Towards Net Zero 2070 Through Sustainable Battery Storage Adoption in India

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The penetration of electric vehicles (EVs) and renewable energy—the foremost measure for cutting greenhouse gas emissions—has been growing in India. But sustaining this progression requires adequate energy storage systems.

India's commitment to the EV30@30 initiative that targets at least 30% of vehicle sales to be electric by 2030 translates into adding 24 million two-wheelers, 2.9 million three-wheelers, and 5.4 million four-wheelers to its EV fleet by 2035. To meet this demand and reduce its reliance on global EV-component markets, India requires around 3,400-4,100 GWh of lithium-ion batteries (LIBs) by 2035, estimates the International Council on Clean Transportation.

Further, India's clean energy transition faces challenges due to the variable and intermittent nature of renewable sources like solar and wind. Energy storage systems are crucial for reducing generation variability and improving grid stability, while reducing peak-load and emissions. The Central Electricity Authority projects India's battery storage requirement to be 236 GWh (47 GW) by 2031-32. This emphasises the urgency to set up domestic gigafactories to enhance competitiveness and reach our Nationally Determined Contributions.

Thus, India's commitment to net-zero emissions by 2070 hinges on significantly expanding its battery storage capacity sustainably.

Among the different battery technologies available, LIBs, with their high energy density and rapid charge/discharge rates, are the most suitable for electric vehicles, portable devices, and renewable energy integration.

What is hindering the sustainable growth of battery storage in India?

Supply-chain complexity: India encounters obstacles in establishing local lithium-ion battery supply chains due to a lack of domestic manufacturing technology and restricted access to key raw materials (like lithium, nickel, cobalt, and manganese), which have major implications for battery cost. While the global LIB pack prices reached $151/kWh in 2022, experiencing a 7% surge due to increased raw material costs and inflation, India already bears higher costs due to its dependency on imports, with batteries priced at approximately USD 300/kWh.

Inadequate standards and regulations: Though India has made headway in boosting battery production and streamlining wastage via policies and regulations, more needs to be done. The Production Linked Incentive Scheme for Advanced Chemistry Cell, which incentivises setting up domestic battery manufacturing units, misses to provide strict guidelines for ensuring adherence and auditing transparency from the producers. Similarly, while the 2022 Battery Waste Management Rules aim at sustainable battery waste management, they do not adequately address issues of regulatory standards, battery labelling, and sufficient compliance incentives.

What can be done?

For easing the supply-chain complexities, lithium nickel-manganese-cobalt-oxide (NMC) and lithium-iron-phosphate (LFP) chemistries should be prioritised under the "Make in India" initiative, as they are cost-effective and safe, and can help in addressing material shortages as well. Considering alternative battery technologies beyond LIBs is also imperative for a stable supply, mandating R&D efforts in advanced lithium-ion as well as other battery variants.

Fostering sustainability in battery storage entails exploring "second life" batteries, particularly repurposing used EV batteries for grid-scale storage. This can optimise resource utilisation and extend the functional lifespan of these batteries, reducing electronic waste. Prioritising battery recycling initiatives that extract valuable materials from used batteries to produce new ones can also help in nurturing a circular economy. Further, by harnessing these materials efficiently, India can reduce its dependence on imports, lower carbon emissions associated with primary material extraction, and promote sustainability by recovering critical materials.

Thus, for moving closer to its net-zero target via sustainable battery storage capacity expansion, India needs to take a holistic approach that includes prioritising critical chemistries, embracing alternative battery technologies, and enhancing recycling initiatives.