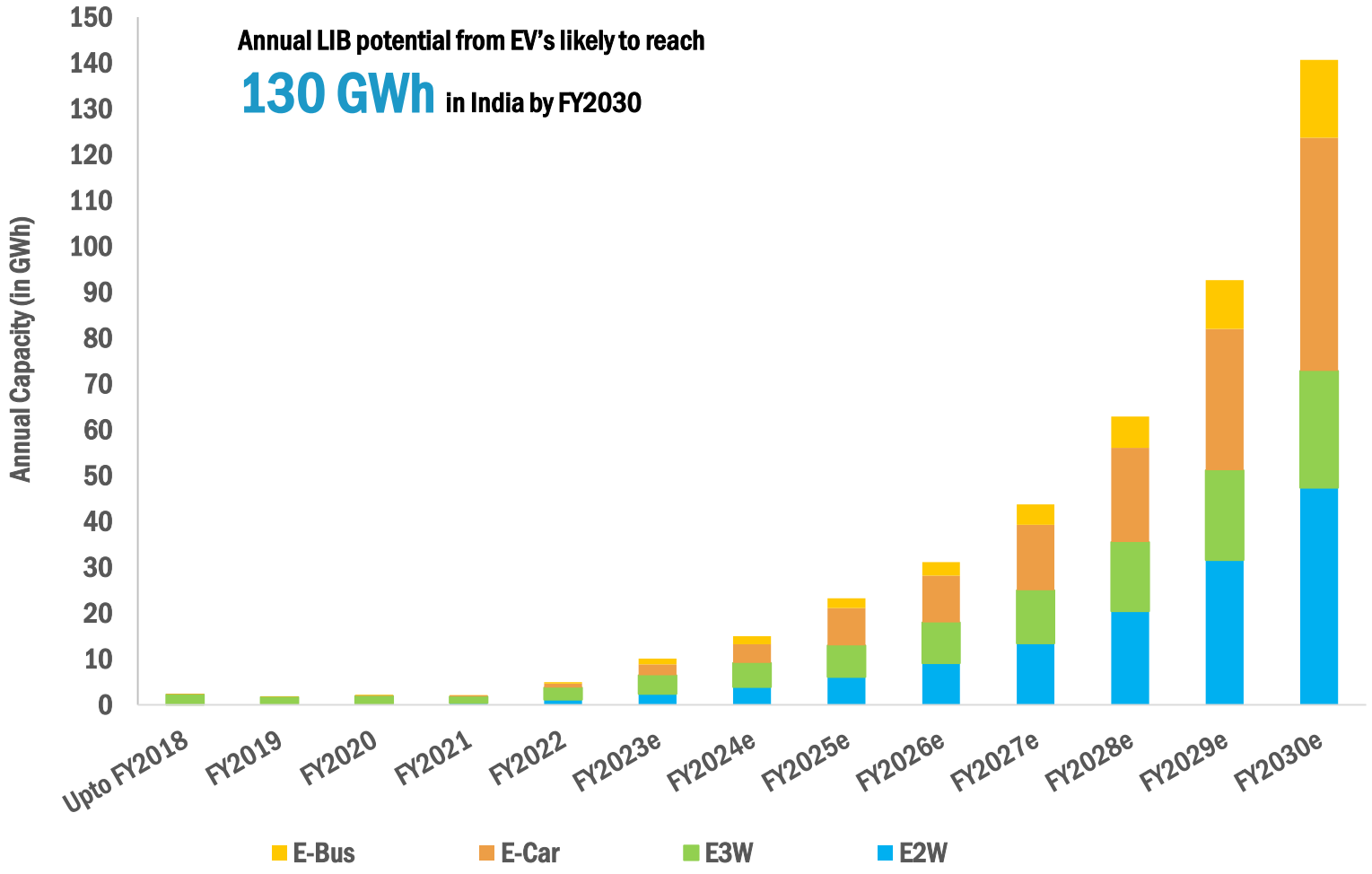
EV Battery Recycling Market in India

LIB-based EV Market in India – Actual & Estimated Market Potential

Fig.1 : Annual Lithium-ion Battery (LIB)-based Market Potential (in GWh) from EV's

