Battery Reuse, Repurposing, and Second-Life Applications

The reuse, restoration, and refurbishment of batteries for second-life applications primarily refers to large packs originally designed for automotive purposes. These batteries are repurposed for a secondary market after no longer being viable for vehicle use, however, generally retaining 70 to 80-percent of its energy capacity.

Lithium-ion battery demand increased by 65-percent between 2021 and 2022 and is expected to increase by approximately 30-percent annually until 2030. Driven by recent regulatory changes towards sustainability and efforts by auto manufacturers to phase out internal combustion engines, EVs are anticipated to make up the bulk of growing demand for Lithium-ion batteries over the next decade.

The rapid rise of EVs will contribute to a growing number of retired battery packs that are no longer suitable for vehicles. With limited recycling capacity in US and European markets, the reuse of these batteries for stationary energy storage (SES) has been proposed as a cost-effective alternative. Applications from back-up residential energy storage and utility-scale storage to electric vehicle charging and telecommunications back-up storage have all been proposed as potential second-life uses.

There remain several challenges to the wide adoption of second-life applications. Prominent challenges to the reuse of lithium-ion batteries include existing regulations and the rate of battery technology innovation.

The absence of government regulations determining who has responsibility for batteries at the end of their primary lives has limited the adoption of retired EV batteries in SES applications. Meanwhile, the lack of differentiation in US certification requirements between primary-use and secondary-use batteries in SES will prevent the majority of retired batteries from being reused on a commercial scale.

Before a retired battery can be used for SES, its condition, energy capacity, and health must be assessed. Standards for EV battery repurposing include the existing UL 1974 standard and the developing J 2997 standard.

Similarly, rapid innovation in battery technology has resulted in diverse battery-pack designs and chemistries fragments the supply of potential second-life batteries. With batteries designed for specific EV models, evaluating the condition of batteries and refurbishing retired batteries to SES specifications becomes difficult to conduct at an economically efficient scale.