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EDITORIAL ANALYSIS

The Waste We Are Creating — India's Circular Economy Challenge in the Age of EVs

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The Waste We Are Creating — India's Circular Economy Challenge in the Age of EVs

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INTERVIEW ANGLE

"India aims to be a global EV leader by 2030, but its waste management infrastructure is unprepared for the battery and vehicle end-of-life surge. What policy changes are needed to bridge this gap?"

WHY IN NEWS

NITI Aayog released three reports at the International Material Recycling Conference in Jaipur projecting India's End-of-Life Vehicle waste to nearly double and e-waste to more than double by 2030 — a reckoning that exposes the contradiction between India's EV ambitions and its waste management reality.

THE ARITHMETIC OF AMBITION

India has set itself an ambitious target: **30% electric vehicle sales share by 2030** under the EV30@30 initiative. The government has backed this with the **FAME-II scheme** (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles), **PLI schemes** for auto components and Advanced Chemistry Cell (ACC) batteries, and the **PM e-DRIVE** programme. EV sales have grown from roughly 50,000 units in 2016 to **2.08 million units in 2024**.

But ambition in one direction has consequences in another. Every vehicle eventually becomes waste. Every battery degrades. The arithmetic of a 30% EV fleet means tens of millions of lithium-ion battery packs entering the waste stream by 2035 — packs that contain lithium, cobalt, nickel, and manganese that India currently imports at significant cost, and which, if mismanaged, can cause soil contamination, groundwater poisoning, and thermal runaway fires.

The NITI Aayog projections are stark: **End-of-Life Vehicles will grow from 23 million (2025) to 50 million (2030)**, and **e-waste from 6.19 million metric tonnes to 14 MMT by 2030**. These are not worst-case scenarios — they are baseline projections assuming current trends continue.

THE INFORMAL SECTOR'S PARADOX

India's waste management for vehicles and electronics is paradoxically efficient and catastrophically harmful simultaneously.

The efficiency: India's informal recycling sector — the kabadiwalas, the itinerant scrap dealers, the roadside dismantling workshops — recovers metals from waste with remarkable economic efficiency. An estimated 85–90% of End-of-Life Vehicles are dismantled informally, recovering steel, aluminium, and copper that feed secondary metal markets. India's informal e-waste recyclers are estimated to handle 75–80% of the waste stream.

The harm: Recovery happens through methods — open burning to strip insulation from copper wires, acid leaching of circuit boards to recover gold and silver, uncontrolled dismantling that releases hazardous fluids (coolant, brake fluid, refrigerants) — that contaminate soil, groundwater, and ambient air. Workers in these workshops suffer occupational health consequences that go untracked and uncompensated.

The critical minerals dimension adds another layer: lithium-ion battery recycling requires **hydrometallurgical processing** — controlled acid dissolution to recover lithium, cobalt, and nickel from "black mass" (the shredded electrode material). This cannot be done informally; it requires capital-intensive industrial infrastructure. If India's battery waste enters the informal stream, the valuable minerals are lost and the hazardous materials are released.

EPR: THE RIGHT MECHANISM, POORLY IMPLEMENTED

Extended Producer Responsibility (EPR) is the correct policy instrument for this challenge. The principle is straightforward: the entity that places a product in the market is financially responsible for its end-of-life management. This internalises environmental costs into product prices, incentivises design-for-recycling, and funds collection and processing infrastructure.

India has enacted EPR for:

- **E-Waste Management Rules (2016, amended 2022)** — electronics manufacturers
- **Battery Waste Management Rules (2022)** — battery manufacturers including EV battery makers
- **Plastic Waste Management Rules (amended)** — includes EPR for tyre manufacturers

The framework exists. The implementation gap is substantial:

Collection targets vs. reality: EPR rules set collection targets that rise progressively. Actual collection by formal recyclers consistently falls short. The gap is filled by informal sector collection that meets the material but not the environmental standard.

EPR certificate trading: The rules allow producers to purchase EPR certificates from registered recyclers rather than directly manage their own collection and recycling. This creates a paper compliance system — certificate purchases satisfy regulatory requirements without necessarily improving actual recycling quality or coverage.

Recycler registration backlog: The Central Pollution Control Board (CPCB) is the nodal authority for EPR compliance. Recycler registration, compliance verification, and enforcement are resource-constrained. Registered recyclers' capacity is a fraction of total waste generation.

THE VEHICLE SCRAPPAGE GAP

The **Vehicle Scrappage Policy (2021)** created a formal infrastructure for End-of-Life Vehicle dismantling:

Automated Testing Stations (ATS) for fitness certification

Registered Vehicle Scrapping Facilities (RVSFs) for formal dismantling

Over 1,500 RVSFs have been authorised. But the policy faces two structural problems:

The economics of informal vs. formal: Informal dismantlers offer higher prices for scrapped vehicles because they have lower compliance costs. A vehicle owner who scraps informally receives more money today than through the formal RVSF channel. The policy's incentives — reduced road tax, manufacturer discounts — partially bridge this gap but are insufficient for older private vehicles where the owner's primary interest is cash recovery.

Missing EPR for vehicles: Unlike electronics and batteries, vehicle manufacturers are not yet subject to binding EPR obligations under the Scrappage Policy. The NITI Aayog report recommends extending EPR to vehicle OEMs — making manufacturers financially responsible for collecting and scrapping their vehicles at end-of-life. This would transform the economics: manufacturers would have an incentive to invest in RVSF infrastructure (as BMW, Volkswagen, and Toyota have done in Europe) rather than leaving it to piecemeal government authorisation.

CRITICAL MINERALS: THE MISSED OPPORTUNITY

Buried in the waste management problem is a critical minerals opportunity. India currently imports approximately **48 critical minerals** that are essential for its clean energy transition. Lithium, cobalt, and nickel — all recoverable from EV battery packs — are among them.

