PennState College of Engineering | CHEMICAL ENGINEERING

Chemical Engineering Seminar Series

Dr. Rui Shi
Postdoctoral Researcher

University of Illinois at Urbana-Champaign

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350 Health & Human Development Building

10:50-11:50 a.m.

Life Cycle Sustainability Assessments of Liquid Transportation Biofuels

Abstract

Biofuels are being pursued as an alternative to fossil fuels to mitigate the climate impacts of energy consumption. However, the complex issue of “food versus fuel”, which implies that biofuel production may further require additional cropland to substitute for the food diverted to biofuels, continues to spark a controversial debate. To avoid displacing food crops production, we targeted the north central and western U.S. wheat-growing states for integration of oilseeds that fits well into rotations with existing grain crops for renewable jet fuel production. The cradle-to-grave environmental impacts were further examined through the integration of a collection of biogeochemical, hydrological, farmer behavior, and biomass logistics models. Systems-scale life cycle assessment (LCA) results indicate that introducing oilseeds to existing crop rotations for coproduction of food and renewable jet fuel has significant advantages in terms of global warming potential, with considerable soil carbon savings from replacing the fallow period. While system-level analyses can provide insight into the potential impacts of expanded biofuel production systems in regional and national context, LCA also has the potential to inform biorefinery- and technology-scale design and innovation pathways. To increase the accessibility and utility of LCA for technology development and detailed process design, an open source sustainable design platform has been developed which integrates biorefinery design, simulation, LCA, and techno-economic analysis (TEA) to elucidate optimal pathways and prioritize research and development for the sustainable production of biofuels. Individual decisions and processes at biorefinery-scale were analyzed to reflect their influence on technical, economic and environmental sustainability, and uncertainties propagated through the system were characterized. Overall, this agile LCA approach can be used to elucidate trade-offs among biofuel yields and environmental impacts, to provide a mechanistic understanding related to biorefinery design and scaling to advance bioenergy production systems as a whole, and to identify critical process parameters governing industrial sustainability. Altogether, this approach to agile life cycle sustainability assessments enables researchers to prioritize research and development pathways in the pursuit of sustainable biofuels.

Biosketch

Rui Shi is a postdoctoral researcher at University of Illinois at Urbana-Champaign (UIUC). Her research focuses on prioritizing research and development pathways of biofuels, bioproducts, and agricultural systems by linking the traditional engineering metrics with sustainability analyses including techno-economic analysis (TEA; for financial viability) and life cycle assessment (LCA; for environmental impacts) under uncertainty. She currently leads the LCA research at Center for Advanced Bioenergy and Bioproducts Innovation, one of the four DOE Bioenergy Research Center in the nation. She completed her Ph.D. in Chemical Engineering from Michigan Technological University in 2018.