BRC Science Highlight
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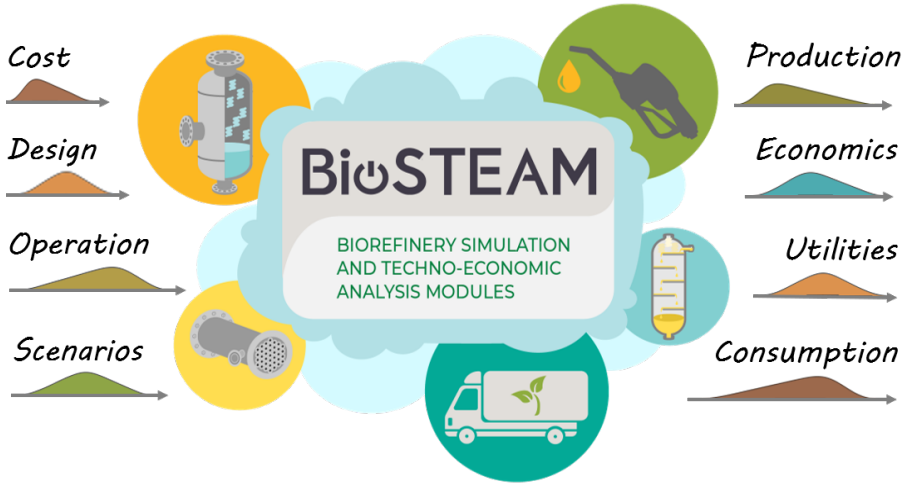
BioSTEAM: A Fast and Flexible Platform for the Design, Simulation, and Techno-Economic Analysis of Biorefineries under Uncertainty

Background/objective

Techno-economic analysis (TEA) of biorefineries allows researchers to compare and prioritize strategies for converting biomass to fuels and products. However, classic approaches to TEA are resource-intensive, computationally burdensome, dependent on proprietary software, and have little to no characterization of uncertainty and sensitivity. Researchers addressed these limitations by developing the Biorefinery Simulation and Techno-Economic Analysis Modules (BioSTEAM), an open-source, community-driven software in Python for the rapid design, simulation, and TEA of biorefineries under uncertainty.



BioSTEAM integrates uncertainty into process simulation and economic analysis, enabling the evaluation and prioritization of new technologies.

Approach

- BioSTEAM implements a thermodynamic framework that enables rigorous mass and energy balances.
- All process specifications, design decisions, and scenario parameters in BioSTEAM can be dynamically specified, enabling flexible evaluation of biorefinery designs with rigorous uncertainty and sensitivity analyses.
- BioSTEAM was used to model lipid-cane and corn stover biorefineries; the results were compared to benchmark models built in Aspen Plus and SuperPro Designer, respectively.

Results

- BioSTEAM was able to evaluate biorefinery designs across a continuum of feedstock compositions under uncertainty. In total, 31,000 different biorefinery designs were evaluated in less than 50 minutes.
- The results of the lipid-cane and corn stover biorefinery models matched the benchmark models and, through sensitivity analysis, revealed key bottlenecks for research and development (R&D).

Significance

BioSTEAM provides an open-source, community-driven platform for rigorous TEA under uncertainty to prioritize R&D and drive the bioeconomy forward.

*Cortes-Peña et al. 2020. "*BioSTEAM: A Fast and Flexible Platform for the Design, Simulation, and Techno-Economic Analysis of Biorefineries Under Uncertainty *." ACS Sustainable Chemistry and Engineering.*
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