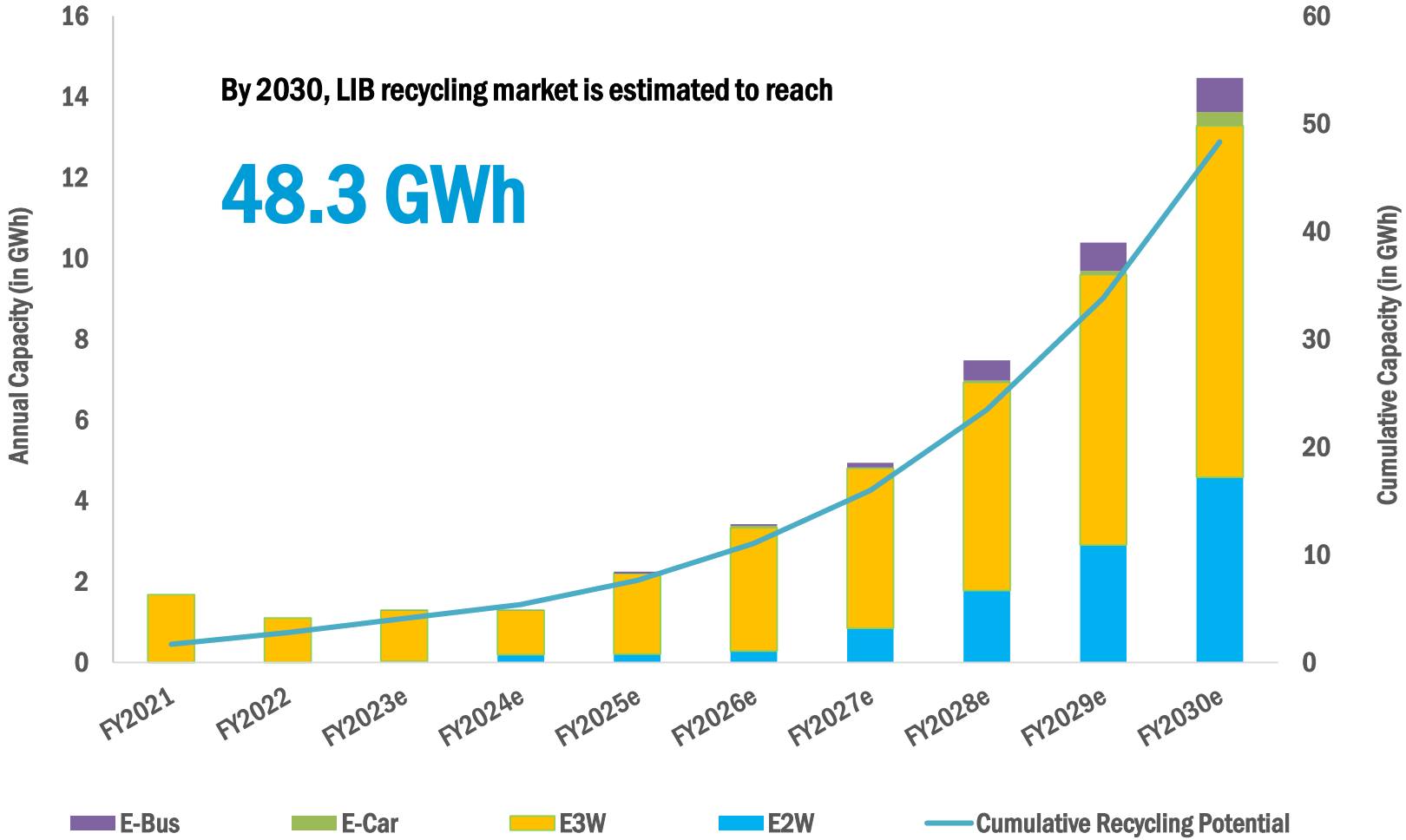


- EVs accounting for **~30%** share in the overall LIB deployment in India with an estimated 5 GWh of deployments in FY2022 alone
- By FY2030, EVs to account for 60% of total LIB demand in India on cumulative basis
  - While the current LIB penetration as part of overall battery demand in E2W is ~42%, it is projected to reach ~80% by 2030
  - For E3W, this share is projected to reach 40% by 2030 from the current share of ~13%
  - In comparison to this, E-Cars and E-Buses have ~100% LIB penetration already in the Indian market

