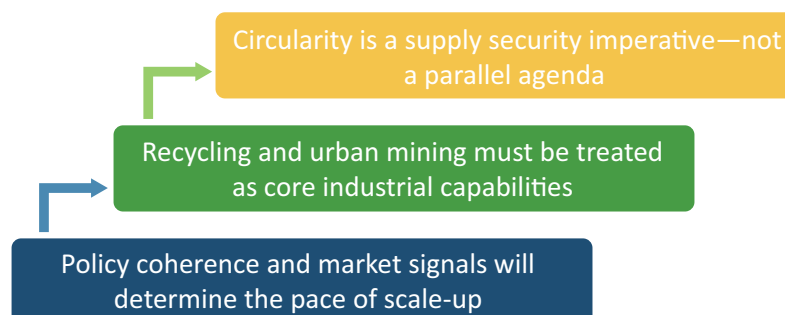
Executive Summary

At the **World Circular Economy Forum (WCEF) 2026 Official Side Event**, convened by Chase Advisors in partnership with TERI, the discussion moved beyond problem statements to identify **actionable pathways** for **strengthening India's critical mineral resilience through circularity**. While policy direction is now firmly in place, unlocking impact will require **greater coherence across the value chain - from design and collection to processing, financing, and market creation**.

Key priorities emerging from the dialogue include:

- Establishing a unified, mission-driven framework to integrate recycling, recovery, and circular procurement within the National Critical Mineral Mission
- Building trust in secondary material markets through accreditation systems, standards, and traceability
- Mobilizing targeted finance and infrastructure investments to scale recycling, refining, and urban mining capabilities
- Strengthening aggregation, reverse logistics, and demand-side incentives to enable viable circular flows
- Driving industry-led transition to circular product design

The session brought together policymakers, including representation from the Ministry of Mines, industry leaders, and domain experts, to advance a solutions-oriented dialogue on resilient and circular critical mineral supply chains. A key message emerging from the discussion was the need for a balanced strategy that combines responsible mining, technological innovation, alternative material research, recycling ecosystems and demand reduction, applied with an urgent sense of implementation.



Main takeaways from the event



Esteemed Panelists at the Official Side Event of WCEF on "Critical Minerals at Scale: Securing Supply and Closing Loops"

Introduction to the Event

1

The World Circular Economy Forum (WCEF) is one of the world's leading global platforms dedicated to advancing circular economy solutions for sustainable growth, industrial transformation, and climate resilience. Convening governments, industries, multilateral organizations, investors, researchers, and sustainability leaders, the Forum serves as a global platform for dialogue on resource efficiency, material circularity, waste reduction, low-carbon industrial systems, and resilient supply chains.

As part of the broader WCEF engagement process, WCEF Side Events are organized globally to deepen discussions on emerging circular economy opportunities and challenges across sectors and geographies. These side events aim to encourage implementation-oriented dialogue, foster partnerships, and exchange practical solutions on themes such as industrial decarbonization, resource efficiency, sustainable manufacturing, recycling, critical raw materials, and circular infrastructure systems.

Global Circular Economy Dialogue

In this context, the event titled “Critical Minerals at Scale: Securing Supply and Closing Loops”¹ was convened as a high-level multi-stakeholder dialogue to examine the growing strategic importance of critical minerals within the global clean energy transition and industrial value chains. The discussions focused on the role of recycling, circular economy practices, resource efficiency, and secondary material recovery in strengthening supply chain resilience, reducing import dependence, and addressing environmental and geopolitical risks associated with critical mineral access.

The event brought together policymakers, industry representatives, sustainability practitioners, recyclers, researchers, and sector experts to deliberate on opportunities, policy interventions, technological requirements, financing needs, and collaborative approaches necessary for building a robust circular ecosystem for critical minerals in India.

1 https://www.sitra.fi/wp-content/uploads/2026/05/Panel-Discussion-Agenda_Critical-Minerals.pdf

To further ground the discussions in stakeholder perspectives, a pre-event survey was conducted with policy influencers, industry associations, sustainability practitioners, and research institutions. The insights emerging from the survey helped shape the thematic focus and deliberations during the event.

The ensuing Event Overview provides a concise summary of the discussions and key deliberations, while the subsequent sections present a deeper analytical understanding of the issues, opportunities, and policy considerations emerging from the dialogue.



India's Critical Minerals Outlook: Global Supply, Secondary Flows, and Circular Pathways

2

India's clean-energy transition is now inseparable from the availability of a small set of critical minerals such as lithium, cobalt, nickel, graphite, rare earth elements, and copper. As the country scales up solar, wind, batteries, and electric mobility, demand for these minerals is projected to rise sharply, turning mineral security into a core enabler of energy and industrial policy.²

Where are we?

India has identified around 30 critical minerals essential for national security, manufacturing, and clean-energy technologies, including battery-grade lithium, cobalt, nickel, graphite, copper, and rare earth elements.³

Modelling for India's energy-transition pathways shows that cumulative demand for some of these minerals could reach over 100 million tonnes by mid-century, with metals like copper and graphite accounting for the largest share. This implies that mineral-intensive deployment of renewables, storage, and EVs will strain both domestic capacity and global supply chains.⁴

What do we need?

From a policy standpoint, India needs to:

- Scale up domestic exploration and processing for minerals where India has geologically relevant reserves (for example, nickel, graphite, and certain rare earth-bearing zones).
- Build specialized refining and processing capabilities for niche materials (such as rare earth separation and high-purity lithium compounds), which are presently underdeveloped compared with global leaders.

² <https://acpet.ashoka.edu.in/projects/strategies-to-address-indias-critical-minerals-vulnerability-through-resource-efficiency/>

³ <https://shaktifoundation.in/critical-minerals-these-are-indias-initiatives-to-strengthen-the-value-chain-and-future-opportunities/>

⁴ <https://cstep.in/thinking-in-models-the-critical-mineral-imperative-in-indias-energy-transition/>

According to an April 2026 analysis by the Institute for Energy Economics and Financial Analysis (IEEFA),⁵ India's critical mineral imports surged from USD 475 million in FY2015 to nearly USD 4.93 billion in FY2024, representing more than a tenfold increase within a decade. Chile alone supplied nearly 2.8 million tonnes of critical minerals between FY2019 and FY2025, while China controls between 60–90 percent of global processing capacity for lithium, cobalt, and rare earth elements. These dependencies expose India to increasing geopolitical and supply-chain vulnerabilities.

I. Global supply chain vulnerabilities and geopolitical concentration

Many critical minerals are highly concentrated in a small number of countries, both in mining and in processing. For example, China dominates rare-earth separation and features prominently in cobalt and lithium-ion battery supply chains, while Indonesia and Australia are key for nickel and lithium-bearing ores. Export restrictions, trade tensions, and strategic hoarding in such environments expose India to supply-side shocks and price volatility, particularly as global competition for these minerals intensifies.⁶

Recent episodes, such as China's export controls on gallium, germanium, and antimony, and Indonesia's nickel-ore export restrictions, have exposed how export-oriented policies, trade disputes, and geopolitical tensions can rapidly disrupt supply.⁷

For India, this means heavy reliance on a few foreign suppliers increases strategic and price-risk exposure, especially for technologies central to national security and energy independence. Moreover, there is a strong case for diversifying sourcing geographies, building strategic stockpiles where appropriate, and strengthening bilateral and multilateral partnerships (such as under the G20 Voluntary Principles on Critical Minerals) to cushion against shocks.⁸

II. Rising role of secondary mineral supply chains

As early-generation batteries, solar panels, and electronics reach end-of-life, secondary (recycled) sources are becoming an increasingly important part of the global critical minerals supply mix. A study conducted by the International Energy Agency (Recycling of Critical Minerals- A World Energy Outlook Special Report)⁹ suggests that, with adequate infrastructure and policy support, recycling could meet a significant share of future demand. For example, one Indian-led modelling exercise estimates that recycling could satisfy all of India's cobalt demand by 2040 and around a quarter of lithium and graphite demand by 2047.¹⁰

5 <https://ieefa.org/node/19534>

6 <https://ieefa.org/resources/building-critical-mineral-stockpiles-key-priority-india>

7 <https://www.globalpolicywatch.com/2025/10/made-in-america-the-outlook-for-critical-minerals/>

8 <https://cetex.org/wp-content/uploads/2025/12/Options-for-diversifying-Indias-critical-mineral-supply-chains.pdf>

9 <https://www.iea.org/reports/recycling-of-critical-minerals/executive-summary>

10 <https://cstep.in/thinking-in-models-the-critical-mineral-imperative-in-indias-energy-transition/>



Policy implications

India cannot treat recycling as merely a 'waste-management' issue. Instead, it must be institutionally and financially integrated into national mineral security planning through missions such as the National Critical Minerals Mission.

