

The IBSS Partnership:

Progress Toward the Southeast's Advanced Biofuels Industry



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Cellulosic Ethanol Capacity, 2014

6

FIBERIGHT

Location: Iowa, USA
Feedstock: Municipal Solid Waste
Launch: 2013

20

MASCOMA

Location: Michigan, USA
Feedstock: Woody Biomass
Launch: 2013

30

CHEMTEX

Location: Florida, USA
Feedstock: Sugar Cane Bagasse
Launch: 2014

1.4

INBICON

Location: Denmark
Feedstock: Wheat Straw
Launch: 2011

13

M&G-CHEMTEX

Location: Italy
Feedstock: Energy Crops
Launch: 2012

25

POET

Location: Iowa, USA
Feedstock: Corn Stover
Launch: 2013

27

DCE

Location: Nevada, Iowa
Feedstock: Corn Stover
Launch: 2013

25

ABENGOA

Location: Kansas, USA
Feedstock: Corn Stover
Launch: 2013

72

BP

Location: Gulf Coast, USA
Feedstock: Energy Crops
Launch: 2014

20

COSKATA

Location: Alabama, USA
Feedstock: Forest Biomass
Launch: 2014

4

PETROBRAS

Location: Brazil
Feedstock: Sugar Cane Bagasse
Launch: 2013

13

ABENGOA

Location: France
Feedstock: Agricultural Residue
Launch: 2013

15

COFCO/SINOPEC

Location: China
Feedstock: Corn Stover
Launch: 2013



In 2014...

...the estimated global production capacity of cellulosic ethanol is **250 million US gallons.**

USDA-AFRI Bioenergy CAP's

1. UWA | GWR | ZeaChem

Biochemical conversion of hybrid poplar to ethylene for conversion to aviation fuel.

2. WSU | WeyCo | Gevo

Biochemical conversion of forest residue (softwood) to butanol conversion to aviation fuel.

3. ISU | Conoco-Philips

Conversion of native perennial grasses to advanced fuels from fast pyrolysis bio-oils.

4. LSU | Virent

Development of energy cane and sorghum as a source of sugars for conversion to advanced fuels.

5. PSU

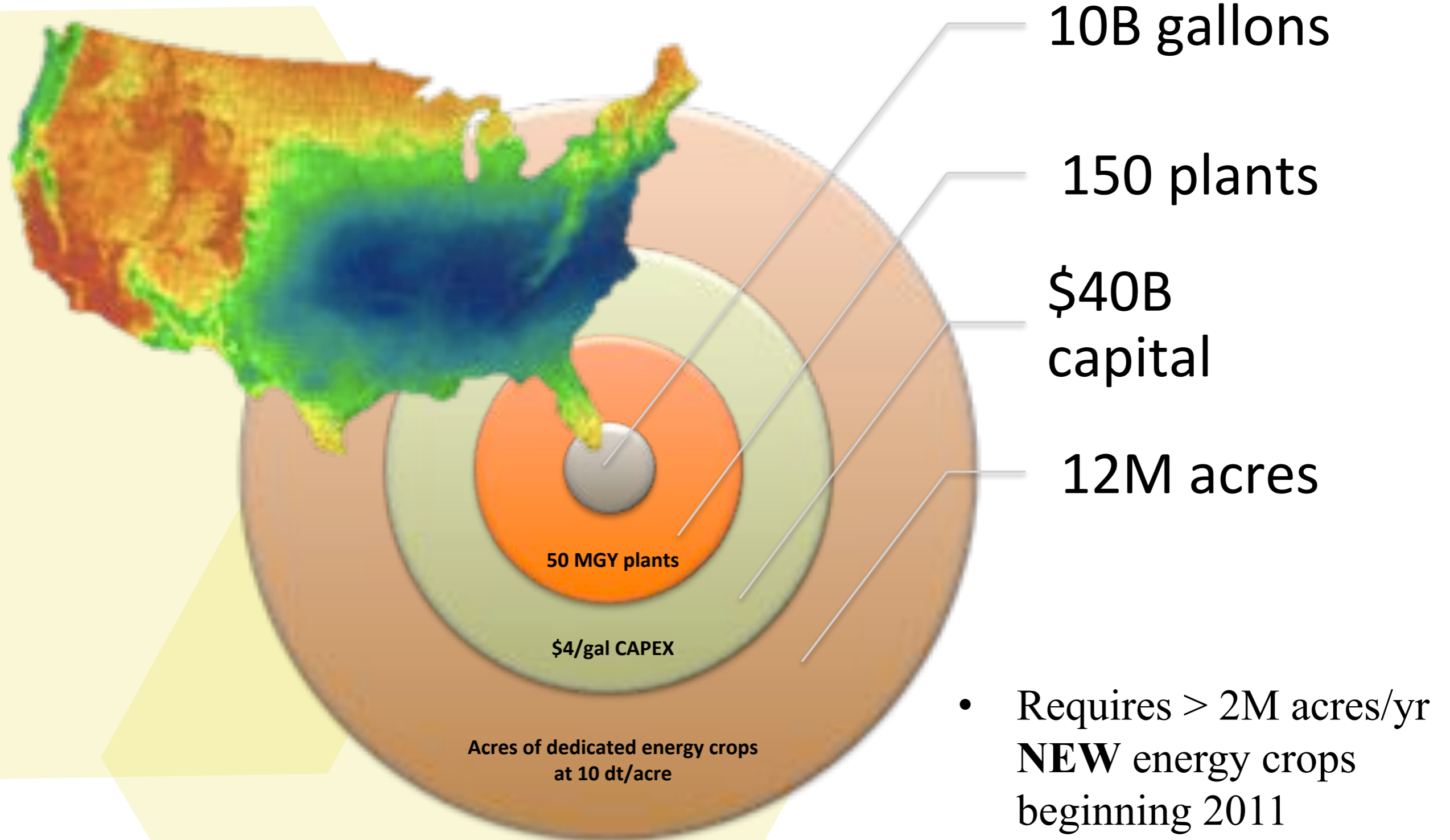
Development of energy crops (willow, switchgrass, miscanthus) as feedstock for advanced biofuels (*unspecified*).

