WHY IS BATTERY RECYCLING KEY TO ECONOMY BY 2070?

AUTHOR

DR ANJALI SINGH

Group Lead , Center for Study of Science, Technology and Policy (CSTEP)

India is committed to its net-zero goals by 2070, and the decarbonisation of the transport sector through vehicular electrification is a major cornerstone.

Evidently, this is expected to increase the demand for batteries in future. Among the available battery technologies, lithium-ion batteries (LIBs) are most suitable for electric vehicles (EVs). EVs are mainly powered by lithium nickel manganese cobalt oxide (NMC) and lithium iron phosphate (LFP) battery chemistries.

By 2050, the LIB demand is expected to grow by 4950–5300 GWh and 750–800 GWh for EVs and stationary applications, respectively.

A critical question at this juncture is whether the supply of materials used in LIBs can keep up with this booming demand.

Achieving a closed-loop economy for LIBs is difficult owing to their complex chemistries, sizes, and components. Further, the key elements used in batteries, such as lithium, cobalt, nickel, and phosphorus, may face shortages over time.

Recently, India has discovered 5.9M tonnes of lithium reserves in Reasi district in Jammu and Kashmir. At this point, it is only an inferred reserve, and the actual estimates could differ. As per experts, it will take 5–10 years for the discovery of proved reserves and mining to have a direct impact on the country's growing EV demand.

Thus, recycling batteries at end-of-life will provide a sustainable means to meet the growing raw material requirement.

Considering the battery manufacturing targets set by the NITI Aayog under its Energy Storage Mission, recent research estimates the cumulative LIB recycling market to reach 160 GWh by 2030.

Additionally, energy and water consumption in case of material extraction from scrap is significantly lower than that in case of material extraction from freshly mined resources. For example, cobalt extraction from scrap requires 20–140 MJ/kg of energy and 30–100 m3/tonnes of water, whereas that from ore requires 140–2100 MJ/kg of energy and 40–2000 m3/tonnes of water.

Although some companies already recycle batteries at a large scale globally, the processes either do not recover lithium or recover it with impurities due to technological constraints. However, several studies on refining recycling technologies are ongoing.

LIBs aid in clean energy and green mobility, but they face end-of-life environmental challenges. Although EV batteries are designed to last for 8 years, most of them start losing their capacity after 5 years, thereby reducing the driving range of the vehicles. Following the end-of-life of EV batteries, they still retain 80% of their capacity. Faded EV batteries can be considered for use in other applications, including as a storage backup for solar and wind energy on the grid or in home inverters.

Currently, as per NITI Aayog data, less than 1% of LIBs are recycled in India, indicating that the battery recycling market is at a nascent stage. Recycling in India is handled mostly by the informal sector, mainly involving unskilled workers. But, LIB recycling requires sophisticated infrastructure, skilled labour, and huge investments.

The Battery Waste Management Rule, 2022, is a positive development to promote circular economy and ensure future self-sufficiency. Stringent regulatory frameworks are needed for safe transportation of batteries and upscaling of the capacities of battery-producer companies.

To achieve net-zero targets, recycling of battery materials will help in filling the supply–demand gap of critical raw materials, for which India is significantly dependent on imports.