Source: *Industry Interviews, JMK Research*
Note: *Battery Capacity considered - E2W: 2kWh; E3W: 7kWh; E-Car: 40kWh; E-Bus: 250kWh*

EV Recycling & Second-Life Market in India – Actual & Estimated Potential

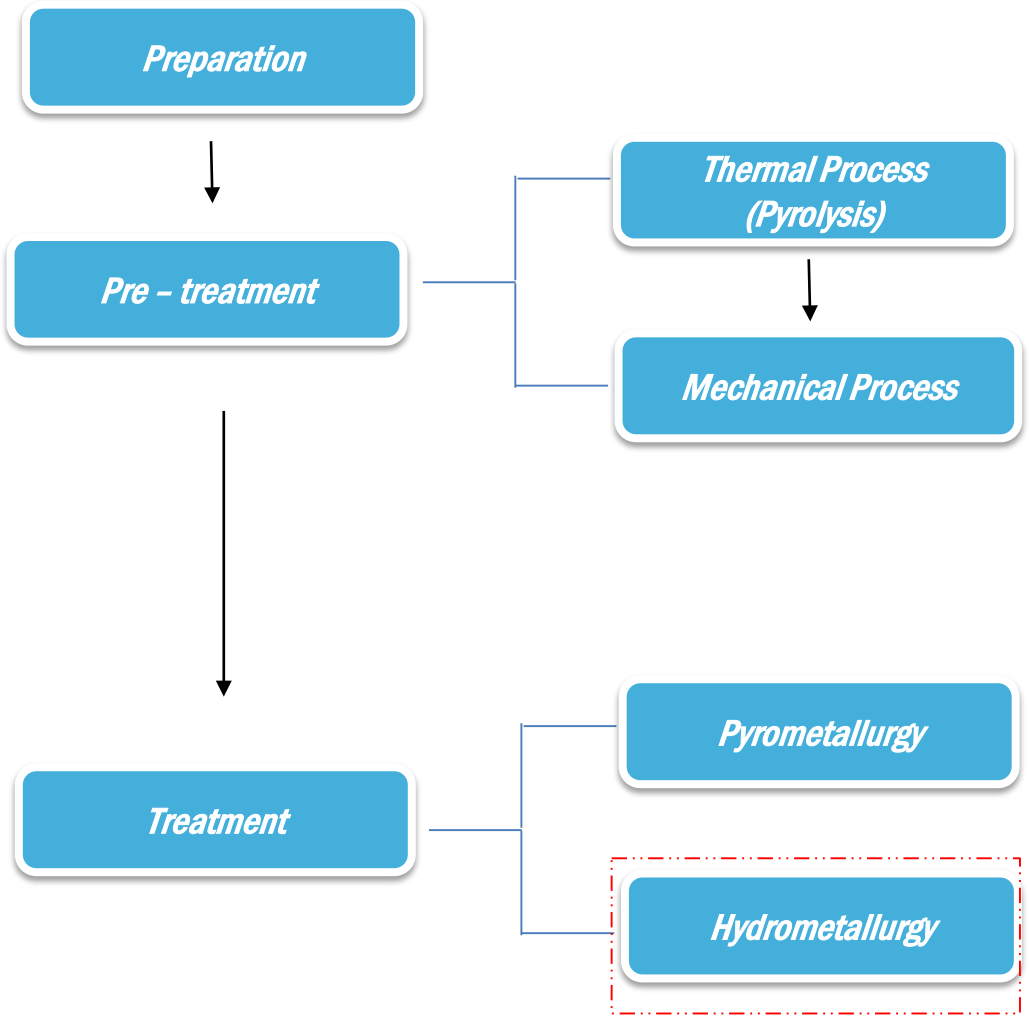
Fig. 2: Annual LIB Market Potential for EVs - Recycling + Second-Life Use



- The LIB batteries from EVs can be recycled as well as refurbished to put them again for reuse (second-life)
  - In case of E2Ws and E3Ws, **~75%** of such batteries are being recycled and rest **25%** being used for second-life in grid-connected and behind-the-metre (BTM) applications
  - In case of E-Cars and E-Buses however the second-life usage goes as high as **60%**
  - **Reuse % of E2W & E3W segment is low because most batteries cannot be reused when their performance falls below 70%-80%**

