Cellulosic Biofuel Potential under Land Constraints: Feedstock Supply, Cost, and Location

BIC Project Proposal

Alicia Rosburg, John Miranowski, and Keri Jacobs
Proposal Goals

• Extend BioBreak model from a point estimate of feedstock supply cost to feedstock supply curves (quantities and marginal costs) over space.

  • Derive feedstock supplies under alternative assumptions of land availability, feedstock demand, and market prices

• Identify location of potential cellulosic biorefineries

  • Economies of scale vs diseconomies of transportation
BioBreak – Current Status

• BioBreak estimates a regional long run biomass supply cost under different market and environmental conditions

\[ WTA = C_{ES} + C_{HM} + C_{NR} + C_{S} + T + C_{Opq} \]

• Limitations of current empirical model
  • Provides point estimate of regional biomass supply cost(s)
  • Does not estimate biomass supply or marginal cost curves
Proposed Extension – Biomass Supply Model

- Extend BioBreak to estimate marginal feedstock cost for given quantities supplied by Crop Reporting Districts (CRD)
  - Preliminary calculations reveal that county land area is frequently insufficient to supply a commercial scale biorefinery

- Estimate biomass supply curves for each CRD using data on:
  - Cropland that could be used for biomass production and associated production and opportunity costs of that cropland
  - Production and environment characteristics (e.g., yields, climate)
Project Scope

• Biomass crops considered:
  • Corn stover
  • Switchgrass

• Sources of land for biomass production:
  • Stover
    • Corn acreage (sustainability constraints, yield growth implications)
  • Switchgrass
    • Cropland pasture
    • Possibly some CRP acreage
    • Cropland that could be switched to dedicated biomass production at relatively low opportunity cost
“Cropland Switching”

- Ideally, we would like to identify cropland for which landowners are willing to switch from current activity (crop) to a relatively more profitable option, such as dedicated biomass production, at relatively low opportunity cost
  - Value of the marginal product of land in biomass production versus current activity
- Data on the quantity and opportunity cost of land that may switch is not readily available
  - Need measure of marginal opportunity cost of cropland in alternative uses (pasture, corn, fallow)
CRP Offers Data

• CRP offers that were not accepted by FSA for CRP signup
  • Land offered for CRP enrollment for a rental rate at or below the parcel-specific maximum rental rate
    • Maximum rental rate based on dry land cash rental rate and parcel characteristics
  • Not accepted due to low EBI score or county-maximum met
  • Indicative of cropland landowner’s willingness to forego current returns for a fixed CRP payment

• Provides a measure of the marginal opportunity cost of potential biomass cropland

• Lower bound estimate that reflects landowner’s willingness to switch from current cropland use for a fixed payment given expectations of future input and output prices
CRD Biomass Supply and Potential Biorefinery Location

• Estimate the CRD biomass supply cost for different quantities of biomass given:
  • Quantity and opportunity cost of cropland available for biomass production in CRD
  • Biomass production cost and expected yield for cropland available in CRD
  • Sustainability constraints applicable to cropland available (e.g., harvestable stover or biomass)

• Given biomass supply curve for each CRD, we can estimate the number of potential biorefineries per CRD given biorefinery annual feedstock demand
  • Biorefinery derived demand for feedstock
  • Economies of scale vs. diseconomies of biomass transportation
**Assumptions:**
- 2006-2009 corn acreage
- Yields: 1:1 ratio of grain to stover
- Sustainability constraint: Karlen (2010)
- Biorefinery: 54 MGY, 70 gal/ton

**Results**
- 42 potential biorefineries
- 2.27 BGY potential
- $76-115/ton for stover feedstock
Assumptions
• CRP land only
• Yields based on regional yield trials
• $C_{Opp} = CRP$ payment
• Biorefinery: 54 MGY, 70 gal/ton

Results
• 16 potential biorefineries
• 0.86 BGY
• $96-$135/ton for SG feedstock
Thank you!

Questions?