Biomass Feedstock National User Facility

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BIOMASS FEEDSTOCK NATIONAL USER FACILITY

Feedstock Preprocessing

Feedstock development
herbaceous and woody resources, on-spec for all conversion platforms

Process development
size reduction, separation/fractionation, thermal treatment, chemical treatment, densification

System-level feedstock solutions
identify preprocessing "bottle necks" and improvement opportunities

Mission: Engage commercial, industrial, governmental, and educational entities through the utilization/deployment of DOE-BETO developed capabilities

What's New? New tools for capability deployment

Approach: Active industry engagement to establish a partnership between DOE and industry

- Satisfy DOE-BETO interests
- Provide products that reduce risk and guide industrial technologies

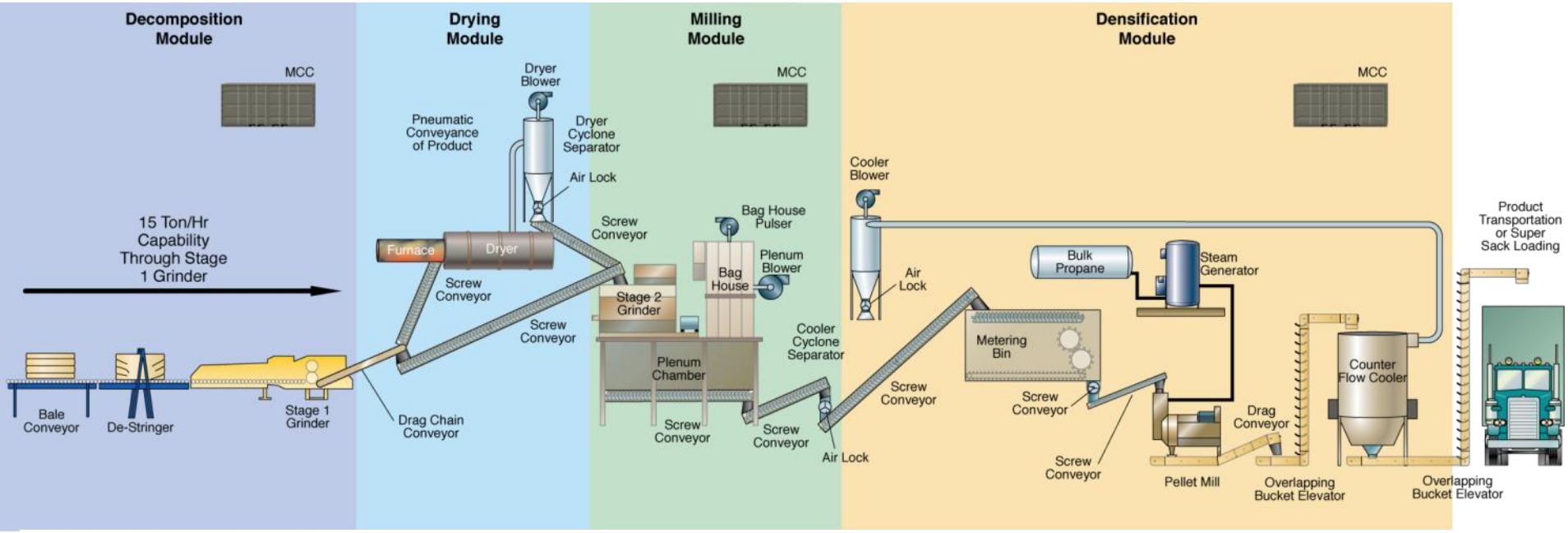
Biomass Analytical Library

Biomass Characterization
understanding physical and chemical variability

Performance Evaluation
informing preprocessing operations to achieve refinery specs

Feedstock Logistics
designing cost-effective, environmentally-sustainable supply systems