6. UT | Rentech | LP

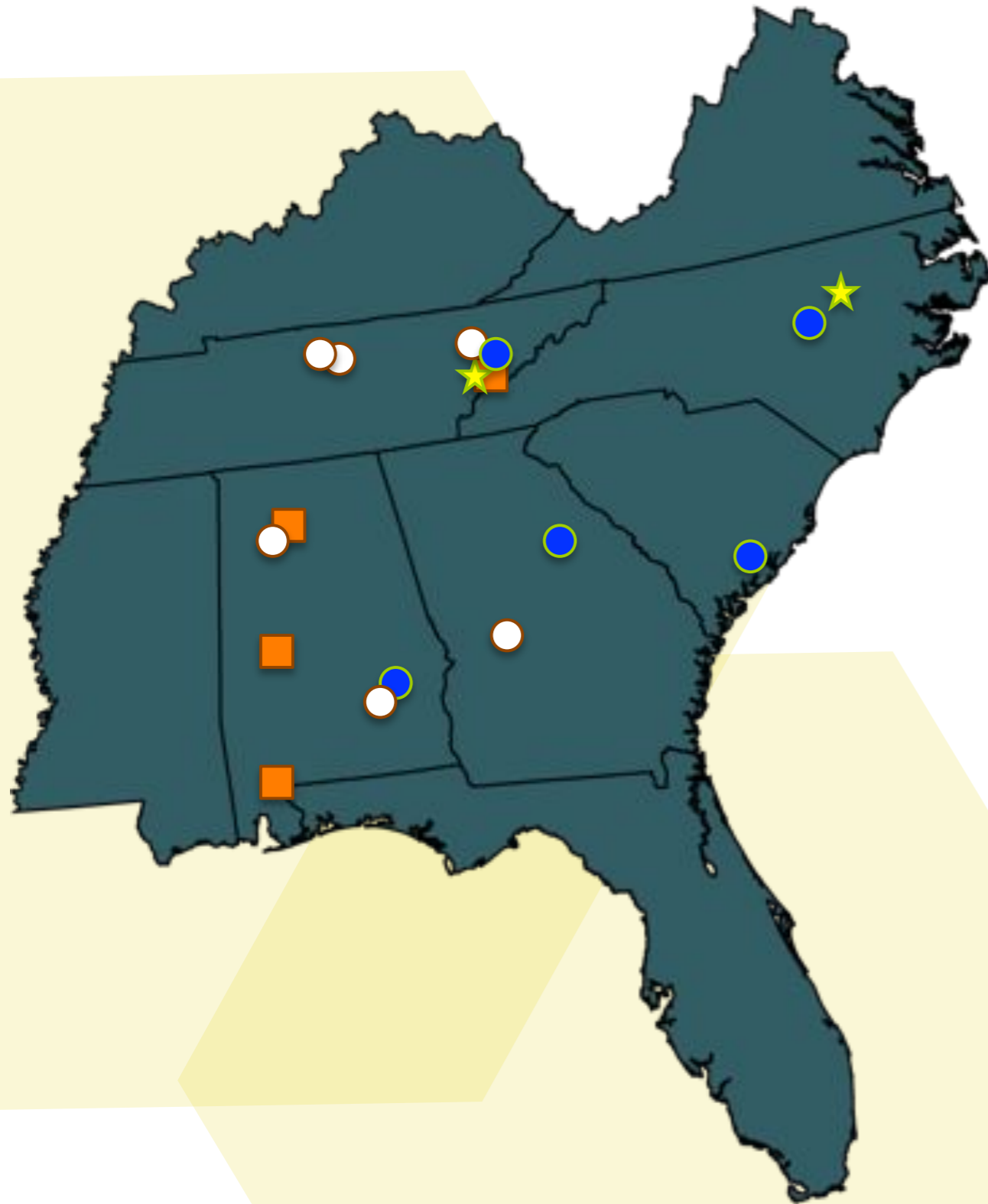
Thermochemical conversion of dedicated energy crops (SRVC's, switchgrass, pine) to green diesel and jet fuel.



