



Policy brief

Is there a future for reusing Electric Vehicle batteries in India?

Summary

- **Countries face rising battery waste** as the global Electric Vehicle (EV) market expands and vehicles reach end-of-life. EV batteries typically retain ~80% of their original capacity at this stage, creating strong potential for second-life use.
- **India has an opportunity for EV battery reuse** to support energy storage, reduce fossil fuel dependence, and mitigate environmental harm from unmanaged battery waste, while recycling capacity scales up.
- **Policies addressing 4 key institutional factors can help unlock reuse potential.**
 - **A framework for high-quality, consistent data collection** on battery design, usage, and health, through standardised collection parameters and recording requirements, supported by enabling policy and institutional frameworks where needed (e.g. a battery passport).
 - **A certification programme to catalyse reverse supply chains for second-life EV batteries**, enabling collection, transportation and storage, diagnostics and testing, disassembly and refurbishing, and redeployment.
 - **A trade strategy in batteries and battery materials** aligned with international conventions on transboundary movement of toxic substances and the national Extended Producer Responsibility (EPR) rules, to enable circular economies beyond national borders.
 - **A framework to identify the value of deploying second-life batteries in local systems** (including their relative affordability versus alternative options), strengthening the 'social license' to redeploy EV batteries in communities.

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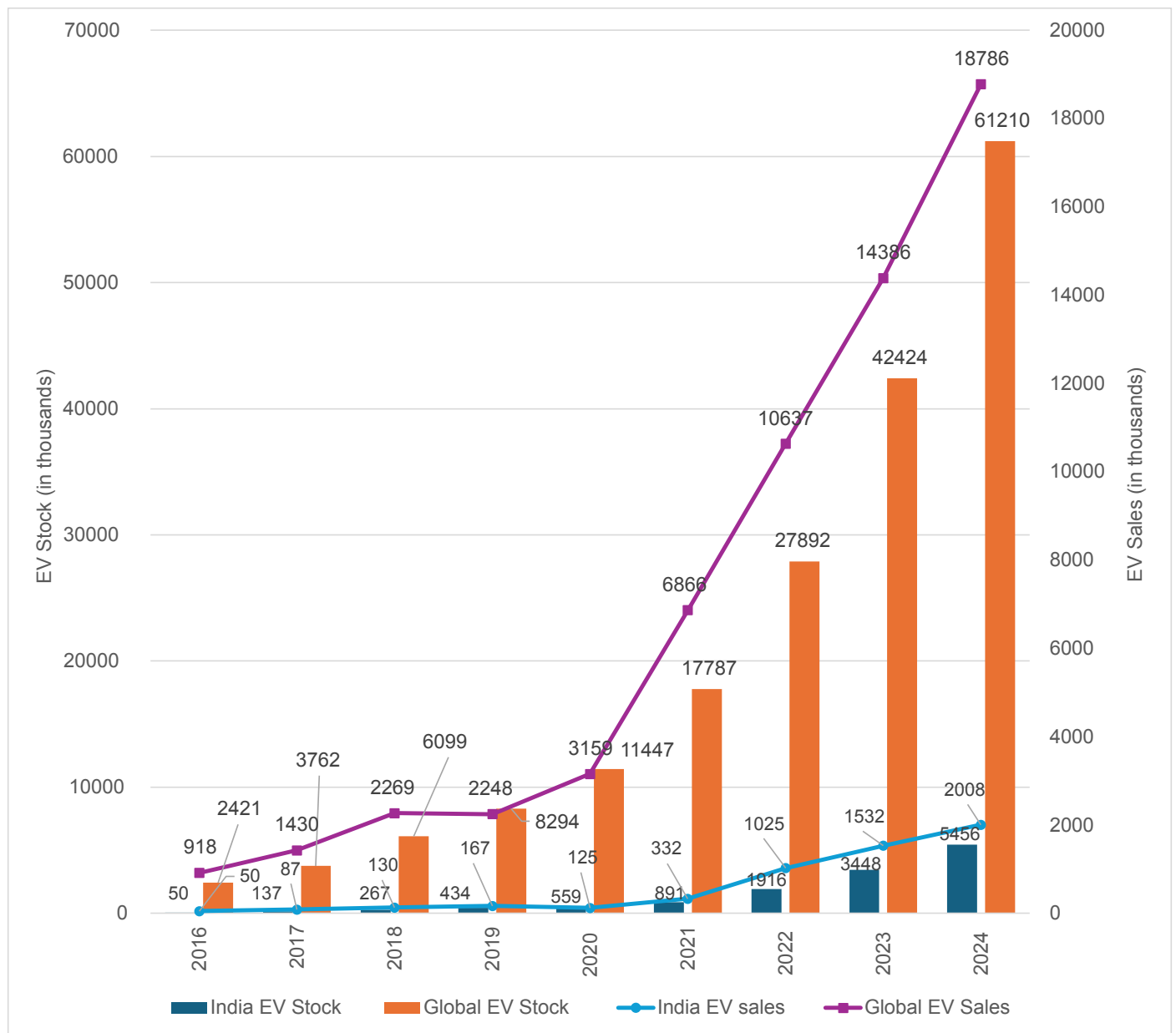
EV adoption is accelerating in India, driving the demand for batteries

