Recycling and Second-Life of Battery and Electronics from Energy Systems Engineering and Sustainability Perspectives

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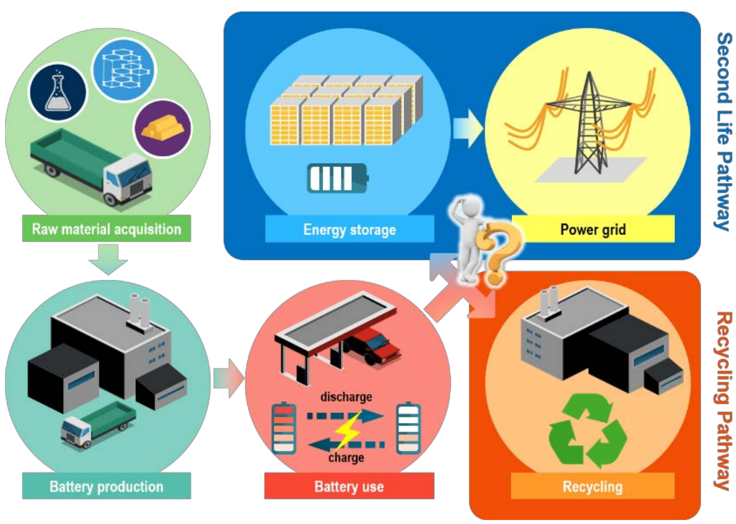
When a battery or electronics reach the end of their primary life, manufacturers have two options if the packs are still functional: 1) recycling the precious metals or other energy-intensive materials embedded within the packs; 2) repurposing the packs for less-demanding second-life applications, such as stationary energy storage. Given a sufficient gap between the procurement and recycling cost, recycling can make sense and drastically reduce the use of virgin resources toward a circular economy. In this way, sustainable manufacturing of battery and electronics is achieved without sacrificing the quality of life for consumers. On the other hand, second-life applications provide the most market value where there is demand for batteries or electronics for stationary energy storage applications that require less-frequent battery cycling. The economic performances and environmental implications of second-life of batteries and electronics vary significantly depending on the applications, requirements, and market conditions. Therefore, it is necessary to conduct systematic analyses from energy systems engineering and sustainability perspectives to identify the most promising recycling strategies.



To address this problem, we will systematically perform comparative techno-economic and environmental life cycle analyses (LCA) of the second-life pathway and recycling pathway, given a wide spectrum of device types, application requirements, and market conditions. We will also use life cycle optimization that integrates the tenets of techno-economic analysis and LCA through a multi-objective optimization framework to determine the optimal pathway and shed light on the EEE performance of the batteries and electronic products.