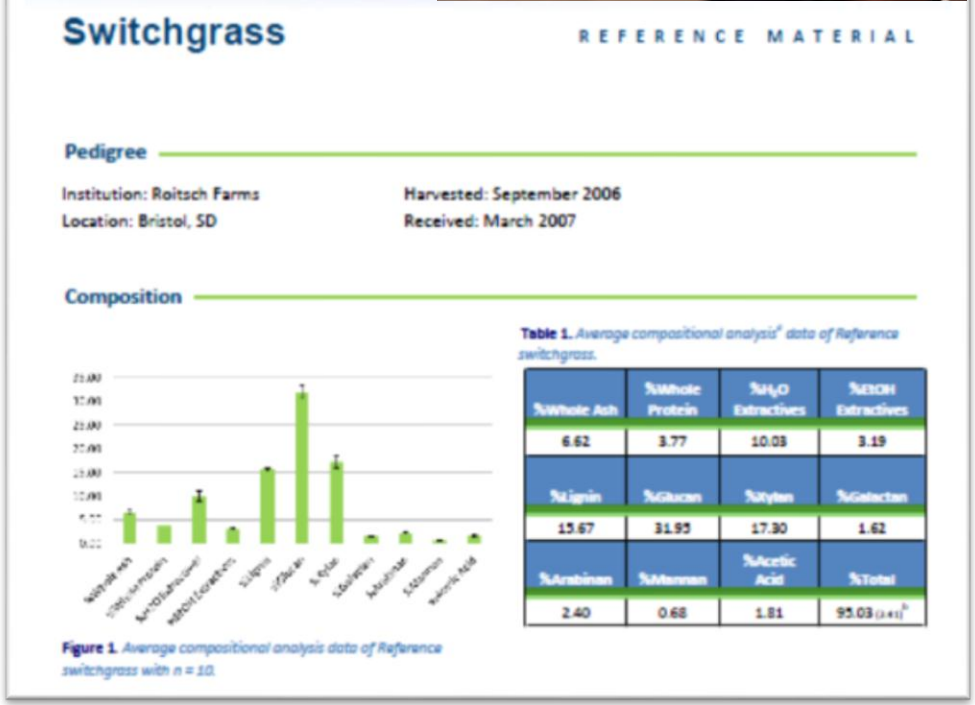
Biomass Feedstock Process Demonstration Unit (aka Feedstock PDU)



- Modular – unit ops designed to operate individually or in any combination
- Reconfigurable – change the order of unit ops or insert additional unit ops
- Deployable – support off-site operation (specific modules with excess capacity)
- Industrial scale – 1 (drying) to 15 (stage-1 grinder) tons per hour, nominal 5 tons per hour
- Fully instrumented for data collection

Biomass Characterization

- Chemical attributes
- Solid fuel properties
- Particle morphology
- Bulk solids properties
- Storage characteristics
- Pellet properties
- Off-gas analysis



Switchgrass REFERENCE MATERIAL

Pedigree

Institution: Roitsch Farms
Location: Bristol, SD
Harvested: September 2006
Received: March 2007

Composition

Table 1. *Average compositional analysis[a] data of Reference switchgrass.*

%Whole Ash	%Whole Protein	%H_2O Extractives	%ETOH Extractives
6.62	3.77	10.03	3.19
%Lignin	%Glucan	%Xylan	%Galactan
15.67	31.95	17.30	1.62
%Arabinan	%Mannan	%Acetic Acid	%Total
2.40	0.68	1.81	95.03

Figure 1. *Average compositional analysis data of Reference switchgrass with n = 10.*

Collaborations That Span the Biofuels Supply Chain

Production

- Feedstock characterization (chemical, solid fuel properties)
- Pairing feedstock to pathways
- Storage
- Pellet

Supply

- Techno-economic assessments

Preprocessing

- Independent testing, development, & scale-up of preprocessing technologies

Conversion

- Feedstock Supply
- Scale-up & integration of preprocessing systems
- Feedstock Feasibility Studies

