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India's Circular Economy Challenge — E-Waste, End-of-Life Vehicles, and the Recycling Imperative

29 January 2026

SUBJECTS COVERED

ENVIRONMENT ECONOMY

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India's Circular Economy Challenge — E-Waste, End-of-Life Vehicles, and the Recycling Imperative

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WHY IN NEWS

NITI Aayog released three major reports on India's circular economy — covering end-of-life vehicles (ELVs), waste tyres, and e-waste/lithium-ion batteries — at the International Material Recycling Conference (IMRC) in Jaipur, flagging that India's annual e-waste economic value of ₹51,000 crore is largely unrecovered and that ELVs will double to 50 million by 2030.

WHAT IS A CIRCULAR ECONOMY?

The **circular economy** is a production-consumption model designed to eliminate waste and keep materials in use for as long as possible. It contrasts with the **linear economy** (extract → produce → use → discard):

Circular economy principles:

Design out waste: Products designed for repairability, disassembly, and recycling

Keep products and materials in use: Remanufacturing, refurbishment, reuse, recycling

Regenerate natural systems: Organic cycles that return nutrients to soils

For India, the circular economy is not just an environmental goal — it is an economic opportunity. The three NITI Aayog reports quantify this opportunity across three high-growth waste streams.

E-WASTE AND LITHIUM-ION BATTERIES — INDIA'S DIGITAL WASTE CRISIS

The Scale

India is the **world's third-largest e-waste generator** (after China and the USA). With one of the fastest-growing digital economies in the world (101.7 crore broadband users; 140+ crore mobile connections), India's e-waste challenge is accelerating.

Metric	Data
India's e-waste (2025)	6.19 MMT (million metric tonnes)
Projected e-waste (2030)	14 MMT — **2.3x increase in 5 years**
Annual economic value of e-waste	**₹51,000 crore**
Currently recovered	Only **18%** of economic value
Extractable (technically feasible)	**60%** of economic value
Recovery gap	**₹21,000+ crore/year** lost

What is in e-waste? Discarded electronics contain:

- **Precious metals:** Gold, silver, palladium, platinum
- **Base metals:** Copper, aluminium, steel
- **Critical minerals:** Cobalt, lithium, rare earth elements (in circuit boards, batteries)
- **Hazardous substances:** Lead, mercury, cadmium, hexavalent chromium, brominated flame retardants

The lithium-ion battery dimension: India's EV sector is growing rapidly (5.4 million EVs sold in FY25). Each EV battery pack requires cobalt, lithium, manganese, and graphite. By 2030:

- India will generate ~**2.5 lakh tonnes** of lithium-ion battery waste annually
- At current extraction rates, only ~10% of lithium and 15% of cobalt are recovered from spent batteries
- China controls 75% of global lithium-ion battery recycling capacity — creating a strategic supply chain vulnerability for India

India's E-Waste Governance Framework

E-Waste Management Rules, 2022:

- Updated from the 2016 Rules (originally E-Waste Rules, 2011)
- Issued under: **Environment (Protection) Act, 1986**
- Ministry: **Ministry of Environment, Forest and Climate Change (MoEFCC)**

Extended Producer Responsibility (EPR) system:

- Manufacturers and importers of electronic products must meet annual EPR targets (percentage of their sales that must be collected and recycled)
- EPR certificates traded on CPCB's EPR portal — similar to carbon credits
- Penalty for non-compliance: Up to ₹1 lakh per tonne shortfall

Key challenge: ~**80% of India's e-waste** is handled by the **informal sector** — which processes it unsafely (acid baths to recover metals; burning to extract copper) causing severe health hazards

Urban Mining: India's e-waste contains approximately:

2 kg of gold per tonne of mobile phone circuit boards (vs 5 grams of gold per tonne of gold ore)

Urban mining is 5–50x more resource-efficient than primary mining

END-OF-LIFE VEHICLES — THE COMING WAVE

The Scale

India is the world's **3rd largest auto market** — generating a correspondingly large vehicle scrappage challenge:

Metric	Data
ELVs in India (2025)	**23 million**
Projected ELVs (2030)	**50 million** — more than double
BS-I vehicles emissions vs BS-VI	BS-I emits **8x more** pollutants
Steel in scrapable vehicles	3+ million tonnes recoverable annually
Economic value of ELV scrap	Estimated ₹60,000+ crore by 2030

Vehicle Scrappage Policy (2021)

The **Vehicle Scrappage Policy** (2021) is India's framework for retiring old vehicles:

Key provisions:

Private vehicles over **20 years** old: Mandatory scrapping (from January 2024)

Commercial vehicles over **15 years** old: Mandatory scrapping (from April 2023)

Vehicles must pass automated fitness tests at **Registered Vehicle Scrapping Facilities (RVSFs)**

Scrapping certificate provides benefits: 5% rebate on road tax, 25% rebate on motor vehicle tax for scrapping commercial vehicles (state discretion)

About RVSFs: Government-approved vehicle scrapping facilities; 61 operational as of early 2026; target of 300+ RVSFs by 2027; private sector-driven (Mahindra, MSTC, Maruti, etc. have established facilities)

Environmental argument:

A BS-VI vehicle emits particulate matter at the level of 50–100 BS-III vehicles

Removing BS-I and BS-II vehicles from roads is estimated to reduce urban particulate pollution by 8–12%

WASTE TYRES — THE HIDDEN CHALLENGE

The Scale

Metric	Data
India's global rank — tyre production	**3rd** (after China and USA)
Waste tyre generation annually	**1.5–2 million tonnes**
End-of-life tyre utilisation	~65% (35% still landfilled or burned)

Current uses of waste tyres:

Cement kilns (co-processing): Tyres used as fuel substitute in cement kilns; reduces coal consumption

Tyre-derived fuel (TDF): Energy recovery at industrial plants

Crumb rubber: Ground rubber used in road construction, sports surfaces, playground flooring

Retreading: Approximately 20 million tyres retreaded annually in India (extending usable life by 50%)

The burning problem: ~20–25% of waste tyres are still illegally burned — releasing toxic gases (dioxins, furans, benzene, particulates) that cause severe respiratory harm. This is the main public health concern in the waste tyre sector.

