Simulating Near-Term Scale-Up of Cellulosic Biofuel Production Using Crop Residues and Biomass Sorghum

Xinguang Cui*[1,2], **Corinne Scown**[1,2]

[1]Joint BioEnergy Institute (JBEI), [2]Lawrence Berkeley National Laboratory

Project Goals: Model biomass feedstock availability for cellulosic biofuels at a fine geospatial resolution using publicly-available datasets and tools, and develop scenarios focused on increasing biomass availability and fuel production in the near-term (next 5-10 years).

The Renewable Fuel Standard (RFS) established in the Energy Independence and Security Act of 2007 aimed at reaching 16 billion gallons of cellulosic biofuels, out of a total of 36 billion gallons biofuel production by 2022. The project presented here focuses on near-term steps toward achieving that goal. We run scenarios in which the current biorefineries will be retrofitted to process cellulosic feedstocks including the crop residues such as the corn stover and dedicated energy crops. Then new refineries are to be built based on where additional biomass exists beyond the reach of current facilities. Thus, an important first step is to assess the biomass availability of feedstocks to provide practical suggestions for retrofitting current biorefineries and build new biorefineries. To accomplish this goal, a high-resolution feedstock analysis model is designed by making use of the county-level feedstock biomass production data set and high resolution satellite land cover data set (30mx30m). This system is created based on the open source databases in the platform of open source program (R), which aims to provide the biofuel community a powerful tool to plan and analyze availability of the cellulosic feedstocks. The model includes evaluation of locations for potential new biorefineries, aggregating clusters of crops, calculating 'biosheds' which redistribute the clusters to bio-refineries, calculation of biomass production, and post-process scripts. With this system, we have studied the biomass availability of current biorefineries and new biorefineries based on different feedstock blending constraints, and evaluated the potential contribution of biomass sorghum (an annual crop that farmers are more likely to adopt in near term). Several factors are considered such as the period, yield variation, biomass price, driving distance. In consideration of base yield, at the year of 2030, price of 50$/dt and driving distance of 50 mile, we have identified that there are 24 corn stover-exclusive biorefineries among 213 current biorefineries and 25 if the biorefineries can process other feedstocks such as switchgrass and Miscanthus by setting the minimum biorefinery size to 800,000 (dt) dry ton of biomass input per year. It is not necessary to build new biorefineries for corn stover in this case, but it is necessary to build another 181 bio-refineries that can process both the crop residuals and energy crops. In short, we have identified ~10% of current biorefineries that could feasibly be retrofitted to process corn stover exclusively, the remaining facilities will require blends of corn stover and energy crops, and there are as many as ~200 new potential biorefinery locations. Our results provide detailed maps indicating where existing facilities can be scaled up under different biomass availability scenarios, where farmers could add sorghum rotations to increase short-term biomass availability, and how many more cellulosic biorefineries could be constructed if biomass production is increased. In conclusion, our model provides the biofuel community with a powerful numerical tool to assess the supply of the biomass production for each biorefinery, at a fine geospatial scale appropriate for analyses ranging from individual localities to national-scale. which has shown its capability to assess the availability of biomass production for both of the current and potential bio-refineries.