Drop-in Sustainable Aviation Fuels Enabled by Feedstock-Agnostic Lignin Deoxygenation

Background/Objective

- Sequential reductive catalytic fractionation (RCF) and hydrodeoxygenation (HDO) were previously shown to be effective at generating high yields of jet-range aromatic hydrocarbons with promising predicted properties for SAF.[1]

Approach

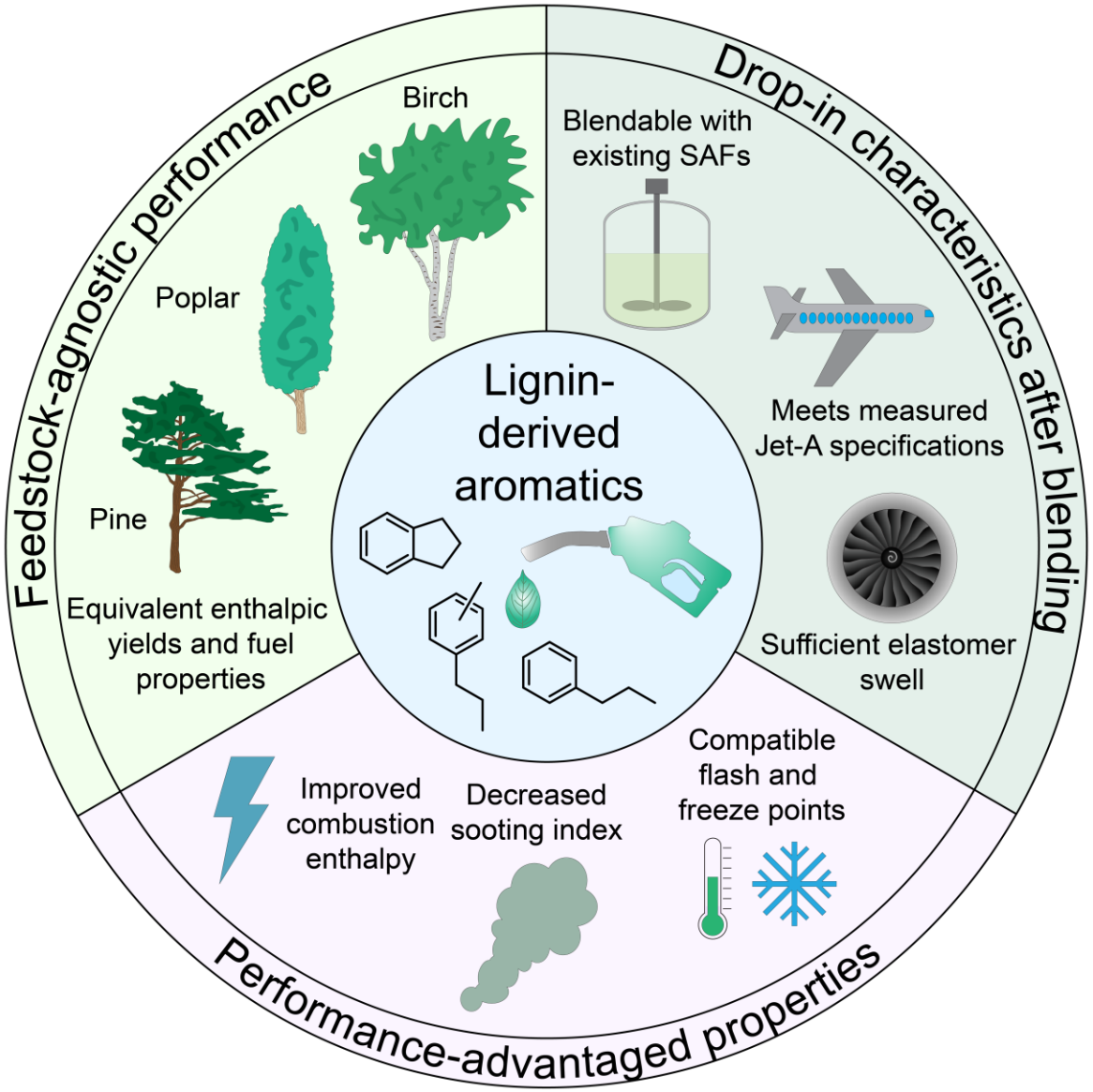
- Scaled, dual-pass hydrodeoxygenation of depolymerized lignin oils derived via RCF over molybdenum carbide enabled rigorous property measurement of both the resulting neat aromatic distillate and blends with conventional SAF.
- Multiple woody biomass substrates with unique lignin structural features confirmed the feasibility of our process using diverse biomass sources.

Results

- 150 mL of neat deoxygenated RCF-HDO product was generated at 93% of the theoretical maximum.
- Resulting jet-range aromatic distillates demonstrated sufficient properties for use as drop in aviation fuel substitutes after blending with conventional SAFs.
- Competing trends in carbon retention and jet-range carbon selectivities resulted for varying lignin S/G ratios.
- Similar enthalpic yields and distillate fuel distributions/properties resulted for all tested woody biomass substrates, including poplar.

Significance/Impacts

- All measured properties (including volumetric seal swell) for blends with conventional SAF suggest the potential of this process for enabling drop-in aviation fuel substitutes.
- Similarity in fuels derived from multiple substrates suggests the process could be applied to mixed biomass streams (e.g., forestry residues).



Webber M. et al. *Cell Reports Physical Sciences* (2025) DOI: 10.1016/j.xcrp.2025.102687

[1] Stone, M. et al. Continuous hydrodeoxygenation of lignin to jet-range aromatic hydrocarbons. *Joule* (2022) 6, 2324–2337.