Meeting The RFS-2: The Southeast



The IBSS Partnership's Footprint



● The Partners

- ArborGen
- Auburn University
- Ceres (not shown, Thousand Oaks, CA)
- NC State University
- University of Georgia
- University of Tennessee

○ The Collaborators

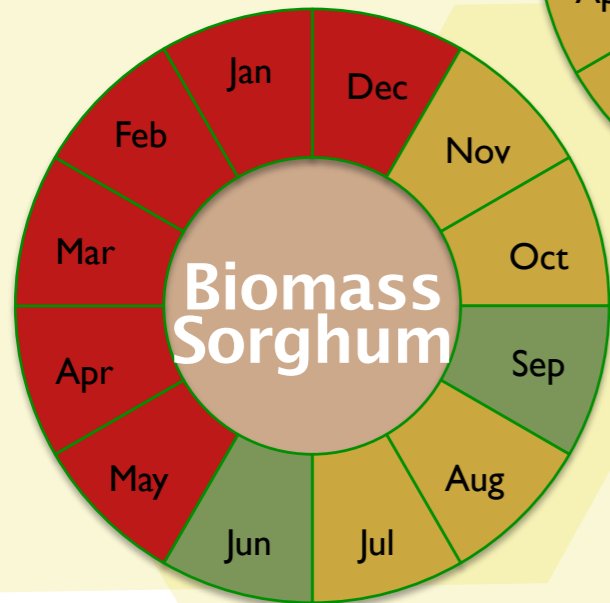
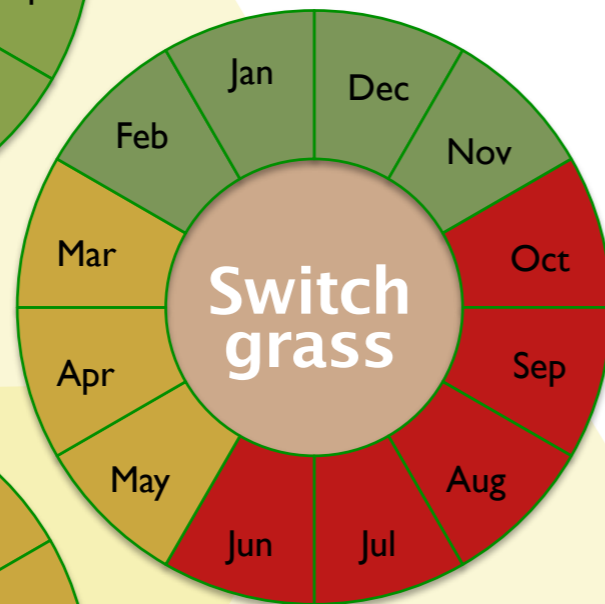
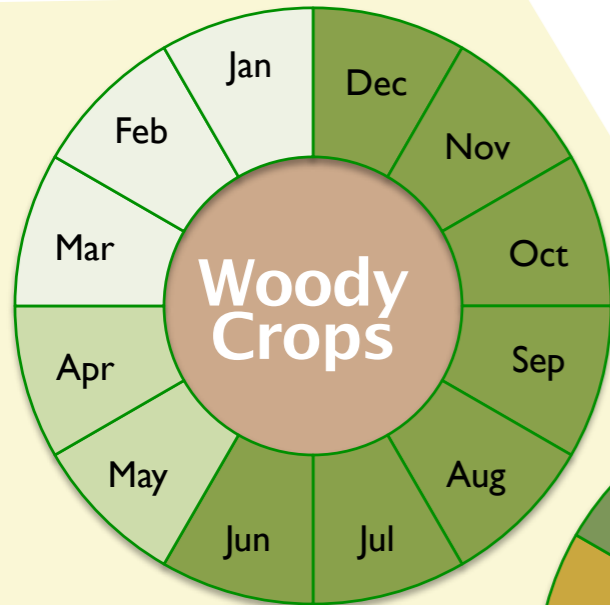
- Fort Valley State University
- Tuskegee University
- Alabama A&M University
- Tennessee State University
- Oak Ridge National Laboratory
- USFS-Southern Research Station
- Louisiana-Pacific Corp, Nashville, TN
- Rentech, Inc. (not shown, Commerce City, CO)
- DuPont/Genera Energy, Vonore, TN







★ The Focal Points (Research)

- Louisiana-Pacific, Roxboro, NC
- Genera Energy, Inc., Vonore, TN

■ The Field Trials

The Value of Integrated Supply



-  Reduce risk of supply chain disruptions
 - Weather extremes
 - Insects/disease
-  Minimize storage costs with JIT delivery
-  Optimize process performance
-  Maximize biomass yield
-  Increase environmental benefits
-  Meet landowner goals

