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Insights: Publications

Maturation of Biomass-to-Biofuels Conversion Technology Pathways for Rapid Expansion of Biofuels Production: A System Dynamics Perspective

Biofuels, Bioproducts and Biorefining

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The Biomass Scenario Model (BSM) is a system-dynamics simulation model intended to explore the potential for rapid expansion of the biofuels industry. The model is not predictive — it uses scenario assumptions based on various types of data to simulate industry development, emphasizing how incentives and technological learning-by-doing might accelerate industry growth. The BSM simulates major sectors of the biofuels industry, including feedstock production and logistics, conversion, distribution and end uses, as well as interactions among sectors. The model represents conversion of biomass to biofuels as a set of technology pathways, each of which has allowable feedstocks, capital and operating costs, allowable products, and other defined characteristics. This study and the BSM address bioenergy modeling analytic needs that were identified in recent literature reviews. Simulations indicate that investments are most effective at expanding biofuels production through learning-by-doing when they are coordinated with respect to timing, pathway, and target sector within the biofuels industry. Effectiveness metrics include timing and magnitude of increased production, incentive cost and cost effectiveness, and avoidance of windfall profits. Investment costs and optimal investment targets have inherent risks and uncertainties, such as the relative value of investment in more-mature versus less mature pathways. These can be explored through scenarios, but cannot be precisely predicted. Dynamic competition, including competition for cellulosic feedstocks and ethanol market shares, intensifies during times of rapid growth. Ethanol production increases rapidly, even up to Renewable Fuel Standards-targeted volumes of biofuel, in simulations that allow higher blending proportions of ethanol in gasoline-fueled vehicles.