Building advanced recycling and refining capacity, including urban mining, e-waste, and battery recycling hubs, would help India turn growing end-of-life flows into secure domestic feedstock.

III. Steps taken so far towards creating a circular economy in India – Policy Interventions

India's approach towards advancing the circular economy is built around a comprehensive and multi-dimensional policy framework that combines regulatory interventions, financial support mechanisms, awareness initiatives, and institutional capacity building. This section examines some of the major policies, reforms, and government-led initiatives that are shaping and strengthening the country's transition towards a circular economy model.

- i National Resource Efficiency Policy (NREP):** Launched in 2019, the NREP aims to promote sustainable production and consumption, improve resource efficiency, and reduce environmental impacts. The policy encourages circular business models, greater use of recycled materials, and sustainable product design. Complementing this is the Extended Producer Responsibility (EPR) framework, which holds producers accountable for post-consumer waste and incentivizes recycling and waste recovery systems.
- ii Swachh Bharat Mission (SBM):** Introduced in 2014, SBM has played a significant role in strengthening waste management systems through initiatives focused on waste segregation, recycling, composting, and reducing waste generation, all of which are central to advancing circular economy objectives.
- iii Financial Incentives for Circularity:** The Government has also introduced financial support mechanisms such as tax incentives, subsidies, and concessional financing to encourage recycling industries, resource-efficient technologies, and the adoption of circular economy practices.
- iv Right to Repair:** Introduced in 2022 by the Department of Consumer Affairs, the Right to Repair initiative represents an important step towards extending product lifecycles and reducing premature disposal of consumer goods. The initiative seeks to empower consumers by ensuring access to repair information, spare parts, and maintenance services for products such as electronics, automobiles, agricultural equipment, and consumer appliances. By enabling repairability and reducing planned obsolescence, the policy promotes reuse, refurbishment, and reduced material consumption.
- v Mission Life:** A sustainability movement, launched in 2022, to promote environmentally conscious lifestyles and responsible consumption practices at both individual and community levels. The initiative emphasizes behavioural change as a critical pillar for achieving sustainability and circularity by shifting focus from 'mindless consumption' to 'mindful utilization'.



- vi Extended Producer Responsibility (EPR) Framework:** The waste management framework has significantly strengthened from 2016 onwards through various waste management rules across multiple sectors, including plastic waste, e-waste, batteries, waste tyres, and used oil. In sectors such as e-waste and battery recycling, EPR has encouraged the formalization of recycling infrastructure and improved recovery of valuable materials such as lithium, cobalt, nickel, rare earth elements, and precious metals. Similarly, plastic waste management rules promote recycled content usage, phased elimination of identified single-use plastics, and greater accountability for plastic packaging waste.

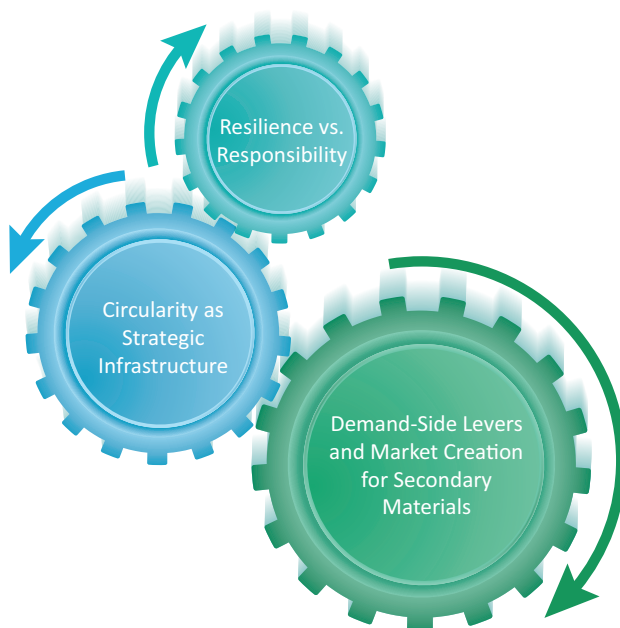


Event Overview

3

India's clean energy transition, across renewables, batteries, hydrogen, and low-carbon technologies, depends on secure and sustainable access to critical minerals. While global supply chains remain concentrated and vulnerable, circular economy approaches offer a strategic opportunity to recover minerals from end-of-life batteries, electronics, and other secondary resources. Such approaches can reduce import dependence, lower environmental impacts, and create domestic green jobs across collection, recycling, refining, and certification.

Against this backdrop, **The Energy and Resources Institute (TERI)** and **Chase Advisors** jointly hosted the panel discussion titled "**Critical Minerals at Scale: Securing Supply and Closing Loops**"¹¹ as an **official side event under WCEF**. Key themes of the session were:



¹¹ https://www.sitra.fi/wp-content/uploads/2026/05/Panel-Discussion-Agenda_Critical-Minerals.pdf

The session was organized to examine one of the most pressing challenges emerging from the global clean energy transition: how to build a resilient, secure, and sustainable critical mineral supply chain amidst rising geopolitical risks, concentrated processing ecosystems, and accelerating demand for minerals required across renewable energy, batteries, electric mobility, semiconductors, and digital infrastructure.

The event convened policymakers, industry leaders, recyclers, sustainability practitioners, researchers, and sector experts to deliberate on the policy, technology, financing, and collaboration imperatives required to build a resilient and globally competitive critical minerals ecosystem for India, with the discussions further shaped by findings and insights emerging from a pre-event stakeholder survey conducted across policy, industry, and research ecosystems.



Themes of the Event

4

I. Resilience vs. Responsibility

A central theme of the discussion focused on balancing the urgent need for resilient critical mineral supply chains with the responsibility to ensure environmentally and socially sustainable extraction, processing, and sourcing practices. With demand for minerals such as lithium, cobalt, nickel, graphite, and rare earths accelerating due to clean energy technologies, electric mobility, semiconductors, and digital infrastructure, concerns around supply concentration, geopolitical dependencies, export restrictions, and market volatility have intensified globally.

Recent studies by the **International Energy Agency (IEA)** and **OECD** highlight that refining and processing capacities for several critical minerals remain concentrated within a small number of geographies, creating significant vulnerabilities for importing economies and clean energy industries.¹²

At the same time, resilience cannot be pursued solely through accelerated extraction and localization strategies. Responsible sourcing, traceability, environmental safeguards, community engagement, and circular resource management must remain central to future supply chain models. The growing need for diversified and trusted supply chains supported by sustainability standards, recycling ecosystems, and international cooperation frameworks that reduce both geopolitical and environmental risks is the defining driver of strategic economic autonomy.

II. Circularity as Strategic Infrastructure

As primary mineral demand continues to rise, recycling, urban mining, re-manufacturing, and secondary material recovery are emerging as critical levers to strengthen domestic supply security, reduce import dependence, and improve resource efficiency. The IEA's recent report on Recycling of Critical Minerals notes that recycling can create a valuable secondary supply source capable of enhancing supply resilience while lowering the need for new mining activity over time.

