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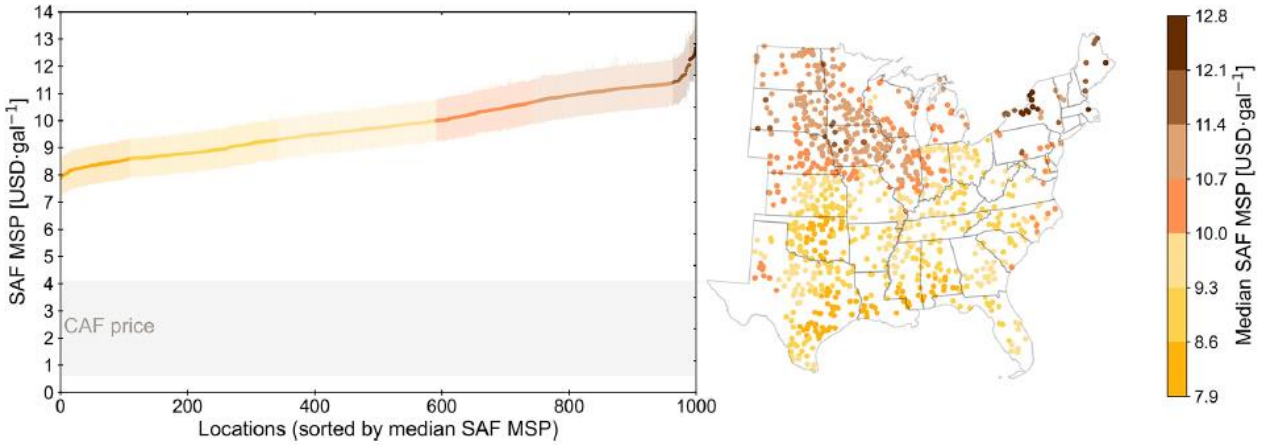
Co-Location of Cellulosic Bioethanol and Alcohol-to-Jet (ATJ) Production Facilities for Targeted Scale-Up of Sustainable Aviation Fuel (SAF) Production

Background/Objective

Achieving aerospace industry net-zero emissions by 2050 requires rapid scaling of sustainable aviation fuel (SAF) production. Leveraging existing infrastructure, proven technologies like Alcohol-to-Jet (ATJ), and low carbon intensity (CI) feedstocks (e.g., switchgrass and miscanthus) can support this transition and help achieve near-term emissions reduction targets. This study evaluates implications of lignocellulosic ethanol biorefinery siting and integration with petroleum refineries to produce SAF.

Approach

1,000 sites randomly sampled from areas suitable for perennial grasses in the U.S. rainfed region were evaluated. To better understand the logistics of material transport and handoffs, models of biomass harvest, transport, ethanol, and ATJ production were integrated in a stochastic framework based on Monte Carlo simulations to characterize SAF minimum selling price (MSP) and carbon intensity (CI), considering site-specific parameters.



SAF MSP from Switchgrass for all candidate locations sorted by mean values (left) and by candidate location (right).

Results

There were trade-offs between MSP and CI across locations with median MSP from 8.9 to 12.8 USD·gal^{-1} and CI from -9.7 to 39.4 gCO_2e·MJ^{-1}. Despite high estimated decarbonization costs (580 USD·ton CO_2e^{-1}), results show that site-specific deployment of ATJ with low-CI feedstocks can improve sustainability outcomes.

Significance/Impacts

This framework provides a systematic approach to assess cost and sustainability trade-offs across locations, considering the end-to-end supply chain and supporting an informed investment in SAF production.

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