Chemical Engineering

Spring 2022 Seminar Series

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Accelerating Technological Change: Quantitative Insights from Three Decades of Lithium-ion Battery Improvement

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Thursday, February 10, 2022
4:15pm, 66-110
or via Livestream (link to be sent day of seminar)

ABSTRACT: A substantial and rapid transition to low-carbon energy resources can help society mitigate climate change. Energy storage technologies can enable this transition by electrifying transportation and facilitating the use of solar and wind energy. However, the broad deployment of energy storage technologies will depend, in part, on their ability to reach cost and performance targets. How to effectively accelerate their improvement and deployment remains uncertain. By building extensive empirical datasets and applying new analytic approaches, I investigate the past three decades of lithium-ion battery improvement. I determine both how quickly and why lithium-ion batteries improved and identify promising strategies for the future. I first develop robust and comprehensive estimates of how substantially and rapidly lithium-ion batteries fell in cost, and then incorporate other performance characteristics into measures of battery improvement. Next, I disentangle and quantify the determinants of the observed cost decline. I examine engineering-related, low-level mechanisms of cost change, such as changes in cell charge density and plant production capacities, as well as high-level mechanisms, such as research and development, learning-by-doing, and economies of scale. I also quantify the contribution of advances in chemistry and materials science. The results contribute new understanding of past improvement and inform future engineering research strategies, financial investments, and public policies for improving a range of electrochemical storage technologies.