Sustainable Biomass Production



 **5,000 acres of switchgrass in production**

 **Vonore, TN**



 **Commercial biomass preprocessing facility**



 **250,000 gallon/year cellulosic biorefinery**



IBSS Installations

- Short rotation woody crop demonstrations/trials installed
 - Fairhope, AL (eucalyptus)
 - Shorter, AL (poplar)
 - Huntsville, AL (poplar)
 - Knoxville, TN (poplar)
- Good survival, exceptional growth
- Significant genetic variation
- Competition control stands out as challenge
- Water quality sites installed in Vonore, TN



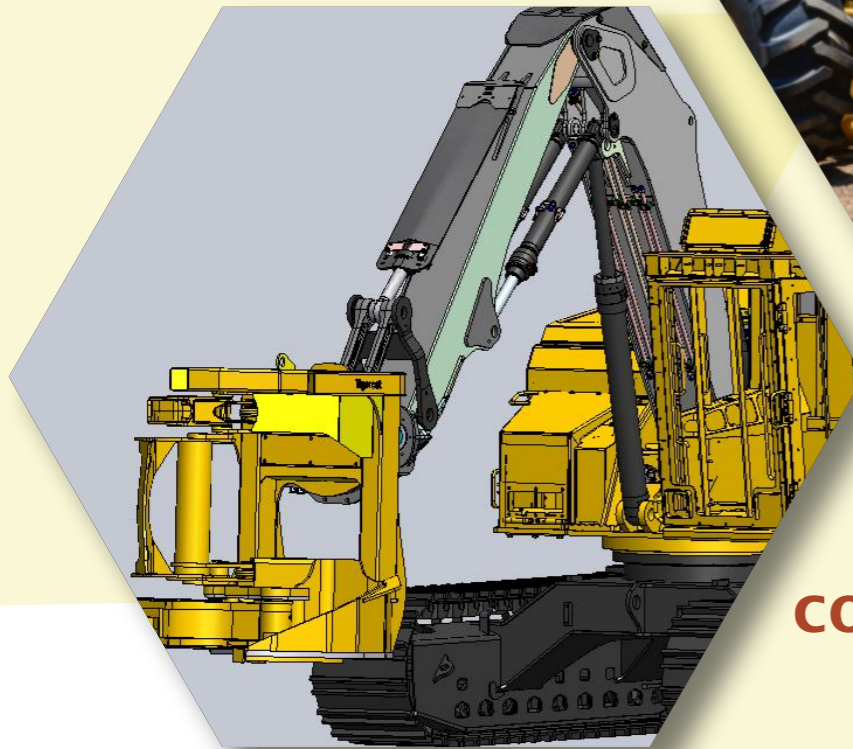
Small Diameter Operations



Economic modeling has identified stumpage price thresholds for economic feasibility in short-rotation southern pine plantations



Pine results will provide the benchmarks in modeling activities for short-rotation hardwood plantations



Modifying harvesting machine design concepts for short-rotation (hard)woody crop systems for the region

