A New Analytical Framework Highlights Current Challenges for Lignin-to-SAF Conversion Pathways

Background

- Lignin has recently gained significant attention as a promising feedstock for the production of sustainable aviation fuels (SAFs), owing in part to its natural abundance, heterogeneity, and high energy content relative to polysaccharides in lignocellulosic substrates.

Approach

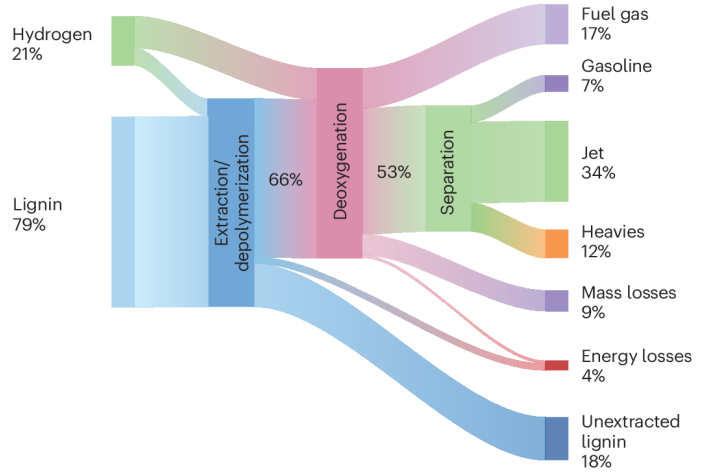
- We developed an analytical framework for SAF production processes, incorporating enthalpy balances across both conventional processes such as alcohol-to-jet and hydrotreated esters and fatty acids as well as a novel lignin conversion pathway.
- We highlighted numerous existing opportunities for lignin upgrading, including those involving feedstock design/choice, extraction/depolymerization, hydrodeoxygenation, and byproduct utilization.

Results

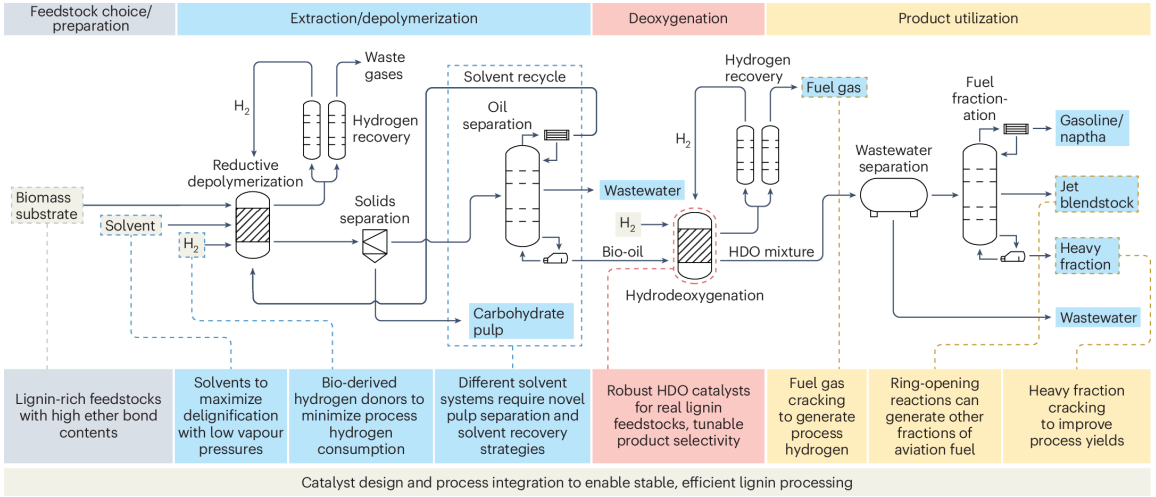
- Existing lignin conversion strategies have the potential to match the enthalpic yields of conventional SAF production processes; the two largest barriers are achieving complete biomass delignification and decreasing process mass losses.
- Other process opportunities include hydrocracking to further improve yields, utilizing co-products, and developing stable catalytic systems for both reductive depolymerization and hydrodeoxygenation.

Significance

- This approach provides a self-consistent framework with which to analyze novel SAF production processes, while providing an overview of challenges facing the lignin utilization field as a whole.



An enthalpy-centric framework to evaluate novel SAF production strategies, applied to lignin conversion.



Numerous opportunities for research and development are highlighted for lignin upgrading to SAF.

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