Feedstock Supply/Logistics Demonstration

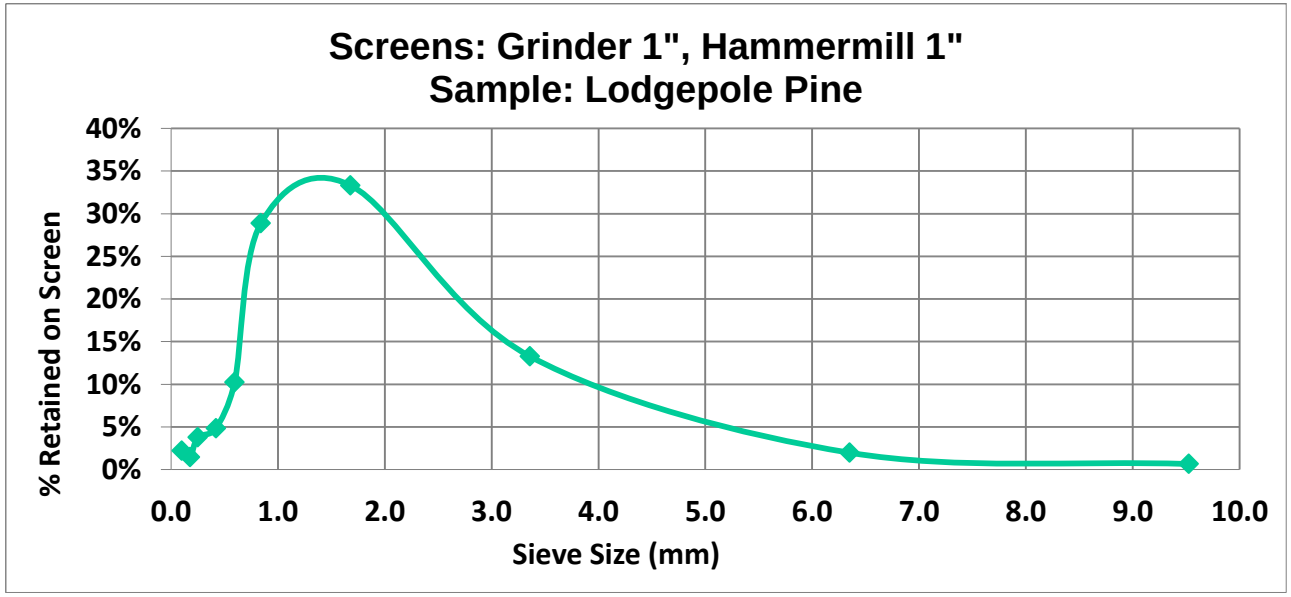





PDU: Feedstock Supply

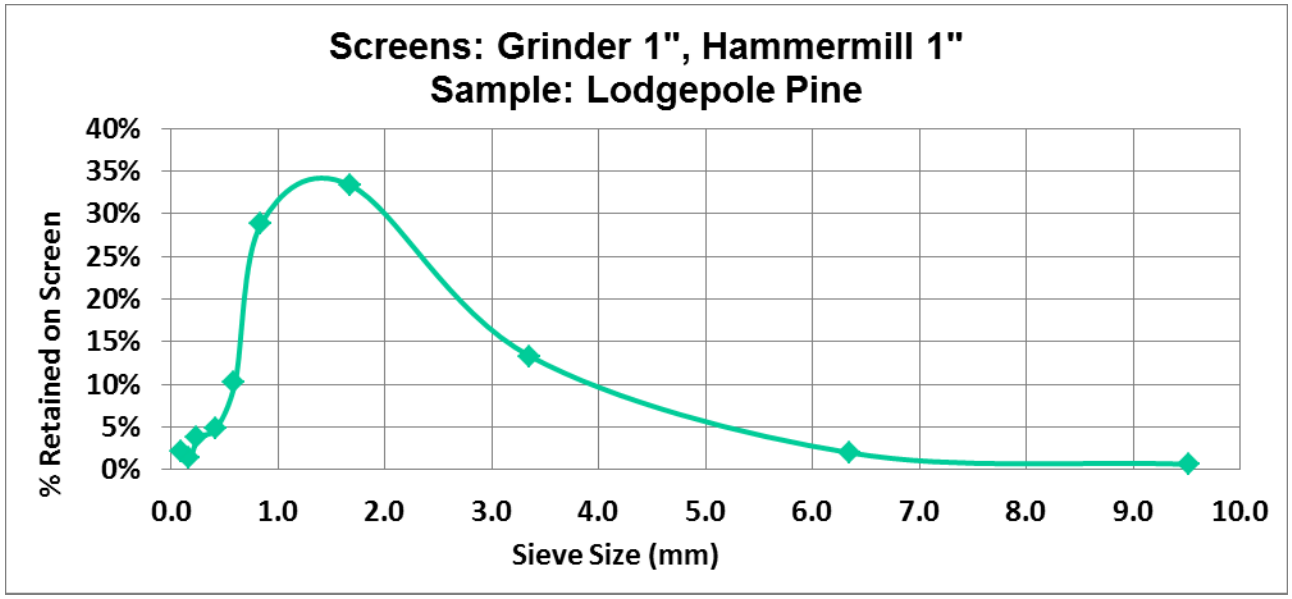
- Objective: Supply 40 tons of feedstock for a pyrolysis validation
- Category: DOE industry project
- Challenge: Achieving feedstock specifications
  - Low Moisture – required drying
  - Particle Size Distribution
    - Fines end up as char
    - Large “pin-chips” cause plugging in handling/feeding systems
- Outcomes:
  - Feedstock - sourced, processed, packaged and shipped (~300 supersacks)
  - Preprocessing configuration & process data (energy consumption, throughput)
  - Feedstock characterization: moisture, particle size distribution, proximate/ultimate