Defining A Chemical Resource



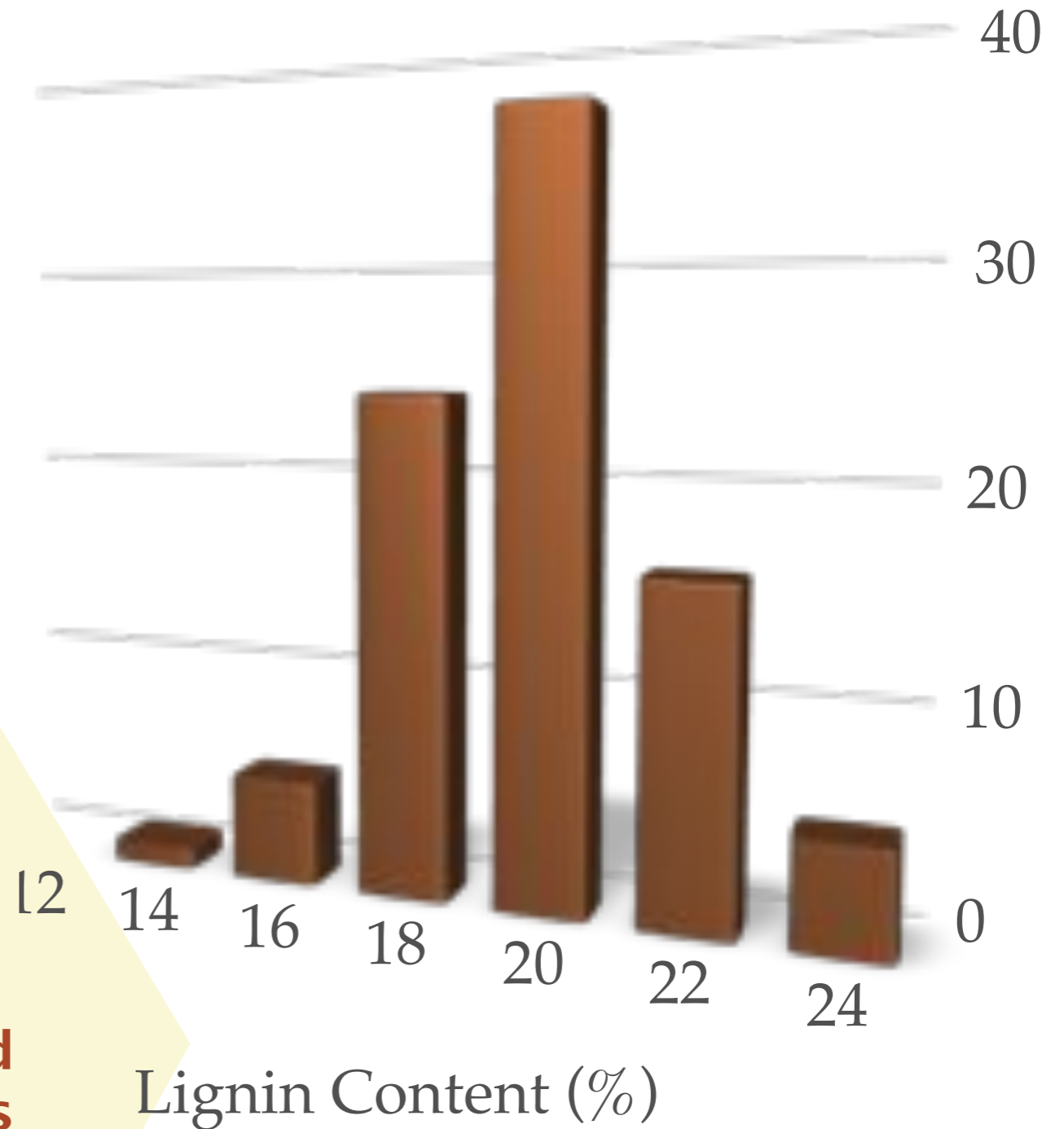
800 biomass samples from across the SE



