

EEE Research Seminar

Date: September 3, 2024, at 10:30AM

Location: POTR 234 (Fu Room)

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Charting technology development pathways for a circular bioeconomy

Abstract

With population growth, urbanization, and rapidly changing environments, challenges to meeting basic human and societal needs are becoming increasingly complex. In many cases, the 20th century model of environmental technologies and infrastructure systems – often characterized by robust but inflexible components that are energy- and chemical-intensive – is no longer viable. Moving beyond maximizing efficiencies and minimizing cost, industries seek technological solutions that meet societal needs in a way that is financially viable while supporting the pursuit of broader goals for sustainability (e.g., carbon neutrality, resource circularity). This transition has become a catalyst for research and development, but a critical challenge to transformative innovation is the expansive landscape of technology development pathways that could be pursued.

In this presentation I will introduce our work to advance the circular bioeconomy through renewable resource recovery (nutrients, energy, water) from wastewaters and through the conversion of plant-derived feedstocks into bioenergy and bioproducts. Using a structured analytical approach – Quantitative Sustainable Design (QSD) – we identify, prioritize, and pursue opportunities for innovation to advance novel technologies. I will introduce the QSD process, including (i) establishing the simulation space, (ii) modeling construction, operation, and maintenance under uncertainty, (iii) tracking progress toward goals across multiple dimensions of sustainability, and (iv) prioritizing research, development, and deployment pathways. Using examples from our recent work, I will demonstrate how we leverage this approach to guide investment in non-sewered sanitation technologies and in precision fermentation for biomanufacturing. Finally, I will highlight my group's progress in developing open-source packages that support system design, simulation, techno-economic analysis (TEA), and life cycle assessment (LCA) under uncertainty.

Bio

Dr. Jeremy Guest (pronouns: he/him/his) is an Associate Professor and the David C. Crawford Faculty Scholar in the Department of Civil and Environmental Engineering at the University of Illinois Urbana-Champaign (UIUC). The core goal of Professor Guest's group is to advance circular bioeconomies to achieve equitable, healthy, and prosperous communities while simultaneously enhancing the ecosystems that support them. His group makes progress toward this goal on two fronts: (i) increasing access to and the sustainability of sanitation in both developing and technologically advanced communities; and (ii) expediting the research, development, and deployment of technologies that advance the sustainability of agriculture and the conversion of plants to bioproducts, biofuels, and nutritious foods.

Professor Guest serves as the Associate Director for Research for the Institute for Sustainability, Energy, and Environment at UIUC and as the Sustainable Design Lead for the Center for Advanced Bioenergy and Bioproducts Innovation (CABBI, a Bioenergy Research Center funded by the U.S. Department of Energy). He is the recipient of a National Science Foundation CAREER Award, the 2016 recipient of the Paul L. Busch Award for innovation in applied water quality research from the Water Research Foundation, and the 2021 James J. Morgan *Environmental Science & Technology* Early Career Award for creativity and leadership in his field. Professor Guest's formal training includes a B.S. and M.S. in civil engineering from Bucknell University and Virginia Tech, respectively, and a Ph.D. in environmental engineering from the University of Michigan.