¹² <https://iea.blob.core.windows.net/assets/d041f616-2f49-4694-861c-97d489ed1856/RecyclingofCriticalMinerals.pdf>

Circularity was framed not merely as an environmental objective but as a strategic capability that can support industrial competitiveness, energy security, and long-term supply chain resilience. The discussions also highlighted that countries that build robust secondary-material ecosystems early could gain strategic advantages in the evolving global clean energy economy.

As per the **Circularity Gap Report 2025**,¹³ released at the World Circular Economy Forum, 2025 edition, tells us that global circularity has actually fallen from 9.1 percent in 2015 to just 6.9 percent today. Material consumption is outpacing recycling by a wide margin. If we were to recycle all recyclable materials globally, circularity could rise to 25 percent, but even that requires a complete transformation of infrastructure and incentives.

For India specifically, the opportunity is enormous. The market value of recycled critical minerals globally is projected to grow from \$40 billion in 2020 to \$200 billion by 2050. India can either be a consumer of others' recycled materials or a producer and innovator in this space.

III. Demand-Side Levers and Market Creation for Secondary Materials

Another important discussion theme focused on the absence of strong and predictable demand signals for recycled and secondary materials. While investments in recycling and recovery technologies are increasing, participants noted that secondary-material markets continue to face challenges related to pricing volatility, quality assurance, certification standards, fragmented supply chains, and limited procurement incentives.

Several global studies, such as the **Global Circularity Protocol for Business**,¹⁴ have emphasized that scaling circularity requires not only supply-side infrastructure but also robust demand-side mechanisms capable of creating commercially viable markets for recovered materials.

The discussions explored policy and industry interventions such as recycled content mandates, green public procurement, product design standards, battery passports, traceability systems, financial de-risking instruments, and harmonized certification frameworks to improve market confidence in secondary materials. These measures were seen as essential to enabling secondary materials to compete effectively with virgin materials and to scale circular economy outcomes across clean energy and manufacturing value chains.

¹³ <https://circularity-gap.world/updates-collection/global-circularity-rate-fell-to-6-9---despite-growing-recycling>

¹⁴ <https://circulareconomy.europa.eu/platform/sites/default/files/2024-08/Global-Circularity-Protocol-for-Business-Landscape-Analysis-Full-Deck.pdf>



Survey Findings and Insights

5

Pre-Discussion Poll: Understanding Circularity in Critical Minerals

The pre-discussion opinion poll was designed to capture stakeholder perspectives on the evolving critical minerals landscape and to understand perceived bottlenecks in scaling a circular economy approach in India. The survey examined views on supply chain risks, design-for-circularity, recycling scalability, policy priorities, long-term national priorities, and the demand outlook for secondary materials.

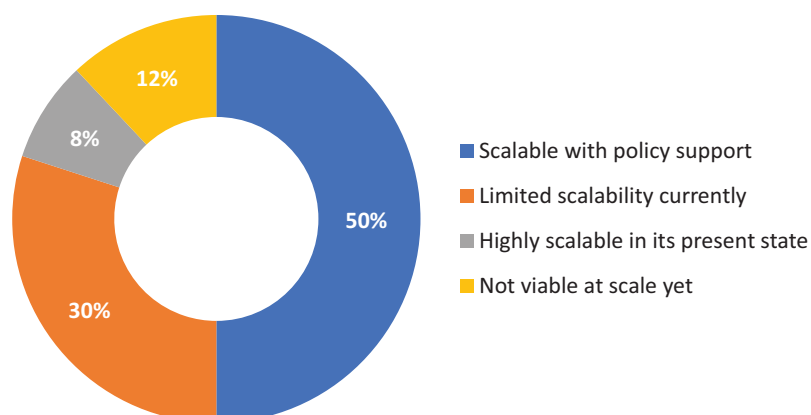
The respondent base was led by research/academia (33%) and mining & minerals stakeholders (25%), with participation also drawn from circular economy practitioners, recyclers, regulatory policy stakeholders, manufacturers, and the battery ecosystem.

I. Survey Findings

i Stakeholders see recycling as promising, but not yet market-ready without policy support

A clear majority of respondents positioned recycling as a viable pathway only if backed by enabling policy architecture. This indicates that stakeholders do not reject recycling as a strategic solution; rather, they see it as a capability that requires active policy and institutional support before it can operate at a meaningful industrial scale.

Recycling of critical minerals

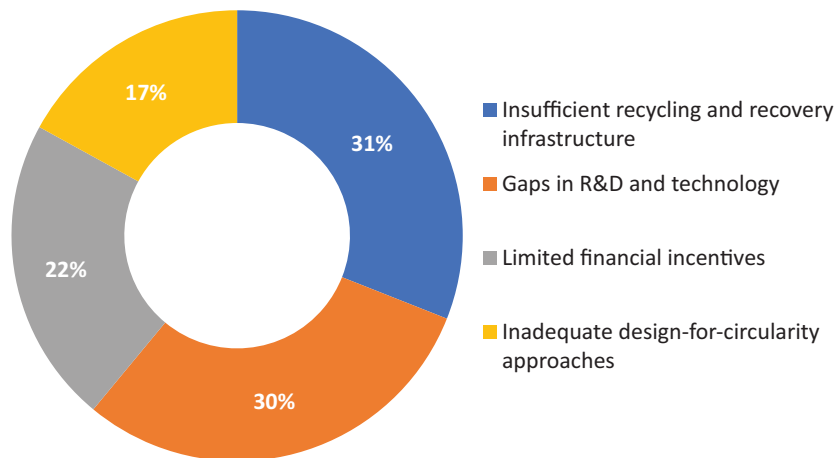


ii Infrastructure and technology gaps emerged as the most significant barriers to circularity

When asked to identify major bottlenecks to scaling recycling and recovery, respondents pointed as provided in the chart below.

The findings point to a strong perception that the challenge is not merely one of intent or regulation, but of industrial readiness, particularly the need for physical recovery systems, processing capabilities, and technology pathways that can support mineral recovery from end-of-life products and production waste.

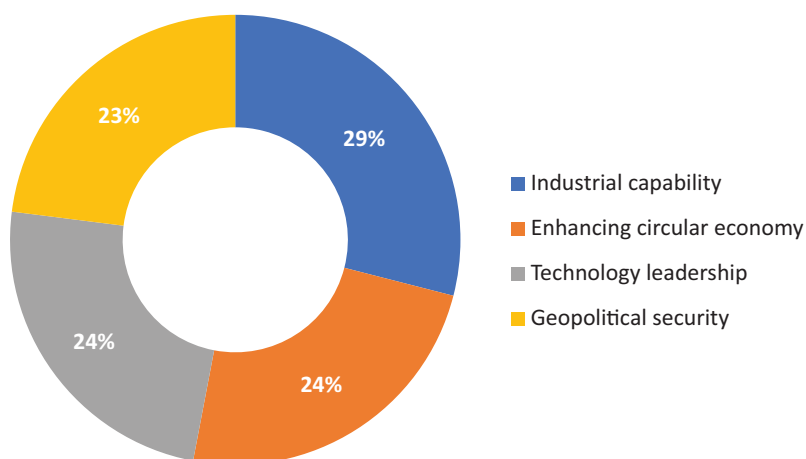
Major bottlenecks to scaling recycling and recovery



iii Import dependence remains the dominant concern in India's critical minerals strategy

On supply chain risks, the most frequently cited concern was overdependence on imports. Stakeholders view the critical minerals challenge first as a strategic vulnerability linked to external dependence, but they also treat India's weak recycling ecosystem as a major domestic risk factor. In other words, circularity is not being seen only as an environmental agenda; it is increasingly being viewed as a resilience and supply-security imperative.