The scope and scale of second-life batteries is relevant for Global South countries such as India, which are poised for large battery use growth. Four-wheeler EV penetration in India is estimated at 2% (for instance, compared with 38% in China), which is low relative to global EV stock and sales (Figure 1).¹² However, India's EV market shows signs of accelerating; its EV stock grew from 50,000 in 2016 to 5.45 million

by 2024, while EV sales grew by around 25% year-on-year between 2023-24 alone, accounting for 7.7% of all new vehicles sold.³

In India, the EV market is currently dominated by electric two and three wheelers (E2W, E3W), which together accounted for 1.9 million units sold in 2024.⁴ India aims to raise the share of EVs in total vehicle sales to 30% by 2030⁵ using policy support to incentivise EV adoption, as well as domestic manufacturing (see Appendix 1). Electric four wheelers (E4W) and E-buses (with sales of 158,080 and 3,740 units in 2024, respectively) form a newer, but promising future growth segment given these targets.⁶

Figure 1. Growth in EV sales and stock (Global and India)



Source: Niti Aayog (2025, p.5)⁷ - uses IEA Global EV Data Explorer for global data; VAHAN Portal for India data

A report co-authored by Indian government think tank NITI Aayog shows that in 2021, the total global estimated annual demand for lead acid batteries and lithium ion (Li-ion) batteries was about 456 GWh and 476 GWh,⁸ respectively, across multiple segments: transportation (for e.g., e-mobility, and starting, lighting and ignition), consumer electronics (for e.g., laptops and mobiles), and stationary applications (for e.g., grid-level and behind-the-meter applications). Of this, transportation applications accounted for the majority (87% and 74%, respectively) of annual demand.⁹

