Fractionation of biomass with CELF enables biorefineries with diverse, low-carbon product portfolios

Background

- CELF (Co-Solvent Enhanced Lignocellulosic Fractionation) is a novel biomass pretreatment technology which promotes high recovery of pentoses, hexoses, and lignin while limiting their degradation.
- Rigorous techno-economic and life cycle analysis (TEA and LCA, respectively) was desired to highlight the potential of using CELF pretreatment to establish advanced biorefineries.

Approach

- Process simulation, TEA, and LCA of CELF-based biorefineries was completed to aid the decision-making process in product selection for biomass conversion and to indicate bottlenecks for process development purposes.

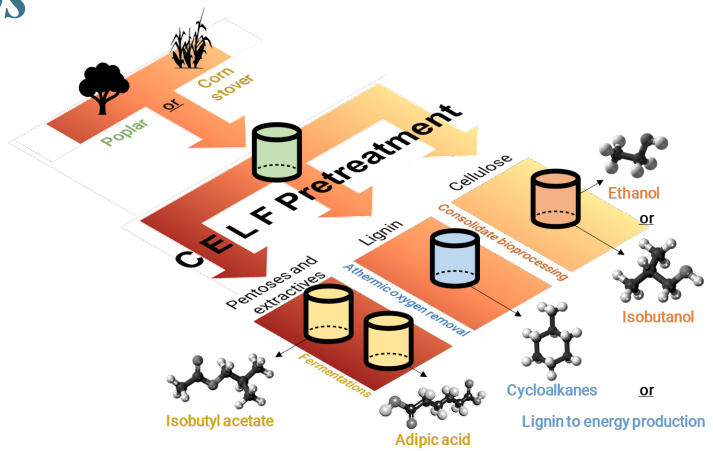
Results

- Suite of downstream conversion technology yields for alcohols, esters, carboxylic acids, and hydrocarbons as co-products from biomass were determined.
- CELF pretreatment favors feedstocks containing more available carbon for processing (i.e., poplar has an edge over corn stover).
- Consolidated Bioprocessing (CBP) of cellulose to ethanol is more advantageous than that to isobutanol.
- CBP-derived ethanol is more suitable for further conversion into sustainable aviation fuel (SAF) than isobutanol.
- All CELF biorefinery configurations offer substantial greenhouse gases (GHG) emissions savings when compared to equivalent portfolio of products obtained using conventional processes/technologies.

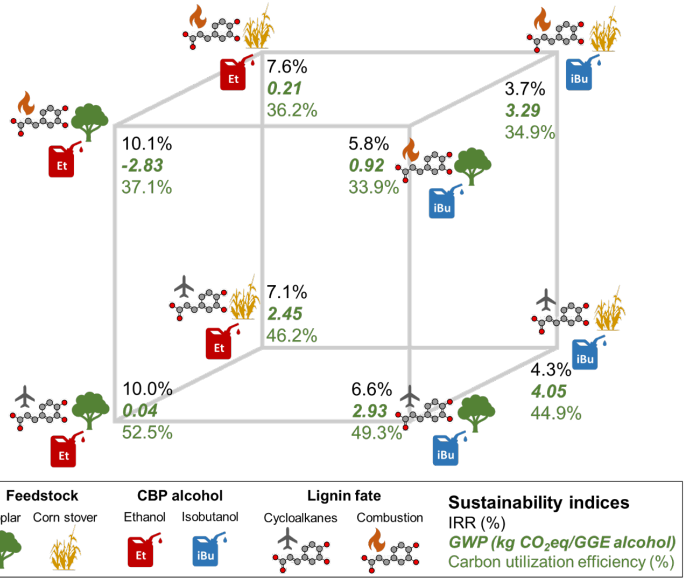
Significance

- First-of-its-kind effort combining multiple conversion pathways of interest shows the possibility of using CBI's overall technology portfolio to enable biorefineries that are both economically competitive and that yield biofuels and bioproducts at a fraction of the carbon footprint of conventional processes.

Klein, B. C. et al. *Energy & Environmental Science* (2024). doi.org/10.1039/D3EE02532B.



Simplified diagram for the proposed CELF-based biorefineries outlining the mass integration strategy



Sustainability indices of CELF-based biorefineries varying three major specifications: feedstock (poplar or corn stover), CBP alcohol (ethanol or isobutanol), and lignin fate (conversion to SAF or combustion).