Supply chain risks



Critical Minerals at Scale:

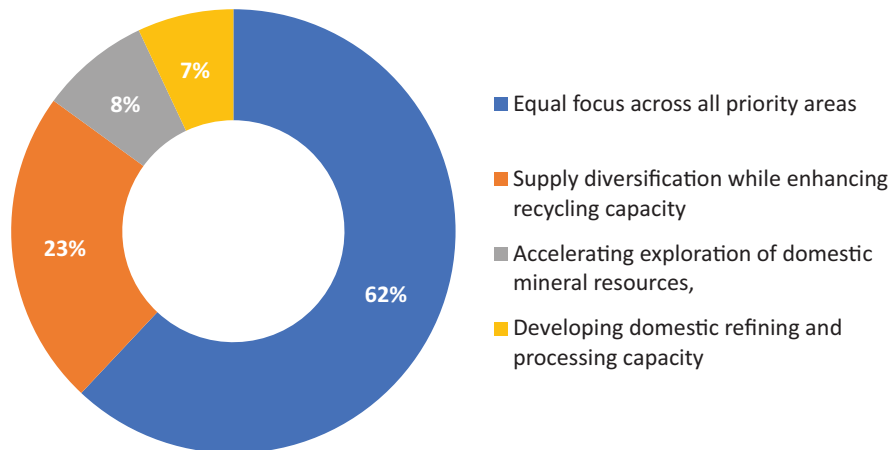
Securing Supply and Closing Loops



iv Respondents favoured a portfolio approach over a single-track national strategy

Asked about short-term priorities for the country, 62% of respondents called for an equal focus across all priority areas. This result strongly suggests that stakeholders see the critical minerals challenge as systemic and multi-dimensional, requiring simultaneous action across sourcing, refining, recovery, and market development.

Short-term priorities for the country



The NITI Aayog report released in February 2026¹⁵ made exactly this point:

India's critical minerals challenge is defined by rapidly rising demand, high import dependence, concentrated global supply chains, and long development timelines. The report called for a National Critical Raw Material Analytical Strategy Unit to conduct continuous risk assessments and coordinate across ministries.

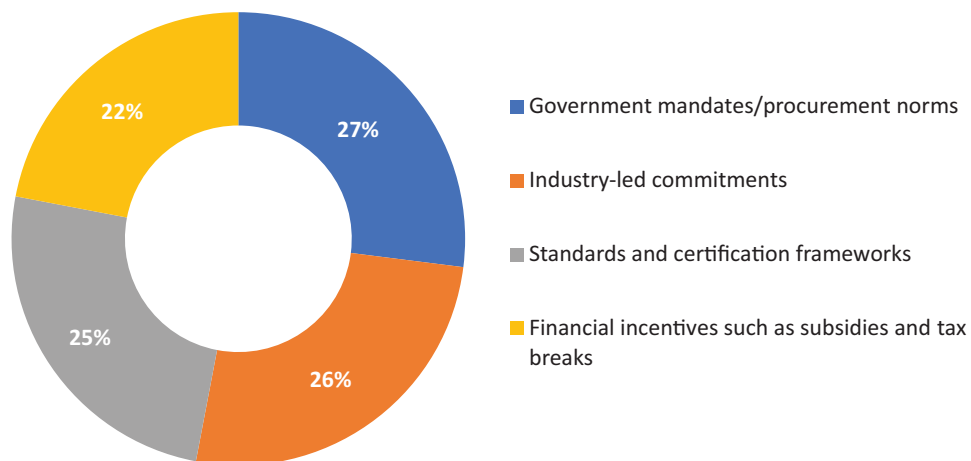
v Demand-side market creation is seen as evenly distributed across multiple policy levers

On the question of what would be most critical in creating demand for secondary materials, responses were fairly evenly distributed. The narrow spread across these categories indicates that respondents do not see demand creation as dependent on a single policy instrument. Instead, they appear to favour a market-shaping approach in which regulation, voluntary industry action, quality assurance systems, and fiscal support all play complementary roles.

¹⁵ <https://niti.gov.in/sites/default/files/2026-02/Scenarios-Towards-Viksit-Bharat-and-Net-Zero-Critical-Mineral-Assessment-Demand-and-Supply.pdf>



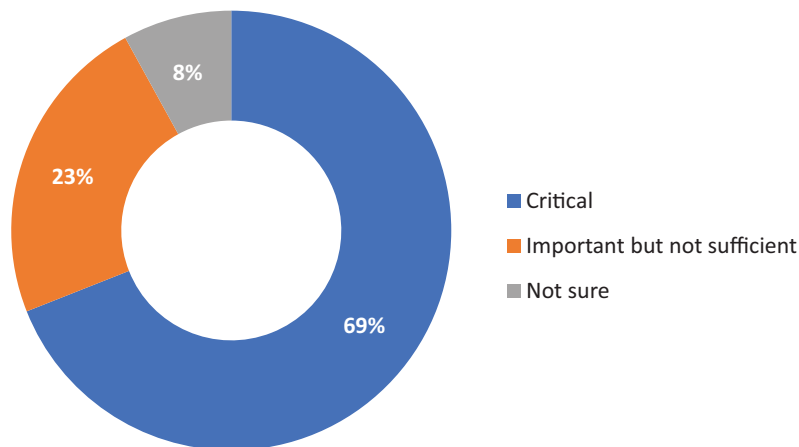
Critical in creating demand for secondary materials



vi Design-for-circularity is viewed as a foundational lever for reducing mineral dependence

This is one of the clearest signals from the poll: respondents recognize that mineral recovery outcomes are shaped not only at the recycling stage, but far earlier in the product lifecycle. The finding underscores a growing consensus that circularity must be designed into products, components, and systems from the outset if recovery, reuse, and material efficiency goals are to be met.

Design-for-circularity for reduced mineral dependence



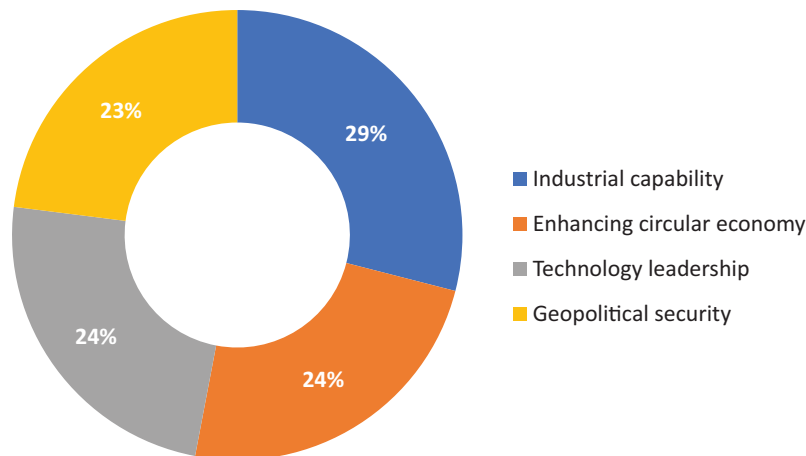
vii Long-term priorities point to industrial capability first, but with close attention to circularity and innovation

Looking ahead over the next 7–10 years, respondents placed the highest priority on industrial capability (29%), defined in the deck as building the value chain end-to-end from feedstock and processing to component manufacturing. The relatively tight distribution across these four pillars reflects an understanding that India's critical minerals strategy cannot rest on upstream access alone; it must also build domestic manufacturing depth, recovery systems, innovation capability, and secure international partnerships.

