Biomass Feedstock: Field to Facility Supply

Advanced Biomass Workshop
Michael Reese
West Central Research & Outreach Center
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Overview:

1. Agricultural Research Station
2. Serve as Living Lab and Public Access Point
3. Developing Community Scale Renewable Energy Systems
4. Focus on Local Ownership
Overview

Community-Scale Renewable Energy Systems:

- Hybrid Wind System
- Biomass Gasification System
- Community Biogas System
- Renewable Energy / Green Office Building

Practical production systems with research and demonstration platforms

“Destination Renewable Energy Research & Demonstration Systems”
Biomass Feedstock Challenges:

- Type / Crop,
- Harvest,
- Storage,
- Processing,
- Densification,
- Transportation, and
- Utilization.
Biomass Feedstock Challenges:

- **Utilization – Two main routes**
  - **Sugar Platform / Fermentation**
    - Larger scale (regional)
    - Very defined feedstock (less flexible)
    - Needs very clean feedstock
    - High water requirement
  - **Thermo Chemical / Gasification / Pyrolysis**
    - Can be smaller scale (localized)
    - Offers greater feedstock flexibility
Biomass Feedstock Challenges:

- **Type / Crop:**
  - Corn Stover
  - Small Grain Straw
  - Grasses and Forbs
  - Alfalfa
  - Woody plants
  - Livestock Wastes – Bedding and Manure
  - Co-products – DDGS, etc
Crop Residues: Corn Stover and Straw
Grasses and Forbs
Alfalfa and Other Energy Crops
Co-Products
Biomass Feedstock Challenges:

- **Harvest**
  - Conventional
  - Single Pass
Harvest: Corn Stover

Raking Windrows

Round Baling
Two Pass Harvest
Single Pass Harvest

Single Stream
Single Pass Harvest

Two Streams
Single Pass Harvest

Three Streams
Single Pass Harvest: Willow
Single Pass Harvest: Miscanthus
Forage Harvest
Storage
Processing & Densification

Large round hay bales have a density of 10 to 12 pounds per cubic foot, but cornstalk bales contain only about 7 to 8 pounds per cubic foot.

-William Edward, ISU
Processing & Densification

1. Preprocess / Grind
   Dry
   Densification
   Pellet
   Briquette
   Other

Why Densification?
- Transport more per truck load
- Storage – Simplifies and increases shelf life
- Allows for mixing
- Simplifies delivery to gasifier / fermenter
- Standardization
Processing & Densification

2. Other Options:

   Liquefaction
   - On-farm processing
   - In-field processing

   Bio-methane
   - Inject into NG pipelines
UMM Biomass Gasification System

Courtesy of Hammel Green and Abrahamson, Inc.
Transport & Logistics
Grain Transport
Gasification Transport & Logistics

Theoretical = 15 M tons/yr
Actual = 677,000 tons/yr
Contractual = 45,000 tons/yr

Examples:
UMM = 9,000 tons / yr (Stevens County)
CVEC = Estimated 100,000 tons / yr (Swift County)
Biorefinery Transport & Logistics

- **Economical Biorefinery Capacity**
  - for 2000 ton/day [UMM = 36 tons / day]
  - Delivery cost $ 35 / dry ton [$10 / acre for farmers]

- **Production Area and Storage Capacity Required**
  - 6950 square miles, Mean Travel Distance 40 miles (Perlack and Turhollow, 2002)
    - [170 Sq. Mi. Ramsey County to 6,000 Sq. Mi. Saint Louis]
      - 30% Corn acreage, 50% farmer participation
  - **Storage Capacity (300 days)**
    - 1,200 million lbs,
    - 109m cubic feet (Density 11 lbs/cubic feet)
    - 2500 acre.ft (100 acres by 25 ft high)

- **Transportation**
  - Bio-refinery delivery
    - 53 ft truck, 50,000lb Tare (Assuming weight limited truck)
    - 80 trucks per day (year round delivery)
    - 320 trucks per day (3 month harvest/ delivery window)
  - Field Harvest Transportation
    - 3 ton/acre, 8 acres/hr, 10 hours / day.
    - 10 truck loads day (assuming weight limit, i.e. 11-14 lbs/cubic foot)
    - 40 truck loads day (raw density 3-4 lbs/ cubic foot)

*Birrell, Iowa State*
Transport & Logistics
Transport & Logistics
UMM Biomass Gasification System

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UMM Biomass Gasification System

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Impact on Soil, Water, and Air
Biomass Cropping Systems