Source: *Industry Interviews, JMK Research, Link*
Note: *Life of battery: E3W – 3 years, Buses- 5 years, E2W – 4 years, E-Cars – 8 years*

Battery Recycling Technologies



- In this step, li-ion batteries are subjected to low-temperature volatilization so that their organic components can be decomposed. Binders and electrolytes are burned off.
- Once the process is finished, the remaining battery metals are subsequently sent to non-dedicated primary metallurgy processors to recover cobalt, nickel, and copper or sent for mechanical process

- Materials recovered in this process: Black mass (consisting of cobalt, nickel, copper and lithium)
- Metals obtained are 90-95% pure and can be used in domestic applications like stainless steel, metal sheds etc.
- Black mass is either exported or transferred to in-house hydro or pyrometallurgical facilities
- No material is lost in this process, however cell material remains in the form of black mass and needs further extraction

- Primary materials recovered in this process: metal alloys containing nickel, cobalt, copper, and iron
- Materials lost: Aluminum, graphite, electrolytes, lithium, silicon
- Metal recovery efficiency: Generally high (>90%) owing to lesser presence of impurities in the metal

- Primary materials recovered in this process: metals (copper, iron, lithium, cobalt, nickel)
- Materials lost: 50% of plastics and electrolyte is burned for energy
- Metal recovery efficiency: Generally **high (>90%)** owing to lesser presence of impurities in the metal

Highly used technology in India

Source: Primary interactions, JMK Research

Industry Challenges for Li-ion Battery Recycling in India

Limited resource availability

- As Government of India is pushing for local manufacturing of lithium cells in the country, demand for raw materials is expected to grow significantly, but currently there are no local resources for rare metals required for cell component manufacturing

Geopolitical risks

- The pandemic has exposed business risks as a result of disruptions in global supply chain especially from China resulting in long lead time for raw material deliveries
- Recent war between Russia & Ukraine has also affected the supply chain of key battery metals like nickel & aluminum as Russia supplies 10% of global nickel demand.

Lack of Awareness

- In India, lack of awareness is another critical challenge among the battery producers as well as end consumers
- The idea of tapping the B2C segment by recyclers is also logistically inconceivable, only battery manufacturers can tap the market through Extended Producer Requirement (EPR) norms, if imposed strictly

High Coct

- Huge upfront costs involved in setting up recycling plants and high processing cost are main deterrants
- Collection & Transportation of waste li-ion batteries is a difficult task and is again highly price sensitive

Source: Primary interactions JMK Research

India – Central Policy Initiative - Battery Waste Management Rules, August 2022 (4/8)

Ministry of Environment, Forest and Climate Change, Government of India ***published Battery Waste Management rules on 24th August 2022*** to ensure environmentally sound management of waste batteries. Following are key responsibilities assigned:

Consumer	Ensure end of life batteries are disposed of to a manufacturer, authorized dealer, or collection center of licensed recycler and keep records of recycled batteries deposited with registered recyclers
Collection Centers	Ensure compliance with standards and guidelines of facilities and safe storage and transportation of battery waste, and maintain records of battery waste handled and of verification and discharge of discarded batteries with residual charge
Dismantler	Maintain records of battery waste collected, dismantled and sent to the authorized recycler and ensure that dismantled battery waste is segregated and sent to the registered recycling facilities for recovery of materials
Recycler	Central recycling facilities to be developed with a capacity greater than 10,000 tons/year to ensure adequate pollution control that is cost-effective
Pollution Control Authority	Periodically monitor all recycling facilities, prepare guidelines/standard operating procedure (SOPs) for battery recycling facilities, standardize technologies for all types of battery recycling, and establish R&D facilities
Manufacturer/Importer	Obligations of Extended producer responsibility (EPR) for the battery that they introduce in the market to ensure attainment of the recycling or refurbishing obligation. Waste batteries collected by the manufacturer shall be sent for recycling and shall not be sent for landfilling or incineration

Source: Battery Waste Management Rules, 2022; JMK Research