Critical Minerals at Scale:
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Design-for-circularity for reduced mineral dependence



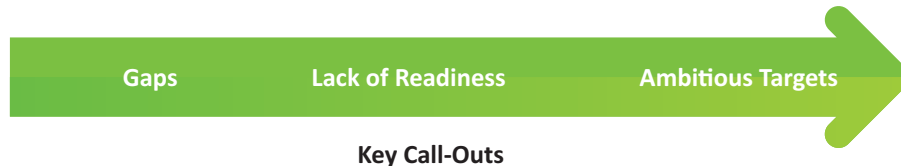
II. Survey Insights

- Circularity is being reframed as strategic infrastructure, not just environmental good practice:** One of the strongest themes that emerged from the poll is that circularity is no longer being understood in narrow waste-management terms. Respondents connected import dependence, lack of recycling systems, and system-wide industrial bottlenecks, suggesting that circularity is increasingly being perceived as part of the country's strategic economic and industrial infrastructure. The survey therefore reinforces the need to position circular economy interventions within the broader agenda of supply chain resilience, industrial capability, and national resource security.
- Policy support is seen as the bridge between concept and scale:** The finding that half the respondents view recycling as scalable only with policy support is particularly important for event reporting. It suggests that stakeholders do not see market forces alone as sufficient to scale India's critical minerals recovery ecosystem. Instead, they appear to expect a coordinated enabling framework involving public investment, standards, incentives, and industrial policy support. This places significant emphasis on the role of government in reducing first-mover risk and accelerating the transition from small-scale or fragmented initiatives to industrially viable systems.
- The core challenge is systemic rather than sector-specific:** Across questions, respondents repeatedly indicated that no single intervention can solve the problem. The preference for an equal focus across all short-term priorities (62%), together with the balanced response pattern on demand-side levers, points to an important conclusion: stakeholders view the critical minerals challenge as a systems problem. This means policy responses will likely need to connect exploration, processing, product design, end-of-life recovery, procurement, standards, and financial support rather than treating them as isolated workstreams.
- Supply security and circularity are no longer competing objectives:** Traditionally, policy conversations often separate resource security from environmental responsibility. However, the survey findings suggest a convergence between the two. Import dependence was identified as the top risk, while lack of recycling/circular systems ranked as the second-largest supply chain



concern. This indicates that stakeholders increasingly see recovery and secondary material use not as environmental add-ons, but as practical tools for reducing vulnerability and improving long-term supply resilience.

- **Design choices are beginning to be recognized as upstream policy levers:** The strong support for design-for-circularity shows that stakeholders understand that circularity cannot be addressed only at the end-of-life stage. If products are not designed for disassembly, repairability, traceability, and material recovery, recycling outcomes will remain constrained regardless of downstream investment.
- **Stakeholders support a ‘build + recover + secure + lead’ model for the decade ahead:** The long-term priority mapping in the survey suggests broad alignment around a four-part strategic architecture: build industrial capability, strengthen circular recovery systems, diversify and secure supply geopolitically, and invest in technology leadership. Since none of the long-term priorities overwhelmingly dominated the others, the poll suggests that stakeholders are not calling for a singular policy bet. Rather, they favour a composite strategy in which manufacturing depth, recycling capacity, international partnerships, and innovation advance together.
- **The findings revealed a clear and consistent message:** The challenge is no longer one of intent, but of readiness. While stakeholders broadly recognize the strategic importance of circularity in strengthening supply chain resilience and reducing import dependence, the ecosystem remains in a transitional phase where ambition is high, but the systems and market conditions required to scale implementation are still evolving. Respondents pointed to several persistent constraints, including gaps in recycling infrastructure, technology maturity, financing availability, collection systems, and circular product design approaches.



Key Call-Outs

Collectively, these challenges underscored a broader consensus that scaling circularity will require coordinated action across the entire value chain rather than isolated interventions. In many ways, this formed the core premise of the discussion: how to move beyond pilot-level successes toward system-level transformation, and position circularity as a credible and scalable pillar of India's long-term critical minerals strategy.

Critical Minerals at Scale:
Securing Supply and Closing Loops



Panel Discussion Outcomes and Takeaways

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The panel discussion brought together a diverse and high-profile set of speakers spanning government, industry, research, and sustainability institutions, reflecting the multi-stakeholder nature of the critical minerals ecosystem.

The session featured a thematic address by **Smt. Leena Nandan, IAS (Retd.), Distinguished Fellow at TERI**, and a chief guest address by **Shri Anshoo Pandey, Director at the Ministry of Mines**, who anchored the discussion in India's evolving policy landscape.

Waste should no longer be viewed merely as discarded material, but as a strategic economic resource capable of contributing significantly to India's mineral security, improving traceability, compliance, and organized supply chains for recycled materials

Although research institutions and CSIR laboratories have developed promising technologies, stronger industry adoption, commercialization, financing, and technological deployment are required to scale recycling operations effectively

Remarks by
Smt. Leena Nandan

Circularity cannot succeed in isolation and requires coordination among multiple stakeholders across the waste management and recycling value chain, calling for stronger collaboration to create stable and resilient recycling ecosystems

The need is to develop efficient systems for waste collection, segregation, aggregation, and material recovery in order to unlock the value embedded in discarded electronic and electrical waste

Under the National Critical Mineral Mission, the Government has scaled up critical mineral exploration projects from 130 projects three years ago to 300 projects planned for FY-2026-27, with 571 exploration projects already completed against the target of 1,200 projects by 2030–31

The Government has enabled centralized auctioning of critical mineral blocks through the 2023 MMDR Act amendment and has already auctioned 46 critical mineral blocks against the Mission target of 100 blocks

Insights shared by
Shri Anshoo Pandey

To accelerate operationalization, the Government is streamlining the approval process while also establishing 4 Critical Mineral Processing Parks in Gujarat, Andhra Pradesh, Maharashtra, and Odisha, alongside proposed CAPEX incentives for lithium and nickel processing

The Government has allocated ₹1,500 crore for critical mineral recycling, received 71 applications under the recycling scheme, and aims to build 270KT recycling capacity with the recovery of 40–50KT of critical minerals through recycling initiatives

Thereafter, **Kaushal Mahan (Managing Principal, Chase Advisors)** shared his thoughts on the growing strategic importance of critical minerals in global trade and economic partnerships, highlighting how critical minerals are increasingly taking centre stage in Free Trade Agreements (FTAs), bilateral engagements, and international supply chain collaborations. He emphasized that as countries accelerate clean energy transitions and advanced manufacturing ambitions, mineral security, resilient supply chains, recycling ecosystems, and circular economy practices are becoming central to global economic and geopolitical discussions. This was followed by the Panel Discussion that comprised of-

- **Dr. Sandip Chatterjee**, Senior Advisor, Sustainable Electronics Recycling International (SERI), USA; Adjunct Professor, IIT Mandi; and Former Senior Director & Group Coordinator, MeitY
- **Dr. Pankaj Satija**, Executive Vice President, JSW
- **Dr. Abhinav Mathur**, Advisor to the Board, Attero Recycling
- **Dr. Nidhi Srivastava**, Head – Research and Strategy, Dravya, IIHS Centre for Materials and Sustainable Development
- **Priti Shukla**, Portfolio Manager, Critical Raw Materials, Energiva Ventures
- **Souvik Bhattacharjya**, Director and Senior Fellow, TERI

Key Highlights from the Discussion

- **Ecosystem readiness must precede or develop alongside recycled-content mandates:** Domestic recycled-content requirements can only be effective when adequate supplies of high-quality secondary materials, recycling capacity, quality standards, certification mechanisms and predictable offtake are in place. The report¹⁶ titled '*Charging Ahead: Transforming India's Lithium-ion Battery Recycling Ecosystem*' similarly identifies feedstock quality and availability, limited battery-grade recycling capacity, lack of standardized recycled-content verification and insufficient domestic demand as key constraints to scaling India's Li-ion battery recycling ecosystem.
- **Design-for-Circularity and Product Architecture:** Circular design is no longer a choice. It is becoming a business imperative. India cannot achieve long-term critical mineral security without fundamentally rethinking product design. The discussion highlighted that extending product life through refurbishment, component harvesting, reuse, and remanufacturing can significantly reduce pressure on virgin mineral extraction while creating domestic recovery value chains.
- **Secondary Materials Need Trusted Standards and Market Credibility:** While India has made progress through digitized EPR systems, stronger auditing and verification frameworks are necessary to validate recovery efficiencies, purity levels, and environmental performance across the recycling ecosystem. Panelists stressed the urgent need for standardized testing protocols, certification systems, third-party validation, and material traceability mechanisms to build trust in recycled materials. Significant variation exists across recyclers in recovery capability of the number of materials extracted, recovery rate, material purity, environmental processes and scale of operations. Capability-based assessment frameworks supported by independent verification and third-party audits can strengthen confidence in recycled materials while identifying recyclers capable of recovering high-purity critical minerals that can be put back to the highest value use case.