Lodgepole Pine Preprocessing PDU Process Development



1" x 1"
Mean: 2.17 mm
Standard Deviation: 1.97 mm
Passing 250 micron screen: 3.2%
Retention on 6.4 mm screen: 1.8%

Lodgepole Pine Preprocessing PDU Process Development



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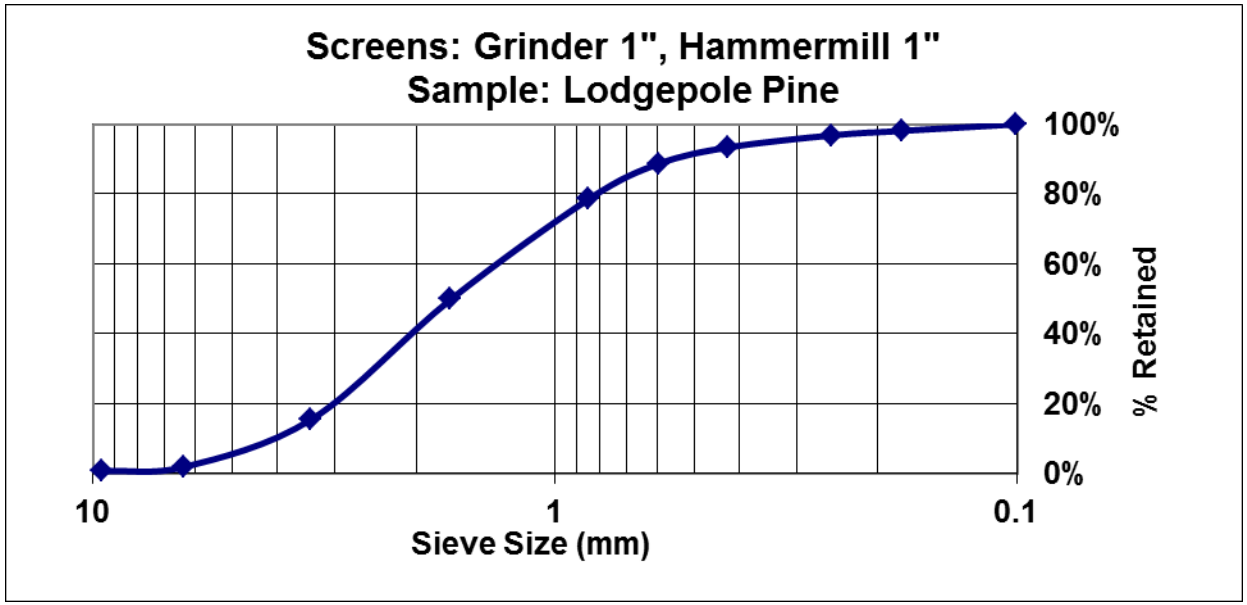
Lodgepole Pine Preprocessing
PDU Process Development



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PDU: Comminution Project

- Objective: Compare user comminution technologies (shear milling and collision milling) with hammer mill technology
- Category: Non-Proprietary Industry
- Approach:
  - UF sourced and prepped (with PDU) identical feed materials
    - 3 feedstocks: corn stover, switchgrass and pine
    - 3 moisture levels: low, medium and high
  - Collaborators brought machines to INL for testing
  - Energy data was collected during testing
  - Product particle size distributions were measured after testing