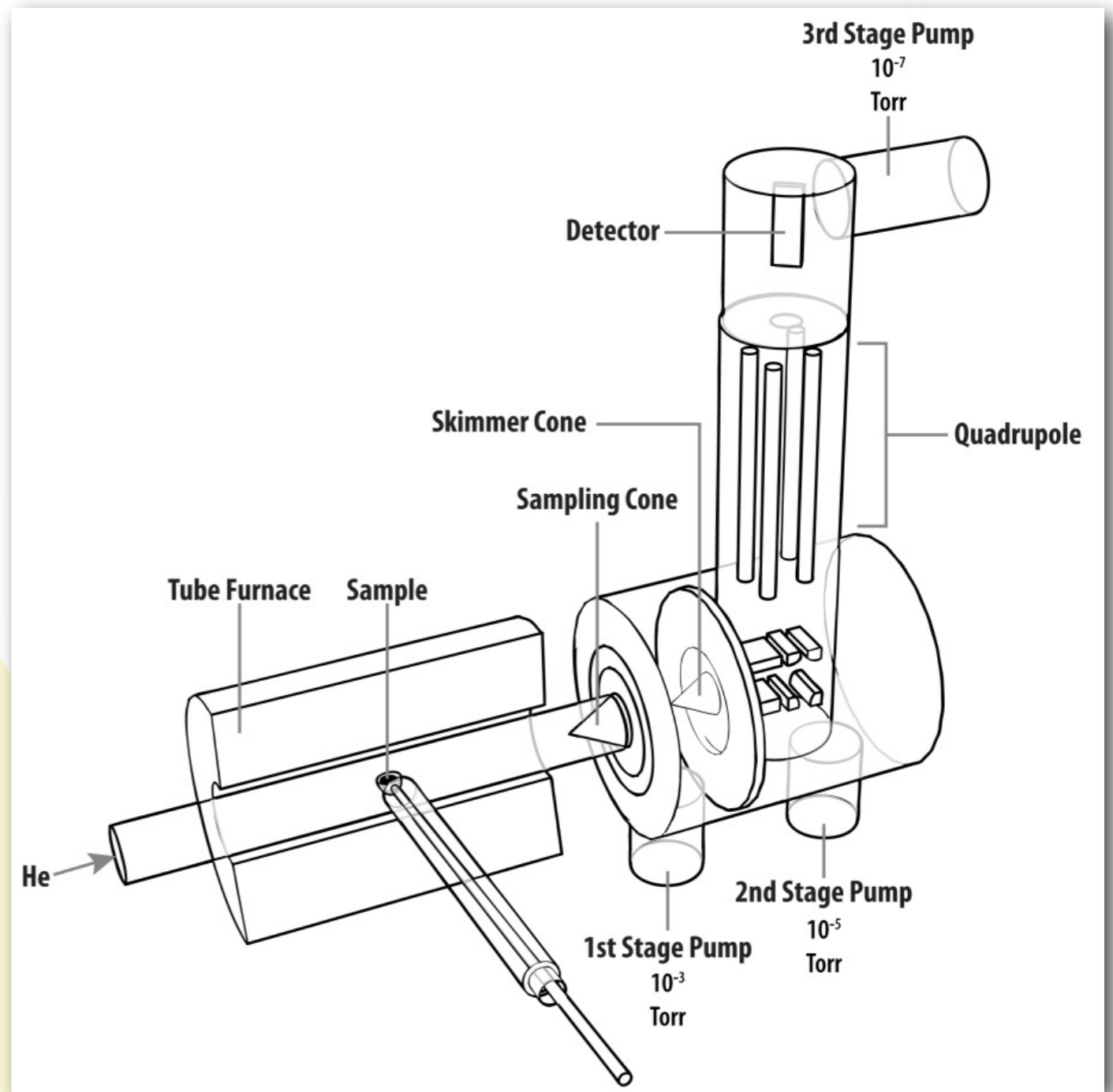
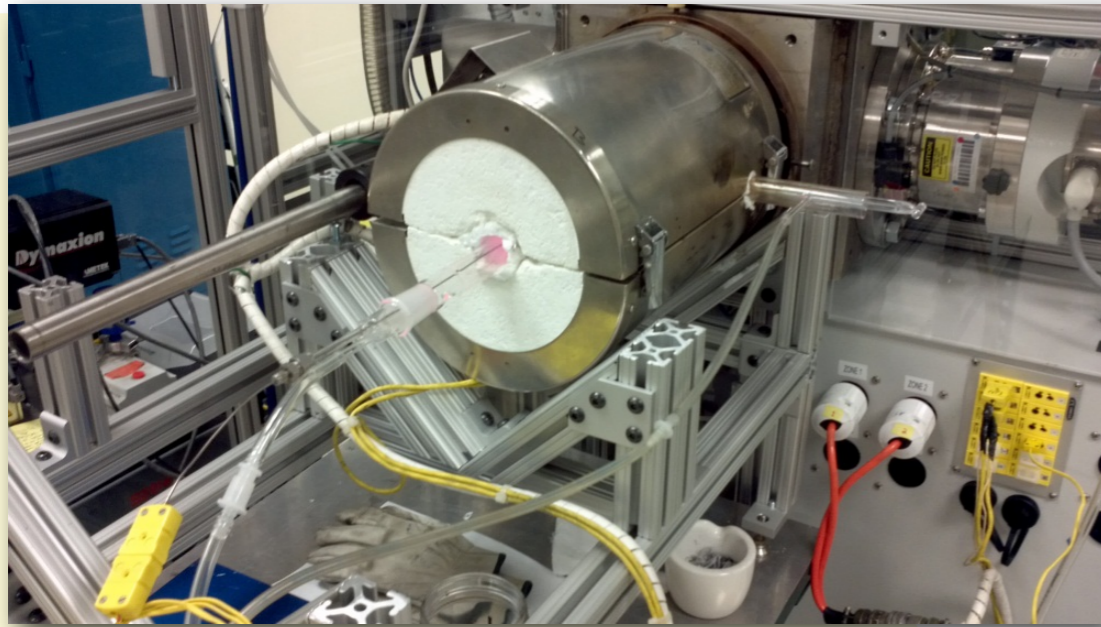
Grass incl. different storage time



