

Logistic modeling of a biomass utilization system

Maetee Patana-Anake, Jinglu Tan, Steve Flick, Kurt Herman, Shane Danson

A logistic model was developed for a biomass utilization system and implemented in ExtendSim, a high-level object-oriented simulation platform. The model allows for system simulation and analysis of biomass supply chain in terms of economic viability and energy balance under given constraints. It accounts for the availability and flow of biomass based on yield, transportation distance, and harvest time of selected crops. The supply chain network was divided into three main subsystems including crop production, biomass handling and logistics, and biomass processing. The processes and operations, energy input and output, and costs were described as functions of time in each subsystem for analysis and simulation. After validation, the model was used to simulate different conditions and practices so that favorable system configurations and realistic limitations could be determined to maximize net energy output and economic viability. Validation of the model was based on data collected at Show Me Energy Coop, a local biomass pelletization plant near Centerview, MO. Published data from the literature were also used. The model captures the main characteristics of the plant in terms of feedstock collection, storage, process throughput, and product shipments. Based on the model, the maximum radius of feedstock supply was determined for the plant to remain energy-positive and profitable under different scenarios. The simulation results also suggested more efficient transportation fleets to increase the maximum radius for feedstock supply or reduce energy consumption in transportation by up to 80% without expanding the radius. Production scenarios for different types of feedstock, including hay, saw dust, corn stover, and switchgrass were simulated for system constraints and desirable configurations.