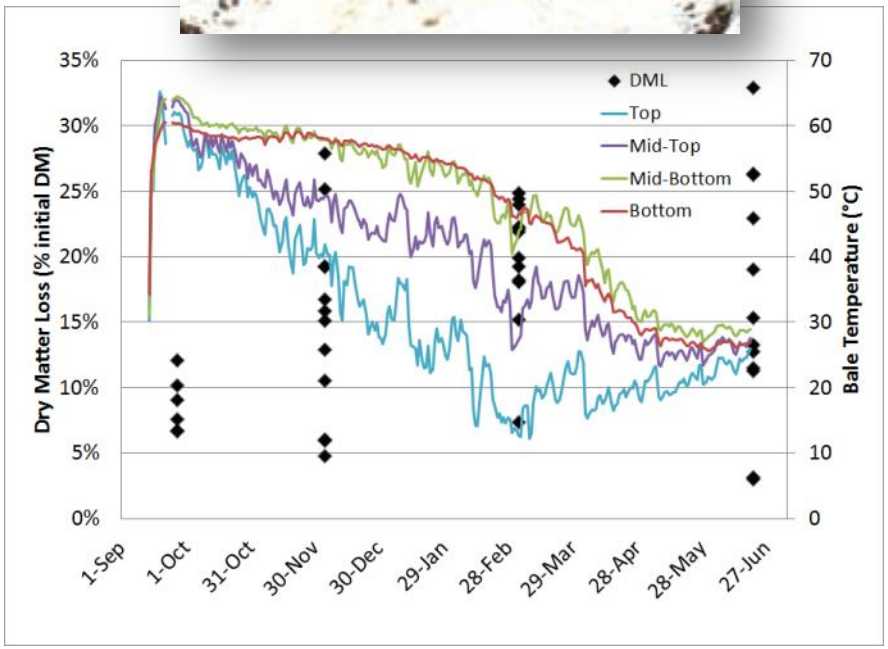
PDU: Comminution Project

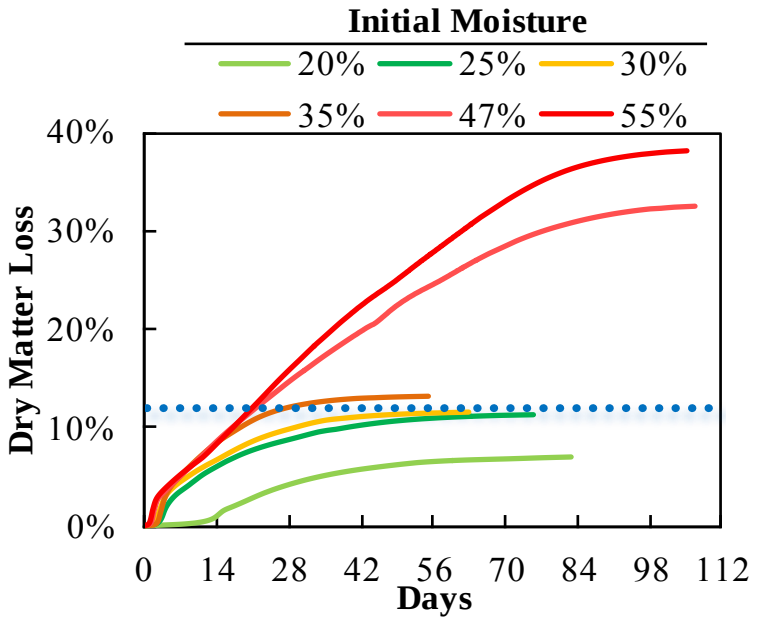
- Outcomes:
  - Each comminution technology exceled in different areas
  - Hammer mill was least sensitive to material type
  - Collision mill produced consistent but small particles, and exceled with low-moisture corn stover
  - Shear mill was least sensitive to moisture, and exceled in high moisture, fibrous materials

PDU/Characterization: Supply and Characterization of MSW Feedstocks

- Objective: Supply MSW feedstocks for gasification process development
- Category: Proprietary/Non-Proprietary Hybrid
- Uniqueness of Project Challenge:
  - Tightly coupled collaboration
  - Combines PDU feedstock supply with characterization of feedstock inputs and gasification products (syngas and slag)
- Expected Outcomes:
  - Non-proprietary: MSW characterization, processing data, thermal deconstruction performance data
  - Proprietary: Predictive process model

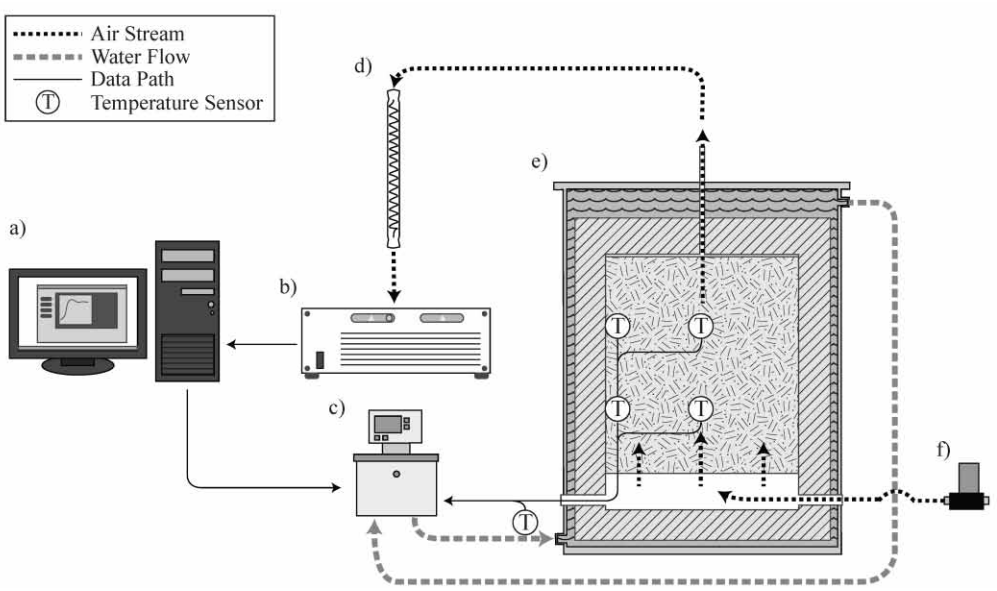
Biomass Characterization: Biomass Storage Performance