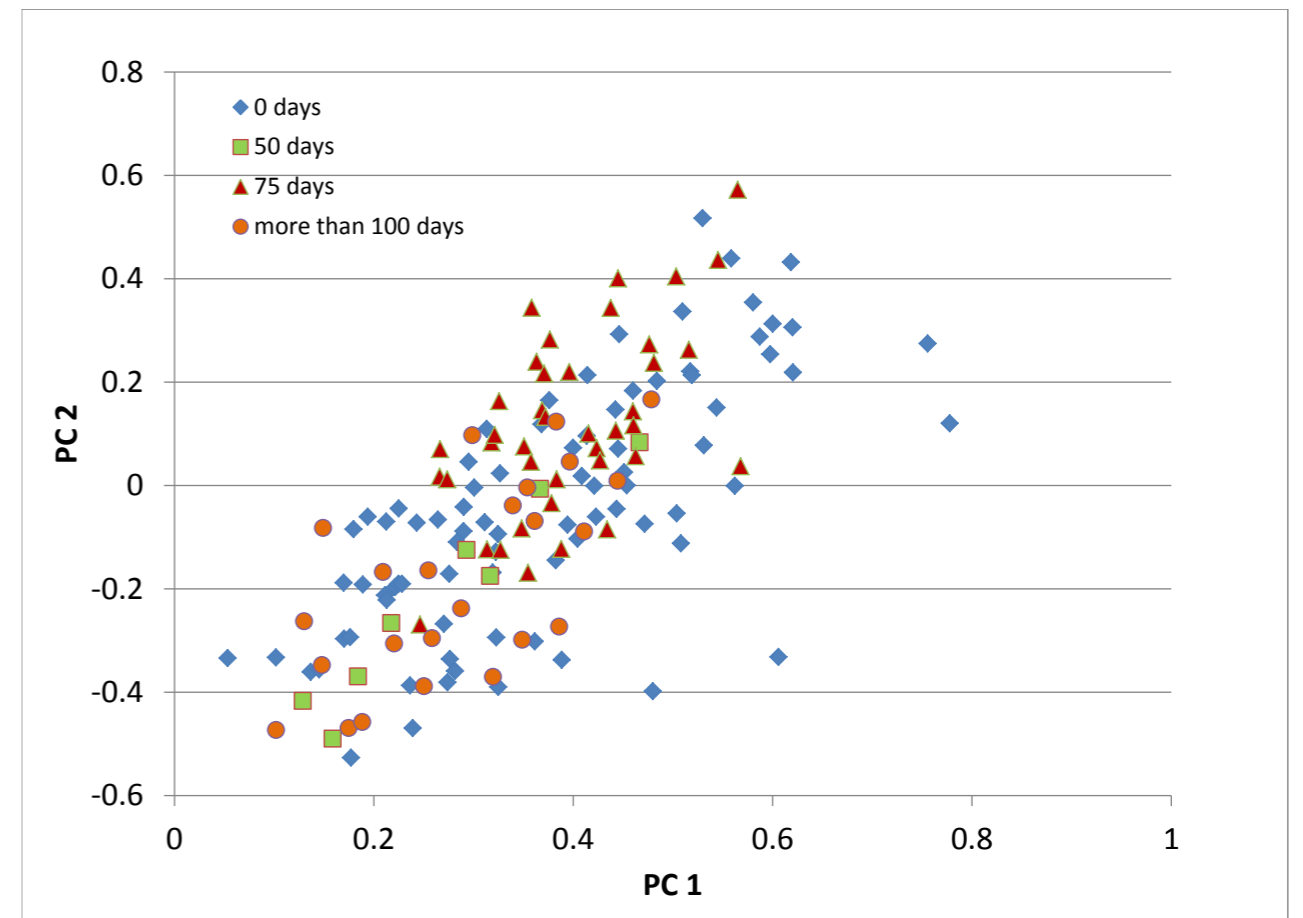
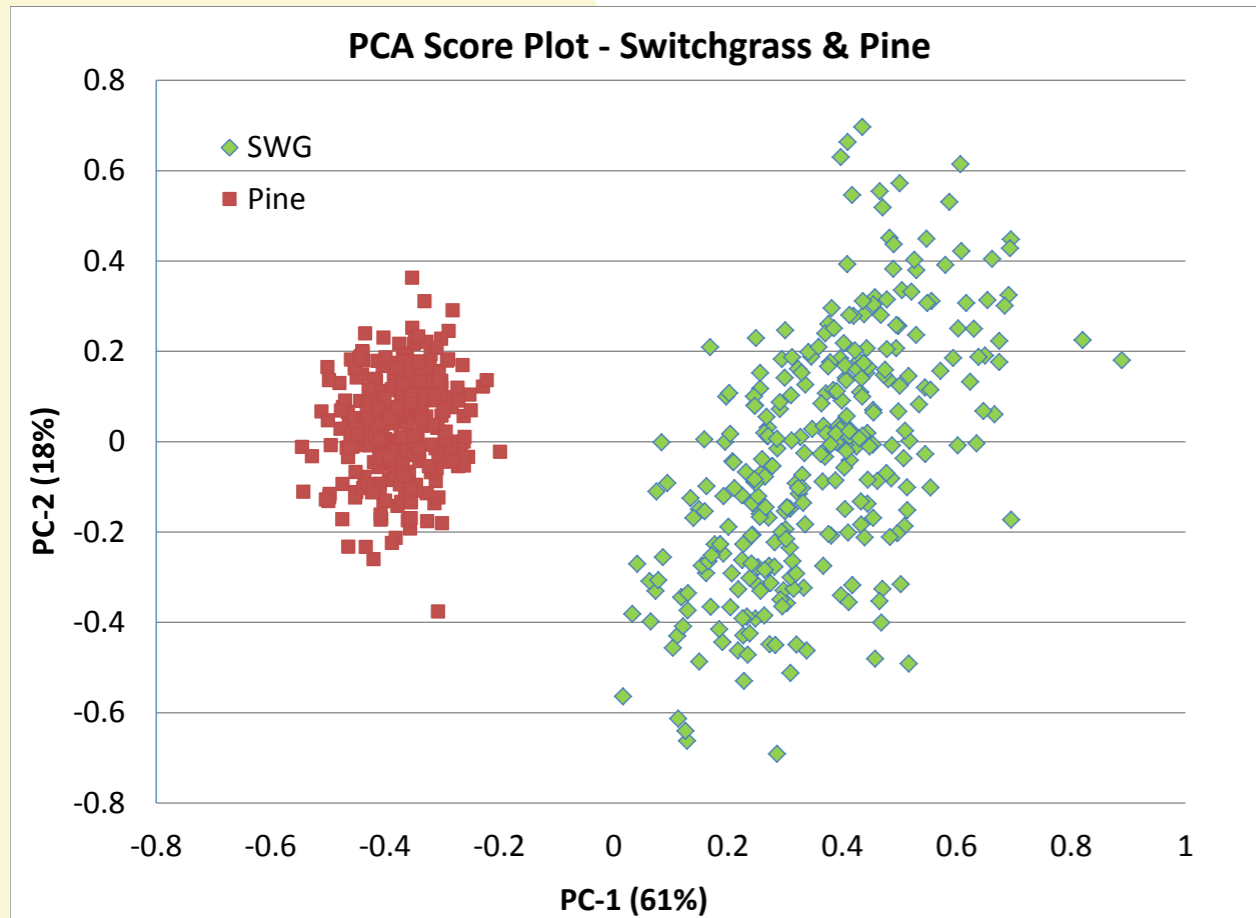
Chemical and physical properties under evaluation