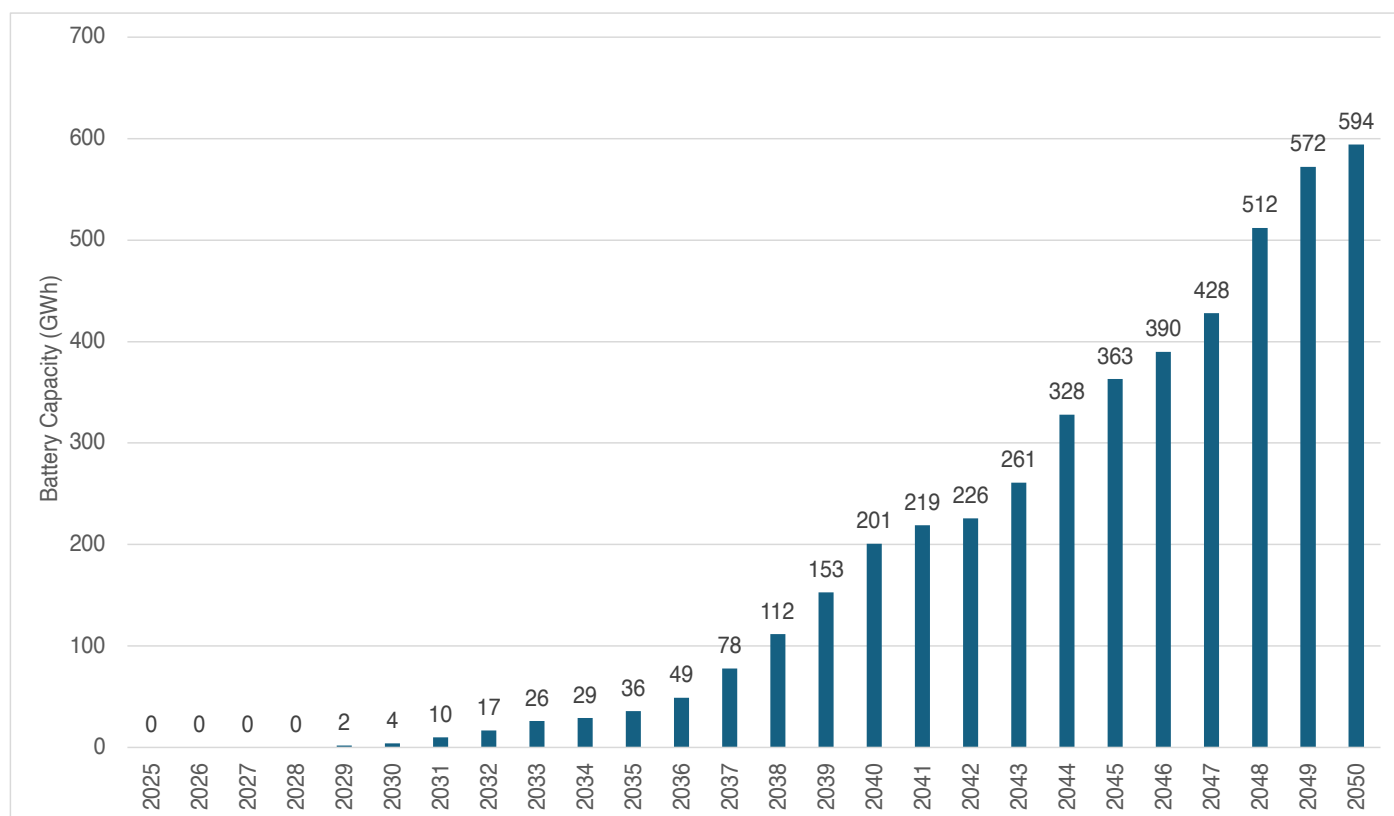
High energy densities, fast charging capacities, and long lifespans make Li-ion batteries particularly popular for use in EVs. Although lead acid batteries historically dominated the Indian market, growing battery innovation and declining costs suggest that Li-ion batteries are expected to be the dominant choice within energy storage applications, including within transportation, such as in on-board storage for EVs¹⁰. A report by RMI India estimates that India's annual EV-driven battery demand will rise from 25 GWh in 2025 to 1,080 GWh by 2050.¹¹

A clear opportunity exists for battery reuse

At the time they become non-viable for use in EVs (at EV end-of-life), estimates suggest that batteries can retain around 80% of their initial capacity,¹² creating a gap between their first life use in EVs, and the stage where batteries enter rapid degradation and need recycling. Consequently, these batteries hold considerable reuse potential for second-life applications in other sectors such as stationary storage.^{13,14} While Li-ion waste battery recycling has risen up policy agendas, the sector is still at an early stage of development, estimated at around 5% globally^{15,16} and will require significant investment to become viable and efficient at scale. Battery reuse can thus delay the demand for recycling, allowing that sector to scale while simultaneously reducing reliance on imported batteries and overall resource requirements.

Batteries might be available for reuse in significant volumes by the 2030s in India, as the first wave of EVs begins to retire. An RMI study estimates that 80% of collected batteries are projected to be re-usable, while the remaining 20% may be unsuitable due to degradation and damage.¹⁷ With a rise in EV volumes and assumed improvements in collection rates, the volumes of batteries available for reuse annually are expected to grow from 4GWh in 2030 to 600 GWh by 2050 (Figure 2).¹⁸

Figure 2. Estimated re-usable battery as year-on-year inflows from 2025-2050



Source: RMI (2025, p.29)⁹

Battery sizes, lifespans, and reuse potentials differ by vehicle type. While E2W and E3W form the bulk of EV sales in India, they have smaller sizes and go through more charging and discharging cycles, and therefore have a lower second-life potential. In comparison, E4W and buses have relatively longer lifespans and larger battery sizes, with greater potential for reuse. Additionally, the operation of fleets (e.g., buses) by municipalities lends them to defined use and maintenance schedules. The changing nature of EV sales, particularly growth in currently smaller segments such as E4W and E-buses (along with other large vehicles such as ambulances and trucks) is likely to increase volumes of batteries for reuse. In addition, collection rates are also expected to improve over time, adding to re-usable volumes.²⁰