¹⁶ <https://icea.org.in/icea-in-collaboration-with-accenture-successfully-concluded-the-national-report-launch-of-charging-ahead-transforming-indias-lithium-ion-battery-recycling-ecosystem/>



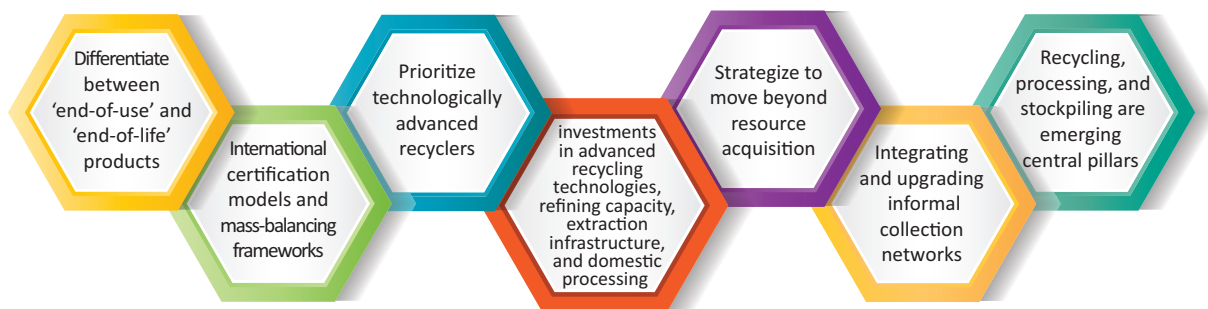
- **Recycling Must Be Treated as Strategic Industrial Infrastructure:** India possesses substantial untapped reserves of critical minerals embedded in e-waste, industrial slags, mine tailings, and end-of-life products. However, inadequate infrastructure, weak material aggregation systems, fragmented collection networks, and limited financing continue to constrain recovery potential. The panel strongly emphasized that recycling and urban mining should no longer be viewed solely as waste management activities, but as strategic industrial capabilities critical to India's economic and geopolitical resilience.
- Critical mineral-bearing waste streams should be recognized as strategic "Urban Mines" and channelled to validate scientific recyclers with proven extraction and refining capabilities. This requires a policy shift from viewing recycling solely as a waste management activity to recognizing it as a national strategic resource and critical minerals security imperative, capable of strengthening domestic supply chains, reducing import dependence, and enhancing resource resilience.
- **Financing and Scale Remain Critical Gaps:** Industry stakeholders highlighted that despite growing policy momentum, the recycling sector continues to face weak profitability, high capital requirements, and limited investor confidence. These challenges are further compounded by the continued dominance of informal channels in material collection, tax and compliance asymmetries faced by formal recyclers, and persistent uncertainty surrounding EPR pricing mechanisms. Together, these factors undermine the commercial viability of scientific recycling operations and weaken investor confidence in the sector, thereby constraining the capital required for capacity expansion and technological advancement.
- The economics of formal recycling remain disadvantaged relative to informal operators, who are able to avoid many of the regulatory, environmental, labour, and taxation costs borne by authorized facilities. As a result, significant volumes of critical mineral-bearing waste continue to bypass formal recycling channels.
- Tax reforms such as rationalization of GST rates from 18% to 5% in the RCM format, will be essential to improving project bankability, attracting private investment, and scaling India's domestic critical mineral recovery capacity.
- **Reverse Logistics is the Weakest Link:** Despite growing recycling capacity, the collection and aggregation of end-of-life products remains the weakest link in India's critical minerals value chain. Fragmented and informal collection networks result in the loss of valuable critical minerals, foregone economic value, and significant environmental and occupational health risks arising from sub-optimal processing practices. Currently, an estimated 99% of e-waste collection is undertaken by the informal sector. Once precious metal-, critical mineral-, and rare earth-bearing waste enter informal channels, it typically follows one of three pathways: it is manually dismantled and processed using crude and environmentally harmful techniques; selectively stripped of high-value fractions while losing access to recoverable secondary materials; or exported outside the country, resulting in the leakage of strategic resources from India's economy. Informal operators generally lack the technological capability to recover the full spectrum of critical minerals and rare earth elements contained in complex waste streams, leading to substantial material losses and reduced resource efficiency.
- The absence of robust collection, aggregation, and traceability mechanisms limits the ability to direct critical mineral-bearing waste towards authorized recyclers with advanced recovery capabilities. Consequently, significant quantities of recoverable strategic materials remain



outside the formal ecosystem, reducing domestic recovery rates, undermining resource-security objectives, and constraining India's ability to build a resilient circular economy for critical minerals. Strengthening reverse logistics infrastructure, incentivizing formal collection networks, and improving traceability across the waste value chain will therefore be critical to achieving the objectives of the National Critical Minerals Mission.

- **Industrial Policy Must Create Markets for Secondary Materials:** The discussion highlighted the importance of recycled-content mandates, circular public procurement frameworks, green procurement standards, and industrial purchasing commitments to create market confidence for recycled materials. Speakers noted that sectors such as steel, automotive, batteries, and electronics will increasingly face pressure to integrate recycled inputs due to evolving global sustainability regulations and carbon-related trade measures. Greater adoption of recycled materials can also strengthen demand certainty for recycling outputs and encourage large manufacturers, cell makers, and component suppliers to integrate domestically recovered critical minerals into their supply chains, thereby supporting the development of a more resilient and circular critical minerals ecosystem.
- **Securing Resilient and Diversified Supply Chains:** Speakers stressed the importance of diversifying mineral sourcing across geographies, strengthening engagement with ASEAN and other mineral-rich regions, and integrating critical minerals more strategically into trade and bilateral cooperation frameworks.
- **The National Critical Mineral Mission (NCMM) has elevated Circularity to a Strategic Priority:** The discussion acknowledged the NCMM as a major policy milestone that has embedded recycling and circularity into India's long-term critical minerals strategy from the outset. This has accelerated momentum around recycling incentives, processing infrastructure, stakeholder consultations, and strategic stockpiling discussions. Recycling, processing, and domestic value addition were identified as emerging priorities within India's broader critical mineral ecosystem.

Key Takeaways



Way Forward: Policy Recommendations to Achieve the Transition Towards a Circular Economy

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The discussion made clear that India's critical minerals strategy must move beyond resource acquisition alone and adopt a full value-chain approach spanning product design, collection, recycling, refining, standards, and downstream market creation. Building on the event's key highlights, the way forward lies in treating recycling and urban mining as strategic industrial capabilities, while aligning environmental regulation, industrial policy, and market development around a circular critical minerals ecosystem.

I. Technology Incentives and Industrial Scale-Up

Recommendation I - Accelerate incentives for advanced recycling, extraction and refining technologies: India should prioritize incentives for facilities that go beyond basic dismantling or black-mass generation and are capable of actual extraction, separation and refining of critical minerals from e-waste, battery waste and other secondary streams. This directly reflects the panel's emphasis on advanced recycling technologies, refining capacity, and higher-purity recovery systems.



Multi-stakeholder approach

- Existing recycling incentive schemes may increasingly prioritize support for advanced extraction and refining facilities capable of producing battery-grade and industrial-grade recovered materials, rather than focusing solely on collection or dismantling capacities. The Ministry of Mines, Ministry of Heavy Industries, and Ministry of Environment, Forest and Climate Change may play an important role in designing technology-linked incentive structures and industrial support mechanisms.
- Targeted support may be considered for facilities deploying advanced hydrometallurgical and refining technologies capable of recovering high-purity lithium, cobalt, nickel, graphite, and copper from secondary streams. Institutions such as CSIR laboratories, IITs, technical universities, and private technology developers may help accelerate indigenous technology development and commercialization.

- Concessional financing mechanisms, blended finance windows, viability gap support, and pilot-scale demonstration funding may therefore help accelerate technology adoption. Such support may involve coordination between the Ministry of Finance, SIDBI, public financial institutions, State Industrial Development Corporations, and green finance platforms.
- Industry associations, BIS, CPCB, and sectoral ministries may help facilitate collaborative R&D platforms, pilot projects, and standards-development initiatives for secondary critical minerals.

