Beyond Boundaries: Applying Process Systems Engineering to Sustainable Energy and Smart Education

Abstract — Process Systems Engineering (PSE) offers a unified, quantitative toolkit for designing and evaluating complex sociotechnical systems. In this seminar, I will introduce core PSE concepts and demonstrate their value across various domains, including sustainable energy and modern engineering education. I will present an end-to-end framework that couples validated unit-process simulation with techno-economic analysis and cradle-to-gate LCA to compare chemical energy carriers (H_2, methanol, ammonia, LOHC) for international renewable-energy supply chains, highlighting key tradeoffs in conversion efficiency, cost drivers, land & equipment sizing and sensitivity-guided decision rules. I then discuss emerging directions that fuse PSE with AI, especially large language models, drawing on our collaborative study (Tsai et al., 2023) that explored LLMs for building core-course problem models in chemical engineering. I summarize practical benefits, current limitations and safe workflows for integrating LLMs into teaching and research.