India aims to double its 'non-fossil fuel' electric capacity from over 240 GW in 2025 to 500 GW by 2030, and to reach net zero emissions by 2070.²¹ This second-life opportunity can therefore help India's energy transition – both due to its renewable targets and the structure of its existing market for battery waste. It has been estimated that around 411 GWh of storage will be needed to balance intermittent renewables by 2030, of which half is expected to be from batteries.²²

Simultaneously, India has also witnessed a transition in its EV battery market per se, with a rise in lithium iron phosphate batteries, which have a longer life than previously used battery chemistries and utilise less high-value materials, making them economically less attractive for recycling. These batteries are particularly suited for second-life applications and can contribute to a growing need for battery storage to support the renewable energy transition.²³ These factors collectively point to a clear opportunity for battery reuse.

Second-life batteries require policies that develop markets and help to scale reuse applications

The future for second-life batteries will rely on the techno-economics of reusing and repurposing batteries at scale. It will also be determined by context-specific institutional factors, such as the infrastructure for redeployment, and the socio-economic viability of use cases.

With over 70% of global EV battery production capacity, including Li-ion cells, in China,^{24,25} the 'life of a battery' often begins with imported Li-ion cells that are used by domestic firms to manufacture battery packs. While India has developed policies for supporting domestic cell manufacturing, this has not as yet achieved scale. Despite policy efforts, raw material sourcing for cell manufacturing is likely to remain import-dependent, with limited domestic resources. End-of-life EV batteries can thus reduce import dependencies

through reuse and eventually recycling. However, the formal recycling industry is as yet nascent, requiring substantial investment.²⁶ The relative nascency of domestic cell manufacturing further inhibits the use of recycled materials in new battery creation and limits economic returns on recycling.²⁷

Figure 3 below sets out the battery supply chain for the Indian context. After battery packs are manufactured by domestic firms, they are then sold on to EV producers, through to auto dealers and retailers, and to the end-consumer. At EV end-of-life, there have historically been three possible routes for a battery: dump, storage (for future recycling), or, third-party collection (for example, by battery waste aggregators or automobile workshops).²⁸ Third parties dismantle and sell battery parts to dealers for used parts and scrap. Notably, the majority of battery waste collection in most developing countries is carried out in the informal sector (for example, ~70% in India), within an ecosystem which evolved based on older, cheaper, lead acid batteries that underpinned the first generation of E2W and E3W and are now giving way to Li-ion batteries.²⁹

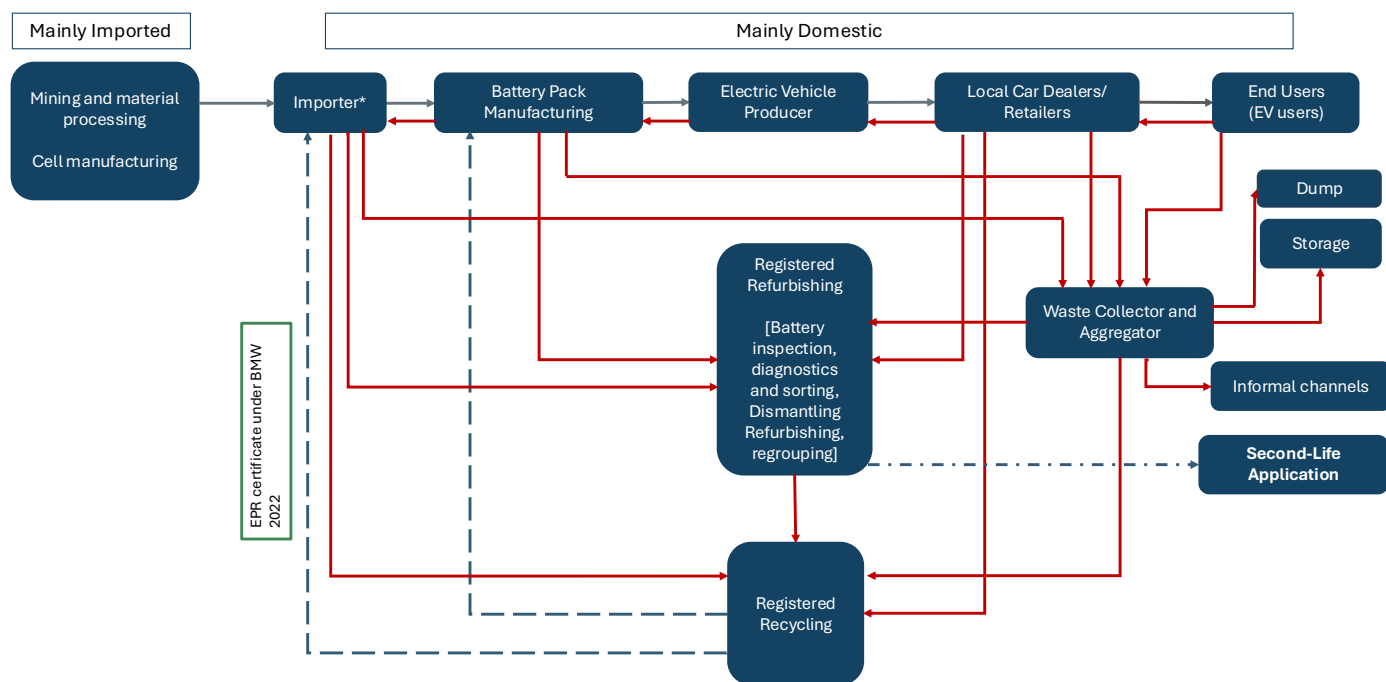
While informal battery waste management can be cheaper and establish effective collection channels, it can also compromise effective data collection and traceability of battery chains, be time-consuming, and risk damaging cells and engaging in practices hazardous to worker health and the environment. Existing informal battery management chains limit the viability of second-life applications.³⁰