Policy gap: India does not yet have a dedicated Extended Producer Responsibility (EPR) framework specifically for waste tyres — unlike e-waste (E-Waste Management Rules 2022) and plastic waste (Plastic Waste Management Rules 2021). NITI Aayog's 2026 report recommends creating a tyre EPR framework.

THE RESOURCE SECURITY DIMENSION

The circular economy is not just about waste management — it is about **strategic resource security**:

Material	India's import dependence	Circular economy potential
Cobalt	>90% imported	E-waste recovery
Lithium	~100% imported	Battery recycling
Copper	~40% imported	E-waste, ELV recovery
Rare earths	60%+ from China	E-waste magnets, batteries
Steel	Domestic (but scrap = premium input)	ELV, appliances

National Critical Minerals Mission (2025): Identifies 30 critical minerals; one of its pillars is domestic recovery through recycling — circular economy as a supply chain resilience strategy.

THE INFORMAL SECTOR — LARGEST RECYCLER, BIGGEST PROBLEM

India's informal recycling sector employs an estimated **1.5–2 million** workers (ragpickers, kabadiwala network, informal processors). They collect and process ~70–80% of India's recyclable waste — including e-waste — using methods that are:

Economically efficient (low overhead, no capital investment)

Environmentally hazardous (acid stripping for PCBs, open burning of cables)

Labour unsafe (no PPE; heavy metal exposure; carcinogenic fumes)

Formalisation as a policy goal:

Registration of informal workers in the e-waste chain through EPR portals

Integration with formal recycling through "collection aggregators" who buy from informal sector and sell to registered recyclers

Training and skilling through ITIs and NGOs

UPSC RELEVANCE

NITI Aayog circular economy reports (IMRC, Jaipur, Jan 29, 2026); e-waste India: 6.19 MMT → 14 MMT by 2030; ₹51,000 crore economic value; only 18% recovered; ELVs: 23 mn → 50 mn by 2030; BS-I emits 8x more than BS-VI; waste tyres: 1.5-2 mn tonnes/year; India = 3rd largest tyre producer; E-Waste Management Rules 2022 (under Environment Protection Act 1986); EPR (Extended Producer Responsibility) framework; Vehicle Scrappage Policy 2021 (20 yr private; 15 yr commercial); RVSFs (Registered Vehicle Scrapping Facilities); National Critical Mineral Mission 2025.

Circular economy principles and India's challenge; e-waste management governance (EPR, informal sector, urban mining); ELV scrappage policy — environmental and resource benefits; critical mineral security through recycling; informal recycling sector — integration vs formalisation dilemma; Lithium-ion battery waste and India's EV transition challenges.

📌 FACTS CORNER — KNOWLEDGEPEDIA

E-WASTE — KEY NUMBERS:

India's e-waste: **6.19 MMT** (2025); projected **14 MMT** by 2030

India's global rank: **3rd largest** e-waste generator (after China, USA)

Economic value: **₹51,000 crore/year**; only **18%** recovered; **60%** technically extractable

E-waste is 5–50x more resource-efficient to mine than primary ore

E-WASTE GOVERNANCE:

E-Waste Management Rules, 2022 — under **Environment Protection Act, 1986**

Ministry: **MoEFCC** (Ministry of Environment, Forest and Climate Change)

Framework: **EPR** (Extended Producer Responsibility) — manufacturer + importer meet annual collection targets

Informal sector handles: ~**80%** of India's e-waste

END-OF-LIFE VEHICLES:

ELVs (2025): **23 million**; projected (2030): **50 million**

Vehicle Scrappage Policy 2021: Private vehicles **>20 years**; Commercial **>15 years**

BS-I vs BS-VI: BS-I emits **8x** more pollutants

RVSFs: Registered Vehicle Scrapping Facilities; 61 operational (early 2026)

WASTE TYRES:

Annual generation: **1.5–2 mn tonnes**

India's rank: **3rd globally** (tyre producer and consumer)

Uses: Cement kiln co-processing; crumb rubber (roads); retreading; TDF

Gap: No dedicated EPR framework for tyres yet (recommended by NITI Aayog 2026 report)

LITHIUM-ION BATTERY WASTE:

Key minerals: Cobalt (India 90%+ imported), Lithium (100% imported), REEs

India EV battery waste by 2030: ~**2.5 lakh tonnes/year**

China controls: **75%** of global Li-ion battery recycling capacity

NATIONAL CRITICAL MINERAL MISSION (2025):

Identifies **30 critical minerals**

Pillar: Domestic recovery through recycling (circular economy as supply security)

OTHER RELEVANT FACTS:

Kabadiwala network: India's informal rag-pickers / scrap collectors — backbone of recycling economy; 1.5-2 mn workers

Urban mining gold content: 2 kg/tonne in mobile PCBs vs 5 grams/tonne in gold ore

IMRC: International Material Recycling Conference — organised by NITI Aayog

Crumb rubber in roads: India's road construction using crumb rubber under guidelines of MoRTH (Ministry of Road Transport and Highways)

Co-processing in cement: Approved under the Cement Manufacturers Association; reduces coal use

Sources: NITI Aayog, MoEFCC, InsightsIAS, Drishti IAS

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