Biomass Characterization: Biomass Storage Performance

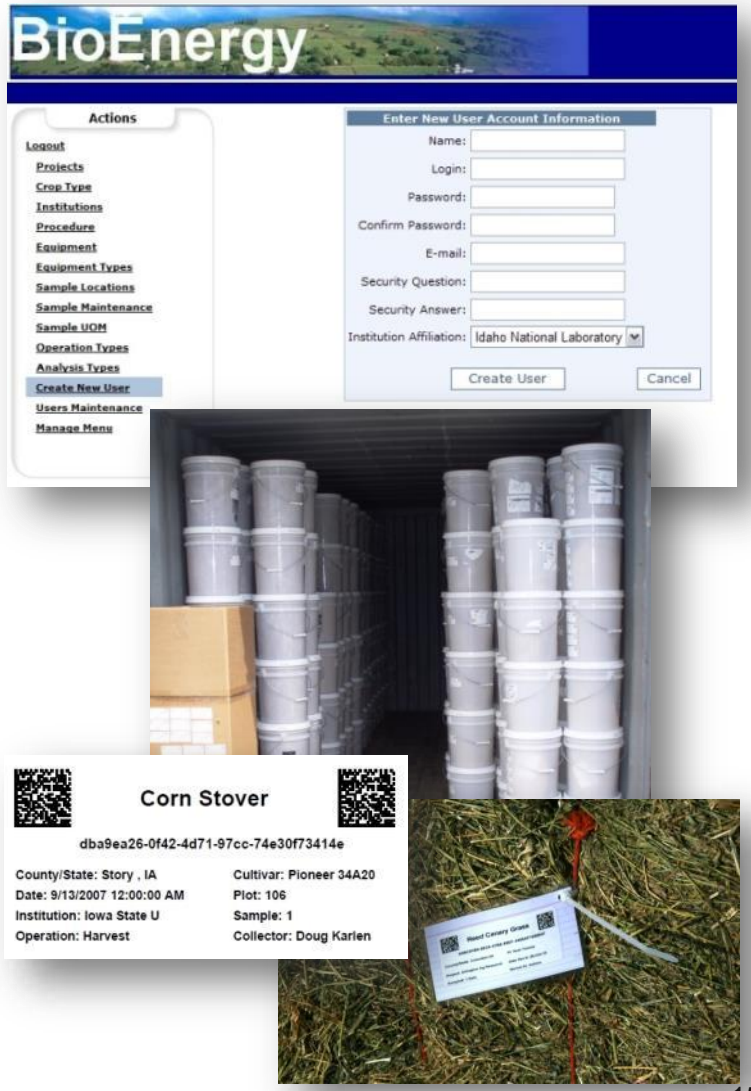
- Simulate the behavior of a range of storage conditions
  - Control: heat loss, oxygen availability, moisture content
  - Monitor: heat generation, microbial respiration, moisture change, DML, composition
- Generate ample quantities of post-storage material with a well documented history for chemical analysis
- Microbial respiration: Gas exiting the reactor is analyzed for CO2 production in real-time
  - DML estimated by $CH_2O + O_2 \rightarrow CO_2 + H_2O$



National Biomass R&D Library

Integrated knowledge management that:

- Facilitates physical storage and tracking of research feedstocks
- Assimilates biomass sample data into a single data system
  - Feedstock pedigree information
  - Harvest and storage information
  - Operational data from the PDU and field trials
  - Physiochemical characterization data
  - Lab-based biological data
  - Lab-scale conversion data
  - Full-scale conversion data from the conversion platforms
- Enables better understanding supply chain processes and feedstock performance



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…building a viable bioenergy feedstock supply to enable a strong bioeconomy…