Policy mechanisms for repurposing and redeployment of batteries are key to the scalability of the second-life of batteries. India adopted Battery Waste Management Rules in 2022 (BWMR, 2022) in order to regulate and address the potential environmental costs of battery waste. These lay out a framework for collection as well as targets for refurbishment and recycling of batteries, along with allocating responsibility for this to specific actors.

The BWMR is embedded in the Extended Producer Responsibility (EPR) model. In such a setup, 'producers' include entities that manufacture and sell batteries, sell batteries produced by another manufacturer under their own brand, or, are importers and entities manufacturing and selling refurbished batteries. Under EPR, producers are responsible for the management of the entire battery waste chain. However, EPR models are not specifically designed for second-life. In most cases, policies currently fail to clearly distinguish between reuse and recycling, and thus to appropriately design incentives. Therefore, the policy does not incentivise an efficient allocation of batteries to the end-of-life pathway through which their value can be maximised.³¹

EV battery reuse also requires coordinated effort, including for procurement, across multiple entities (battery manufacturers, Original Equipment Manufacturers (OEMs), EV owners, waste collectors, registered refurbishers, consumers) and multiple government agencies and ministries (transport, industry, environment, energy), requiring institutionally complex coordinated action.³²

Figure 3. Battery Supply Chain in India



Source: Based on Ministry of Environment, Forests and Climate Change, 2022; RMI, 2025; Niti Aayog, 2022³³

*Note: Under BMWR importers of batteries or equipment containing batteries are included in EPR responsibility. Grey arrows indicate first life; red arrows indicate the chain after disposal; blue arrows indicate second-life/ post recycling or refurbishing.

Institutional factors can help unlock the potential for second-life batteries

There are four key institutional factors i.e., regulatory bodies, market actors, and ecosystem enablers,³⁴ which if addressed, could help unlock the potential for the redeployment of EV batteries in second-life applications.

First, reuse is currently impeded by the lack of high-quality, consistent data on battery design, usage, and health. This is particularly impacted by the reliance on imported cells with limited information available on aspects such as origin, chemistries, performance, and expected timeline of degradation. Further, there are significant impediments to data sharing once batteries are in use, for instance, a lack of policy incentives for individual EV users to participate in data collection, and hesitancy on behalf of OEMs to share collected data, potentially due to competitiveness concerns. Additionally, there is also a lack of standardisation around data collection parameters and the frequency of recording. Batteries usually arrive as ‘black boxes’ into reuse facilities, necessitating assessment and testing to determine the state of health. The current EV battery

eco-system lacks incentives for open-data sharing and creates information asymmetries that make reuse and repurposing both technically difficult and economically costly. In recent years, however, India has seen a growing battery waste ecosystem with a limited number of reuse cases (see Appendix 1), based on direct partnerships between OEMs and waste EV battery aggregators. Key policies such as ‘battery passports’ can further address such gaps in data sharing, enabling potential second-life applications.³⁵

