

EEE Research Seminar

Date: November 19, 2024, at 10:30AM

Location: POTR 234 (Fu Room)

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Multi-Scale Life Cycle Systems Modeling for A Carbon-Negative Bioeconomy

Abstract

The bioeconomy aims to replace fossil-based, non-renewable products with biological resources and processes. Various bioeconomy pathways involve natural and engineered solutions for carbon dioxide removal (CDR), such as biochar and bioenergy coupled with carbon capture and storage. These pathways offer significant opportunities to mitigate climate change and address global resource challenges. Developing a sustainable, carbon-negative bioeconomy requires thorough understandings of the environmental, economic, and societal impacts of diverse biomass pathways and their CDR effectiveness across different technologies, regions, and timeframes. However, obtaining these insights is challenging due to limited knowledge of system effects and the lack of robust assessment methodologies across spatial and temporal dimensions. This talk will introduce the multi-scale life cycle systems frameworks developed by Dr. Yao's research lab to address these gaps. By integrating life cycle assessment with methodologies from various fields —such as machine learning, engineering process modeling, techno-economic analysis, and ecosystem modeling — these frameworks offer a dynamic toolset for understanding complex biomass systems. Through several case studies, the presentation will demonstrate how these integrated frameworks enhance our fundamental understanding of the interlinked biomass and engineered systems across various scales. In addition, the talk will cover policy implications and illustrate how insights gained from these case studies can inform system-level design, fostering a resource-efficient, climate-beneficial bioeconomy aligned with global sustainability goals.

Bio

Dr. Yuan Yao is an Associate Professor of Industrial Ecology and Sustainable Systems, and Chemical & Environmental Engineering at Yale University. Her research focuses on understanding the potential environmental impacts of emerging technologies and biomass utilization. Dr. Yao received many awards, including the U.S. National Science Foundation CAREER Award, 35 Under 35 Award from the American Institute of Chemical Engineers, and the Laudise Medal from the International Society of Industrial Ecology. Dr. Yao is the associate editor for the journal *Resources, Conservation & Recycling*. She served on the provisional committee for the U.S. National Academies to assess the current life cycle analysis methods for low-carbon transportation fuels in the United States. Her research has been published in high-impact journals, including *Science*, *Nature Sustainability*, and *Environmental Science & Technology*. She was also the technical advisor for the LEAP Partnership in the United Nations' Food and Agriculture Organization. She received her Ph.D. degree in Chemical Engineering from Northwestern University.