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Life cycle analysis as a decision-making tool for sustainable chemical production

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Understanding the environmental and economic implications of new technologies in the chemical industry is critical for decision making related to technology investment and research priorities. To quantify the environmental impacts of a product/service's life cycle, this has been widely used to assess the environmental burdens of chemical production. However, quantifying the potential environmental impacts of new technologies using traditional LCA method is very challenging due to the lack of process data and the poor understanding of system effects and temporal/geographic changes. Furthermore, transferring the results from LCAs to insights that can directly guide research is even more challenging due to the lack of effective methods to dynamically model the relationships between environmental impacts and technical parameters related to chemistry and chemical engineering research. This presentation will discuss novel parametric analytic frameworks that are being developed to quantify the prospective energy, emissions and economic implications of new technologies and concepts in chemical production. The frameworks systematically integrate engineering, economic, environmental life-cycle models and statistical analysis to estimate future impacts of new technologies at both plant and industry-wide scales. The life-cycle environmental burdens and costs are linked to key research parameters to identify key technical factors driving impacts. Case studies related to petrochemicals, biofuels and bio-based materials will be discussed for demonstration.

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