Recommendation 2 - Establish dedicated critical mineral recycling and processing clusters:

The event discussion highlighted that critical mineral processing parks and industrial capability are central to India's long-term strategy. Dedicated clusters can reduce logistics costs, co-locate pre-processing and refining, and improve environmental monitoring.



Government prerogative

- Recycling and material recovery units may be integrated into the planning and design of critical mineral processing parks and state-level mineral development strategies. This could be undertaken through coordinated planning between the Ministry of Mines, State Mining Departments, and State Industrial Development Corporations to ensure that recycling infrastructure is embedded within broader industrial and mineral value chain planning.
- State Governments, SPCBs, and PCCs may consider developing plug-and-play industrial infrastructure with common facilities for hazardous waste handling, storage, dismantling, testing, wastewater treatment, reverse logistics, and environmental compliance. This could help reduce entry barriers for recyclers and encourage the formalization of the sector. Such infrastructure may be developed through industrial parks, special economic zones, or dedicated circular economy clusters supported by viability gap funding, public-private partnerships, or green industrial incentives.
- The development of integrated recycling and recovery infrastructure may draw lessons from the Registered Vehicle Scrapping Facility (RVSF) model being implemented for end-of-life vehicles. Similar dedicated facilities for e-waste and battery waste could support systematic dismantling, segregation, and recovery of valuable materials while ensuring environmentally sound management of hazardous fractions. Such facilities may also facilitate the separate collection, storage, and processing of batteries, critical metals, and other recoverable components, improving material traceability and recovery efficiency across value chains.



Multi-stakeholder approach

- Research institutions, CSIR laboratories, IITs, and industry stakeholders may collaborate to establish technology demonstration centres and pilot facilities within these clusters to accelerate the deployment of advanced extraction, refining, and recovery technologies. Such partnerships could support indigenous innovation, improve recovery efficiency, and reduce dependence on imported processing technologies.
- Shared infrastructure such as collection centres, aggregation hubs, pre-processing facilities, testing laboratories, and advanced recycling lines may be co-invested in by government agencies,

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private industry, producer responsibility organizations (PROs), and recycling associations. This may help smaller recyclers access technology and infrastructure that would otherwise be financially unviable individually.

- Financial institutions, development finance agencies, and industry bodies may also explore blended financing mechanisms, concessional financing, and green investment frameworks to support infrastructure creation and technology adoption within these clusters. This could help mobilize long-term capital required for scaling circular economy infrastructure in the critical minerals sector.

2. Recycler Support and Sector Formalization

Recommendation 3 - Partnership with certified recyclers meeting emerging standards:

The discussions highlighted the need for a differentiated support architecture for recyclers, recognizing that large integrated recyclers, MSMEs, start-ups, and informal-to-formal transitioning enterprises face distinct operational, technological, and financial challenges. Participants noted that strengthening the recycling ecosystem may therefore require a coordinated multi-ministerial support framework involving the Ministry of Mines, Ministry of Environment, Forest and Climate Change, Ministry of MSME, Ministry of Heavy Industries, financial institutions, State Governments, and industry stakeholders. Further, a recycling process aligned with global standards (*like R2v3 - Responsible Recycling version 3*) would also be imperative to ensure material traceability, mass balance, chain of custody, and environmental safeguards. Global standards, including ISO 9001, ISO 14001, ISO 45001, and R2v3 standards, should be made mandatory for recyclers to arrest the loss of critical minerals from the formal and informal sectors.



Government support

- Discussions highlighted that incentive structures may consider incorporating support measures such as performance-linked incentives (PLI) for higher recovery rates of critical minerals, concessional electricity tariffs for compliant recycling facilities, capital subsidies for deployment of advanced extraction and refining technologies, viability gap funding for environmentally compliant recycling infrastructure, reduced GST or tax incentives on recycled material usage, and additional incentives for achieving certified traceability and digital material tracking standards.
- State Governments may consider offering capital subsidies on utilities, testing, and common infrastructure for compliant recyclers operating in formal industrial zones.



Industry role

- Large OEMs, battery manufacturers, electronics companies, and producer responsibility organizations may explore aggregating recyclable feedstock demand and entering medium-term offtake or supply arrangements with authorized recyclers. Such arrangements could help reduce revenue uncertainty for recyclers, improve the bankability of projects, and strengthen long-term investment confidence within the sector.
- Industry associations, recycling federations, and technical institutions may support recyclers through operational capacity building, workforce skilling, safety training, environmental



compliance guidance, and quality assurance systems. This could include developing standard operating procedures, certification frameworks, and shared best practices to improve operational efficiency and build trust in recycled materials markets.

Recommendation 4 - Upgrade and integrate informal collection networks into formal value chains: The panel identified reverse logistics as the weakest link and stressed the need to integrate informal collection systems into an inclusive circular economy. India cannot recover minerals at scale if end-of-life products continue leaking through fragmented, low-traceability channels. Given that an estimated 1.5–4 million waste pickers and kabadiwalas (itinerant buyers and small scrap dealers) form the backbone of India's circular economy, strengthening their participation in formal collection and recycling ecosystems will be critical to improving collection efficiency, traceability, and resource recovery.¹⁷



Government support

- CPCB may further strengthen end-to-end digital tracking systems for e-waste, batteries, and critical material flows to improve transparency, reduce leakages into informal and environmentally non-compliant channels, and strengthen confidence in EPR certificate systems.
- The MoEFCC and CPCB may consider introducing differentiated compliance pathways for MSMEs, start-ups, and large recyclers so that smaller formalizing enterprises are not disproportionately burdened by uniform compliance requirements while still maintaining environmental safeguards.
- The MoEFCC and CPCB may explore mechanisms to facilitate the structured integration of informal collectors and aggregators into EPR-compliant collection ecosystems through registration, aggregation models, skill certification, and partnerships with authorized entities.
- Skill development programmes and certification frameworks may be introduced for informal workers engaged in waste collection, dismantling, sorting, and aggregation activities. Such programmes could potentially be supported through collaboration between the Ministry of Skill Development and Entrepreneurship (MSDE), State Skill Missions, industry associations, and recyclers to improve occupational safety, material handling practices, and operational efficiency.
- The Ministry of Micro, Small and Medium Enterprises (MSME) may initiate a suitable subsidy scheme to attract informal operators to support their skilling, providing minimum infrastructure and technology to upgrade them in the formal fold.



Industry role

- PIBOs, OEMs, and authorized recyclers may further explore incentive-based collection models that encourage informal collectors to channel materials into compliant recycling ecosystems through assured buy-back arrangements, aggregation incentives, or performance-linked collection partnerships.
- Recyclers should offer traceable procurement channels and commercial incentives for authorized collection partners.

¹⁷ <https://india.mongabay.com/2026/05/how-ngos-are-bringing-indias-informal-waste-collectors-into-the-system/>



3. Standards, Accreditation and Market Credibility

Recommendation 5 - Develop a recycler accreditation and graded certification framework:

India should therefore develop a formal recycler accreditation framework that differentiates facilities by technological capability, environmental performance, recovery efficiency, and material purity by adopting global recycling standards, including ISO 9001, ISO 14001, ISO 45001 and R2v3 standards.



Government support

- The MoEFCC shall develop a benchmark for graded recognition of recyclers under circular economy / EPR implementations.
- The CPCB already administers recycler registration portals and scientific management guidelines under the e-waste and battery regimes, providing a strong institutional foundation to further develop national criteria/SOPs for recycler accreditation linked to process capability, environmental safeguards, recovery benchmarks, and standardized data reporting on the EPR portal.
- SPCBs/PCCs may verify on-ground compliance, inspect facilities, validate installed capacity and environmental controls, and differentiate better-performing recyclers through state-level operational scrutiny. Under battery and e-waste systems, SPCBs/PCCs retain an inspection and consent-linked role.