Second, adequate institutional support must be built for the development of ‘reverse supply chains.’ Ensuring EV batteries reach waste reusing and recycling companies involves effective EV battery collection, safe transportation and storage, diagnostics and testing, and disassembly and refurbishing if required. From here, batteries must then reach end consumers for second-life applications. As noted above, in India as in many developing countries the battery waste ecosystem has historically been dominated by the informal sector, which while contributing to collection, raises challenges such as hazardous practices and damage to batteries that limit second-life potential. While the BMWR 2022 is an encouraging step, India has limited formal infrastructure for the collection, testing, and reuse of batteries. On the other end of the chain, batteries are rarely designed with second-life applications and recycling in mind, making for a difficult and costly disassembly and refurbishing process. Moreover, there is a lack of standardisation around testing protocols and recognisable and universally applicable technical standards for reuse, including universal certification programmes. This raises uncertainties around the safety and performance of second-life batteries, further limiting potential for second-life applications. Investment in infrastructure for reverse logistics,

circular design, standardised technical standards, and certification programmes are thus key for the viability of second-life applications.³⁶

Third, policymakers can consider creating circular economies which go beyond national borders and optimise for existing and future trade flows.

Many Global South countries import raw materials, battery cells, and even second-hand batteries (for instance, through the sale of second-hand cars). Conversely, waste batteries, intermediate recycled materials such as black mass, and recycled materials are also exported. This is particularly likely where there is a lack of refining capacity, lack of advanced refurbishing and recycling capacities, and limited to no upstream opportunities to utilise waste batteries or materials from them. Such trade in batteries may provide some benefits: imports can, for example, boost the development of refurbishing and recycling infrastructure in countries with low volumes of existing waste batteries, such as India. On the other hand, exports may prove cheaper and effective in dealing with growing volumes of battery waste. However, such trade can encourage prioritising economic efficiency over mitigating environmental impacts, potentially delaying the buildout of waste management infrastructure. A shift towards EPR can reduce the need for exports and encourage imports by incentivising the development of domestic waste management capacity. However, there are regulatory challenges, both international (e.g. conventions regulating the transboundary movement of toxic substances) and national (e.g. the framing of EPR rules), with often unclear responsibilities towards tracing waste battery management beyond national borders.³⁷ Policies to develop reverse supply chains for battery waste should in general consider cross-border flows, with trade presenting several potential benefits but also challenges for enabling battery reuse.³⁸

Fourth, the 'social license' to redeploy EV batteries in communities is driven by its value to the local system and its relative affordability compared to alternative options. The cost of new Li-ion batteries has been on a continuous downward trend.³⁹ In contrast, second-life involves significant costs in collection, transportation, testing, and dismantling to repackage batteries, as discussed.⁴⁰ Uncertainty around used batteries is heightened by challenges such as lack of essential enabling conditions such as data transparency, infrastructure for reverse logistics, circular design which makes disassembly easier and less time consuming, and certification programmes that raise trust in used batteries. Consumers are sensitive to the price differential between new and second-life batteries, and to the safety concerns that second-life batteries pose, both of which will need robust market and institutional support to enable scale.⁴¹ Additionally, second-life applications will also require enabling conditions in recipient areas. For instance, re-purposing in grid-level energy storage requires the existence of an electricity market with a price signal that encourages arbitrage, or the opportunity for off-grid second-life applications which result in material improvements for end-user communities⁴². As such, the viability of second-life applications requires significant institutional support to create the necessary enabling conditions that promote cost competitiveness and trust in second-life batteries.

Appendix 1

Table 1. Major EV brands by vehicle type

Vehicle Type	Brand
E2W	Ola Electric
	TVS Motor
	Bajaj Auto
E3W	Mahindra Last Mile Mobility
	Bajaj Auto
	YC Electric
E4W	Tata Motors
	MG Motor
	Mahindra
E-Bus	Tata Motors
	Olectra Green Tech
	PMI Electro

Source: JMK (2025)⁴³

Note: Based on top three sales figures for the year.

