Life-Cycle Assessment of Alternative Corn Stover Supply Chains using Production Scale Experimental Field Data

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Second Generation Biofuels Supply Chain

Biofuels Production Supply Chain

Feedstocks Logistics—shares ~30% of GHGs emissions during biofuels production. (Source: Searchinger et al., 2008; Morey and Tiffany, 2009)

requires Further Investigation through LCA

(Source: DOE-EERE, 2008)
Life Cycle Assessment

• None of the earlier studies focused directly on comprehensive LCA of feedstocks logistics
• Limited studies have reported GHGs emissions from feedstocks logistics
• Variability in reported GHGs emissions values
• Example-Reported GHGs emissions values for feedstocks logistics:
  – Sokhansanj et al. (2006): 100 kg C/Mg
  – Morey and Tiffany (2008): 55 kg C/Mg
Inconsistencies in LCA Results

LCA results differ due to inconsistencies in:

✓ Assumptions
✓ System boundaries
✓ Data sources
✓ Units

One Approach to impart transparency in LCA: use of Production Scale Experimental Field Data
Project Goals

• Synthesize results from previously conducted large scale biomass production research to quantify life-cycle GHGs emissions and fossil energy inputs for harvest, collection, storage, upgrading, and transportation operations.

• Identify the best environmentally sustainable cellulosic biomass supply chain configuration by comparing life-cycle GHGs emissions and fossil energy inputs for alternative biomass supply chains.
Project Tasks

• Analyze relevant field data collected in 2008, 2009 & 2010.

• Develop model to synthesize field data for performing LCA of different baled corn stover supply chain configurations.

• Compare seven most likely Midwestern corn stover supply chain configurations to identify the best environmentally sustainable option.

• Reporting: Develop final report and journal publication on LCA of alternative feedstock supply chains.
Alternative Corn Stover Supply Chain Configurations

- Harvest and Collection:
  - Single pass
  - Multi pass
- Storage:
  - Tube-wrapped
  - Tarped
  - Within covered storage
- Upgrading:
  - Grinding
- Transportation:
  - Trucking

Figure 1: Different cellulosic biomass flow routes between field and biorefinery.
Summary of 2010 Biomass Harvest

SINGLE PASS HARVEST
- 750+ Acres
- 1.5 tons/ac
- 1000 Tons Collected
- 500 Bales
- 700 Tons Bulk

MULTI PASS HARVEST
- 2300+ Acres
- 1.2 tons/ac
- 3000 Tons Collected
- 6500 Bales
Production Scale Bale Collection - An Example
Summary of Fuel Consumption - An Example

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<th>Type of Harvest</th>
<th>Harvest Rate (tons/ac)</th>
<th>Fuel L/dry Ton Interval Plot</th>
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Interval Plot of Fuel L/ dry Ton
95% CI for the Mean

Harvest Rate (tons/ac) Type of Harvest
0.50 Towed Baler
1.10
1.75
Project Deliverables

• Database containing unit time and fossil fuel consumption for different operations of feedstocks logistics synthesized from field data collected in 2008, 2009 & 2010.

• LCA model for different baled corn stover supply chains.

• Comprehensive report and peer reviewed journal article on LCA of alternative feedstock supply chains.
Questions?