The recoverable value of critical minerals from India's projected 2030 battery waste stream runs to **billions of dollars at current prices**. If this material enters the informal sector and is partially recovered or lost, India will continue importing the same minerals to make new batteries. If captured in a formal circular economy — battery packs collected, shredded into black mass, hydrometallurgically processed to recover cathode precursors — India builds domestic supply security.

Battery second-life adds another dimension: EV battery packs that are degraded below the 80% state-of-health threshold for automotive use can typically still serve 5–10 years in **stationary energy storage** — grid balancing, commercial rooftop solar storage, off-grid electrification. This "second life" defers the recycling requirement while recovering economic value. India's burgeoning renewable energy storage market could absorb significant second-life battery capacity if standards and safety frameworks exist — currently they do not.

WHAT INDIA MUST DO DIFFERENTLY

Three policy changes would meaningfully accelerate India's circular economy transition:

1. Extend and strengthen EPR for vehicles: Make vehicle OEMs financially responsible for end-of-life management, as in the EU's End-of-Life Vehicles Directive. Set binding collection targets with genuine enforcement consequences. This shifts the economics without requiring permanent government subsidy.

2. Create a battery passport system: Mandate that every EV battery sold in India carries a digital record of its chemistry, capacity, origin, and recycled content. This enables second-life markets (buyers know what they're getting) and recyclers (knowing chemistry improves recovery efficiency). The EU is implementing this from 2027 — India should establish an equivalent standard before its EV fleet grows to the scale where standardisation becomes difficult.

3. Formalise and upgrade the informal sector: The informal sector's collection reach is an asset. Rather than trying to eliminate it — which is neither feasible nor desirable — policy should create **aggregation centres** where informal collectors can deliver material to formal recyclers, with payments for clean delivery. This decouples collection (informal strength) from processing (formal requirement).

UPSC RELEVANCE

EPR (Extended Producer Responsibility; mandated for electronics + batteries + tyres); ELVs (23 million 2025 → 50 million 2030); e-waste (6.19 MMT 2024 → 14 MMT 2030); Li-ion battery demand (29 GWh 2025 → 248 GWh 2035); Vehicle Scrappage Policy 2021 (ATS + RVSFs); E-Waste Management Rules 2022; Battery Waste Management Rules 2022; GACERE (UNEP + European Commission; India member); PLI-ACC (50 GWh target); FAME-II scheme; EV30@30 initiative; hydrometallurgy; black mass; second-life batteries.

Circular economy framework; EPR as policy instrument; informal vs formal recycling sector; Vehicle Scrappage Policy gaps; critical minerals strategy; EV battery lifecycle management; second-life battery opportunity; India's obligations under Basel Convention; EPR certificate trading loophole.

📌 FACTS CORNER — KNOWLEDGEPEDIA

NITI AAYOG CIRCULAR ECONOMY REPORTS (FEB 2026):

Released at: International Material Recycling Conference (IMRC), Jaipur

Three reports: ELVs | Waste Tyres | E-waste & Li-ion Batteries

ELV PROJECTIONS:

2025: **23 million** ELVs → 2030: **50 million** ELVs

Informal sector handles: **85–90%** of ELV dismantling

Vehicle Scrappage Policy: **2021**; creates ATS + RVSF framework

Commercial vehicle age limit: **15 years**; Private vehicle: **20 years**

RVSFs authorised (Feb 2026): **1,500+**

E-WASTE PROJECTIONS:

India e-waste 2024: **6.19 MMT** → 2030: **14 MMT**

Per capita (India): ~**2 kg/year** (OECD average: ~20 kg/year)

Formal recycling capacity: ~**20–25%** of generation

LI-ION BATTERY DEMAND:

2025: **29 GWh** → 2035: **248 GWh** (nearly 9x increase)

PLI-ACC target: **50 GWh** domestic production capacity

Second-life threshold: Below **80% state-of-health** → eligible for stationary storage

INDIA EV STATISTICS:

EV sales 2016: ~50,000 → 2024: **2.08 million** units

Target: **30% EV sales share by 2030** (EV30@30 initiative)

FAME-II outlay: Rs 10,000 crore (2019–2024)

KEY POLICY INSTRUMENTS:

E-Waste Management Rules: **2016** (first comprehensive); amended **2022** (EPR expanded)

Battery Waste Management Rules: **2022** (separate rules for batteries)

EPR (Extended Producer Responsibility): Producer financially liable for end-of-life management

EPR certificate trading: Legal compliance mechanism; allows buying certificates from recyclers

GACERE: Global Alliance on Circular Economy and Resource Efficiency (UNEP + EU Commission)

Basel Convention: International treaty on hazardous waste transboundary movement; India signatory

CRITICAL MINERALS CONTEXT:

India imports ~**48 critical minerals**

Hydrometallurgy: Controlled acid dissolution to recover Li/Co/Ni from battery "black mass"

KABIL (Khanij Bidesh India Ltd): Joint venture for overseas critical mineral acquisition

MMDR Amendment 2023: Added critical minerals to Schedule; government retains auction rights

OTHER RELEVANT FACTS:

EU ELV Directive: OEMs responsible for end-of-life vehicle management (EPR model)

EU Battery Regulation 2023: Battery passport from 2027; minimum recycled content standards

Circular Economy 6Rs: **Reduce, Reuse, Recycle, Refurbish, Recover, Repair**

> Waste tyre generation India: ~**1.6 million tonnes/year**
>
> Daily MSW India: ~**1.68 lakh tonnes**; only **55–60%** processed
>
> India: 3rd largest e-waste generator globally (after China and USA)

Sources: Indian Express, NITI Aayog

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