Multiproduct Cellulosic Biorefinery Enables Market-Competitive Gasoline and Jet Fuel Blendstocks

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Project Goals: Establish the scientific knowledge and new technologies to transform the maximum amount of carbon available in bioenergy crops into biofuels and bioproducts.

Abstract

Establishing sustainable cellulosic biorefineries requires the production of renewable biofuels and bioproducts at market-competitive prices while reducing their carbon footprints. Achieving these targets is challenging with a single-fuel biorefinery warranting a cellulosic biorefinery with multiple fuels and products equivalent to a petroleum refinery. Here, we modeled a multiproduct biorefinery combining high-energy-density renewable gasoline and jet fuel blendstocks as well as nonhazardous biomass-derived indigoidine (blue dye). The model biorefinery utilizes ensiled biomass sorghum feedstock. Results show market-competitive selling prices of fuels of $0.6/L-petroleum-equivalent and indigoidine of $5.7/kg at the current state-of-the-technology. At present, the multiproduct biorefinery generates annual revenue of $434±10/bone-dry-metric ton (bdt) of biomass—141 to 156% more than single-fuel biorefinery—while meeting the carbon footprint reduction mandate of cellulosic biofuels. With an improved biomass conversion—achieving targeted sugar and lignin utilizations including 95% glucose, 85% xylose, and 95% lignin monomers—the annual revenue and the total carbon footprint reduction, respectively, could increase to $697±18/bdt and 94±3%, but envisioned when the biobased dye fully substitutes the synthetic dye.