

# Chemical Engineering Seminar Series

## Dr. Vikas Khanna

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Thursday,  
January 16, 2020

350 Health & Human  
Development Building

10:50-11:50 a.m.

## Environmentally Sustainable Development of Emerging Technologies: Insights from Systems-level Modeling and Analysis

### Abstract

Emerging technologies capable of producing fuels and chemicals are often touted as environmental panaceas. However, systems-level modeling and analysis of such technologies using life cycle oriented approaches is essential for guiding their sustainable development and avoid unintended consequences. This presentation will discuss our recent work on systems-level modeling and analysis of two emerging technologies. The first part of this talk will discuss prospective life cycle assessment (LCA) modeling for evaluating the environmental sustainability of hydrocarbon biofuel production via multistage torrefaction and in situ catalytic upgrading platform. Several multistage configurations, consisting of a combination of stream specific bio-oil upgrading strategies and coproduct scenarios are modeled and compared with a single-stage pyrolysis platform. Sustainability metrics including life cycle greenhouse gas (GHG) emissions and Energy Return on Investment (EROI) used to assess the environmental performance of multistage systems will be discussed. The second part of this talk will present a systems-based framework for guiding sustainable management of high salinity wastewater produced by the rapidly developing shale gas industry. We evaluate water management alternatives ranging from direct disposal in underground injection wells to advanced centralized, decentralized, and onsite treatment options using membrane distillation (MD). The results of techno-economic assessment (TEA) for shale gas wastewater treatment using MD technology will be discussed. The implications of these findings for long-term management of shale gas wastewater will be described.

### Biosketch

Dr. Vikas Khanna is an Associate Professor and Wellington C. Carl Faculty Fellow in the Department of Civil and Environmental Engineering at the University of Pittsburgh with secondary appointment in Chemical and Petroleum Engineering. Dr. Khanna received his PhD and MS from the Ohio State University, and a BS from Panjab University, all in Chemical Engineering. Before joining Pitt, he was an Associate Engineer in the Biofuels Research and Development group at ConocoPhillips. His research and teaching interests are in the areas of sustainability science and engineering, life cycle assessment of emerging technologies, and modeling of complex systems. His current research focuses on the development of systems-level methods and techniques for understanding the environmental sustainability of engineered systems and products. Applications include emerging biofuel technologies, management of shale gas produced water, food-energy-water nexus, and quantification of ecosystem goods and services.