Industry role

- While several organized recyclers in India have already begun adopting digital tracking systems, process documentation, and recovery-efficiency monitoring practices, the implementation remains uneven across the broader recycling ecosystem. Wider adoption of auditable chain-of-custody systems, traceability frameworks, recovery-efficiency benchmarks, and third-party verification mechanisms may help strengthen transparency, improve confidence in secondary material markets, and align Indian recycling systems with emerging global sustainability standards (R2v3 standards). CPCB, BIS, deagencies, technology providers, and industry associations may play an important role in supporting standardized verification and reporting systems.



Multi-stakeholder approach

- Producers, OEMs, and PROs are increasingly engaging with authorized recyclers under existing EPR systems. However, procurement practices continue to remain largely cost-driven, with limited emphasis on recovery quality, environmental compliance, or traceability standards. Therefore, there is a need to strengthen preferential procurement frameworks and accredited recycler ecosystems through collaboration between the MoEFCC, CPCB, PROs, OEMs, and industry associations to create more stable demand for compliant and technologically advanced recyclers.



Recommendation 6 - Develop standards and testing protocols for secondary materials: To create confidence in recycled outputs, India needs standardized methods for testing purity, quality, recovery efficiency and environmental performance of secondary materials. The discussion explicitly called for trusted standards, certification and material traceability.



Government support

- The CPCB, together with BIS and industry stakeholders, may explore creating standardized quality benchmarks and certification systems for recycled critical-mineral-bearing materials, test methods, recycled-content claims, and quality benchmarks for downstream industrial use.
- The CPCB may consider aligning environmental reporting and verification requirements with such standards, especially where recovery claims are linked to EPR compliance or incentives.
- NABL/BIS-recognized laboratories and technical institutions may consider building accredited testing capacity for purity, contamination and traceability verification. BIS already operates/recognizes conformity assessment and laboratory systems.



Multi-stakeholder approach

- India still lacks sufficiently harmonized quality benchmarks for several secondary raw materials, particularly in emerging sectors such as battery materials and critical minerals. Participants noted that stronger collaboration between BIS, CPCB, Ministry of Mines, technical institutions, recyclers, and industry associations may help accelerate development of common material standards, recycled-content specifications, and recovery-efficiency benchmarks to improve market confidence and industrial adoption of secondary materials.

4. Demand Creation for Secondary Materials

Recommendation 7 - Use procurement, mandates and industrial commitments to create stable demand: Despite growing recycling capacities, recycled materials often continue to face challenges related to inconsistent quality perception, limited industrial acceptance, weak traceability systems, and lack of long-term procurement commitments due to which there is absence of stable and predictable demand for secondary raw materials.



Government support

- Developing nationally recognized quality standards, certification systems, and testing protocols through collaboration between BIS, CPCB, industry bodies, recyclers, and manufacturers may help improve market trust, facilitate industrial adoption, and create more reliable secondary materials markets.
- Establish long-term offtake agreements between recyclers and manufacturers, backed by clear quality and certification standards, to provide demand certainty, de-risk investment in recycling capacity, and create a reliable market for high-quality secondary materials.

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- Due to fragmented traceability across value chain, there is limited visibility regarding the origin, composition, environmental compliance status, and carbon footprint of secondary materials. The development of interoperable digital tracking systems, material passports, blockchain-enabled traceability tools, and standardized reporting frameworks would likely require coordinated action across multiple ministries, regulators, and industry stakeholders. Stronger integration of such systems with EPR platforms and industrial reporting mechanisms could help improve accountability, reduce leakages into informal channels, and strengthen confidence among manufacturers, investors, and global supply chain partners.
- Fiscal incentives, recycled-content mandates, green procurement frameworks, and sustainability-linked industrial incentives would likely require coordinated action led by the Ministry of Finance, MoEFCC, and other sectoral ministries to create stronger and more predictable demand for recycled and recovered materials.
- Businesses and consumers need to be educated about the benefits of the circular economy and how to implement circular practices. Many consumers in India are not aware of the environmental impact of their consumption patterns, and hence they do not demand products that are designed for circularity.

5. Design for Circularity and Product Architecture

Recommendation 8 - Mainstream design-for-circularity in product regulation and industrial practice: For circularity to move from voluntary to mandatory, policy frameworks need to be recalibrated around product lifecycles rather than just end-of-pipe waste management.



Government support

- The current EPR Framework remains concentrated largely around plastics and e-waste, while several other high-impact sectors, such as textiles, automotive components, and renewable energy equipment, continue to operate without sufficiently developed circularity obligations. The MoEFCC and CPCB should consider broadening EPR frameworks across additional sectors to help strengthen accountability for material recovery and lifecycle management.



Multi-stakeholder approach

- Developing eco-design indices, repairability scores, recycled-content labels, and lifecycle efficiency ratings may therefore require collaboration between BIS, Ministry of Consumer Affairs, Food and Public Distribution, MoEFCC, industry bodies, OEMs, and product manufacturers.
- Life Cycle Assessment (LCA) adoption remains limited across several manufacturing sectors, particularly among MSMEs. Sector-specific LCA tools and simplified assessment frameworks may therefore need to be developed by industry associations, research institutions, technical universities, NITI Aayog, and sectoral ministries in partnership with private industry.

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Industry role

- OEMs, manufacturers, industrial designers, and product developers may increasingly need to redesign products for easier disassembly, safer material handling, improved refurbishment potential, and higher recovery yields. Discussions highlighted that stronger engagement between manufacturers, recyclers, repair networks, and technology providers may be important for integrating circularity considerations during product development stages.
- To shift away from glued or sealed components, manufacturers, product designers, and industry regulators may prioritize modular assemblies, standard fasteners, and readily available spare parts to increase a product's usable lifespan.

6. Strategic Supply Security and International Collaboration

Recommendation 9 - Pair domestic circularity with external supply diversification and standards cooperation: Sustainable Development Goal (SDG) 17, i.e., 'Partnerships for the Goals', serves as a foundational enabler by strengthening implementation mechanisms and fostering global partnerships for sustainable development. In this context, the relationship between sustainability and the circular economy moves beyond theory toward a practical and implementation-driven agenda. While the circular economy offers actionable pathways for efficient resource use and recovery, SDG 17 provides the collaborative frameworks and multi-stakeholder partnerships necessary to scale these solutions effectively.



Government support

- India's current overseas critical mineral engagement ecosystem remains relatively limited when compared to several major global economies that have already secured long-term access arrangements across critical mineral supply chains. Therefore, coordinated engagement between the Ministry of Mines, Ministry of External Affairs, Ministry of Commerce and Industry, NITI Aayog, Khanij Bidesh India Ltd. (KABIL), public sector enterprises, private mining companies, refiners, and strategic industry stakeholders is needed to deepen strategic mineral diplomacy through long-term partnerships with resource-rich nations such as Australia, Chile, Argentina, South Africa, Ghana, and Tanzania.

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Conclusion

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India's critical minerals ecosystem will require an integrated approach, far greater coordination across policy, finance, technology, infrastructure, and market development. Building scalable circular supply chains will depend on strengthening reverse logistics systems, developing domestic refining and recovery capabilities, improving traceability and standards frameworks, supporting recyclers through targeted incentives, and creating stable markets for secondary materials through procurement frameworks, mandates, and industrial commitments. Circularity must therefore move beyond sustainability discourse and be treated as strategic industrial infrastructure essential for long-term resource security.

At the same time, the transition presents a significant economic opportunity. As global industries increasingly shift towards responsible sourcing, recycled content, and resilient supply chains, India has the potential to emerge not only as a major consumer market but also as a globally competitive hub for critical mineral recovery, recycling, processing, and circular manufacturing.

So, what we conclude is that India's critical mineral circular economy is not a question of if, but how fast. While the infrastructure deficit is real, the policy momentum is speeding up. Securing critical minerals at scale will not be achieved through silo moves, but through India's ability to close material loops, build domestic capabilities, and create globally credible circular supply chains for the future, all at once. We need integrated action across exploration, recycling, refining, and international partnerships, and we need it now, not in 2030.

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