Table 2. Key players and roles in Indian battery market

Role in Batteries Market	Brand
Cell Production (domestic manufacturers under PLI scheme)	Reliance
	Ola Electric
	Rajesh Exports
Cell Production (global suppliers)	Gotion
	Panasonic
	Octillion
Pack Assembly (OEMs)	Tata Motors
	Ola Electric
	Hyundai
Other Pack Manufacturers	Exide
	Amara Raja
	Battrix
Battery Waste Companies	Attero
	Lohum
	Batx

Source: Assocham (2024)⁴⁴

Note: Key players and roles taken from Assocham (2024) which does not specify methodology. 'Battery Waste Companies' are those which typically claim to engage in both refurbishing (and repurposing) and recycling.

Table 3. Key Schemes for EV promotion in India

Scheme	Years Active	Nodal Agency	Subcomponents	Type	Source
Faster Adoption and Manufacturing of Electric Vehicles (FAME)	2015–2019 (Phase 1)	Ministry of Heavy Industries	Demand incentives for E-2Ws, E-3Ws, E-4Ws and E-buses	Capex subsidy on purchase on EV (based on battery sized and capped at set percentage of total cost of vehicle)	Niti Aayog, n.d. PIB, 2023 Assocham (2023)
	2019–2024 (Phase 2)		Creation of charging infrastructure	By ministry of heavy industry and ministry of petroleum and natural gas (through three oil marketing companies)	
			Phased Manufacturing Programme	Targets for localisation of EV supply chain along with graded duty structure for imported EV parts and lowered duty for domestically produced parts	
PM E-Drive	2024–ongoing	Ministry of Heavy Industries	Demand incentives for E2Ws, E-3Ws, E-buses, E-trucks, E-ambulances	Subsidy on purchase on EV (based on battery size and capped at set percentage of total vehicle price)	Ministry of Heavy Industries, 2024
			Creation of capital assets: E-buses, establishment of network of charging stations & upgradation of testing agencies		
			Phased Manufacturing Programme	Targets for localisation of EV supply chain along with graded duty structure for imported EV parts and lowered duty for domestically produced parts	
Production Linked Incentive Scheme for Automobile and Auto components	2021-ongoing		Incentives to boost domestic production of automotive technology products	Capex subsidy Financial incentives determined as percentage of increase in sales value of automotive parts	Ministry of Heavy Industries, 2021
Production Linked Incentive Scheme for Advanced Chemistry Cell for Battery Storage	2021-ongoing		Incentives to boost domestic production of advanced chemistry cell batteries	Capex subsidy linked to performance targets – beneficiary companies must achieve certain level of mandatory investment and domestic value addition	Ministry of Heavy Industries, 2021
Scheme to Promote Manufacturing of Electric Passenger Cars in India (SPMEPCI)			Incentives to promote manufacturing in India by global electric passenger car manufactures	Lowered duties based on commitment to minimum investment towards setting up manufacturing in India	Ministry of Heavy Industries, 2024 Ministry of Heavy Industries, 2025

Table 4. Second-Life EV battery use-cases in India

Project lead(s)	Location	Year announced/ started	Description	Source
BESCOM (Bangalore Electricity Supply Company) & GIZ	Kempegowda International Airport, Bengaluru, Karnataka, India	2025 (started)	A solar-integrated EV charging station powered by second-life/second-hand car batteries that provide 24/7 charging. It has a 45-kW solar generation system and 100 kWh battery storage, with 23 charging points (18 fast chargers + 5 slow chargers). The system stores solar energy during the day in old car batteries to supply EVs around the clock.	Ramanan et al., 2023 Choudhary, 2025
JSW MG Motors	Multiple Sites (Pune, Maharashtra, Delhi, Nainital, Uttrakhand)	2023 (announced)	Under 'project Revive', MG motors with several collaborating battery reuse and recycling companies have launched pilot projects focused on utilising EV batteries. With BATX and IIT Delhi, the project aims at creating off-grid EV charging station powered by repurposed MG EV batteries. The system will start at 20KWh and is scalable up to 100KWh, supported by 6.6 kW solar power. The project will support charging of E2W and E4W. With Lohum, the project aims at creating a 5kWh storage system for backup/solar integration and weak-grid use. With Vision Mechatronics, the project aims to power an industrial site in Pune, creating a high-voltage second-life battery paired with an industrial UPS delivering 36 kW power; built from six MG ZS EV modules. With Lohum and TERI, the project aims to create a kWh BESS to power a school in Nainital.	MG Motors, 2024 Gupta, 2024 EV India, 2024 Lohum, 2023 Aurocar Professional Bureau, 2025

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