Track #1 - Published Abstract

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Integrated techno-economic and environmental evaluation of biomass-based value-added carbon production

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A modeling process was developed to examine the environmental and economic benefits of utilizing cellulosic biomass as feedstock for value-added carbon products. The supply chain components for both the life cycle and economic modeling processes include feedstock development, harvest, transportation, storage and preprocessing, production, distribution, final usage, and waste treatment. Sensitivity analysis was conducted using Monte Carlo simulation to analyze the uncertainty in both economic feasibility and environmental impacts for both the techno-economic and LCA models.

A base case study is presented to investigate, along with regional biomass delivery analysis, and sensitivity analysis is made to evaluate the effect of resource availability, feedstock payments, harvest cost, transportation distance, facility demand, and IRR. Study of biomass logistics and active carbon production was analyzed regionally in all states of the study area, and production costs by states changed from 86.36% to 206.63% compared to base case scenario.

A life cycle analysis (LCA) model was also developed in SimaPro8 to assess the environmental and health effect of this proposed technology. The LCA study was a cradle-to-grave analysis which studied the GHG emissions, emission to water bodies, water consumption and energy input in the technology. 18 environmental impact indicators were analyzed with 100 year simulation. Where $\alpha = 0.05$, greenhouse gas emission changed from 90.33% to 112.03%, freshwater ecotoxicity was ranging from 69.45% to 159.41%, and human toxicity was between 78.48% and 168.45%.