Molecular Beam Mass Spectrometry

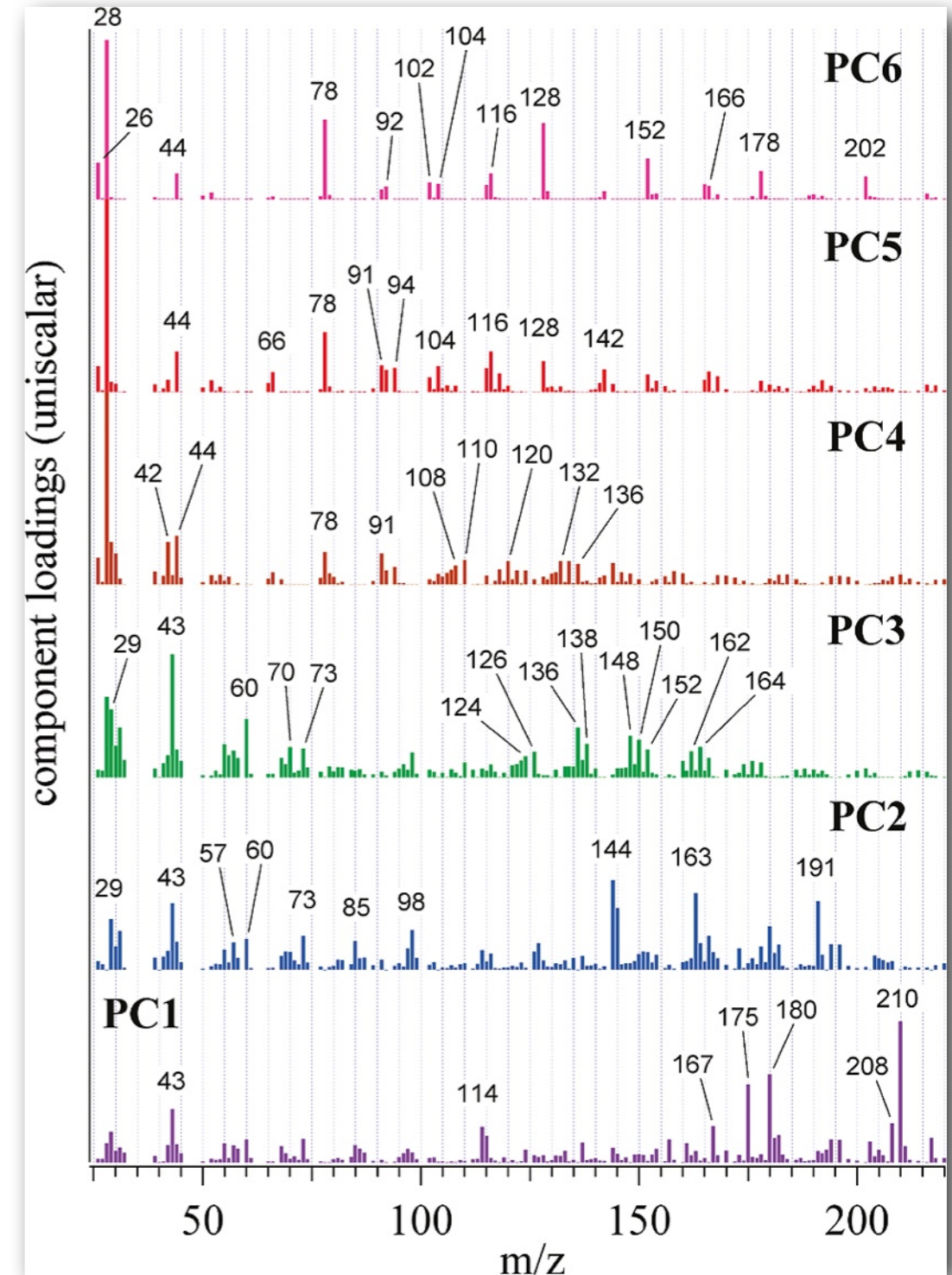
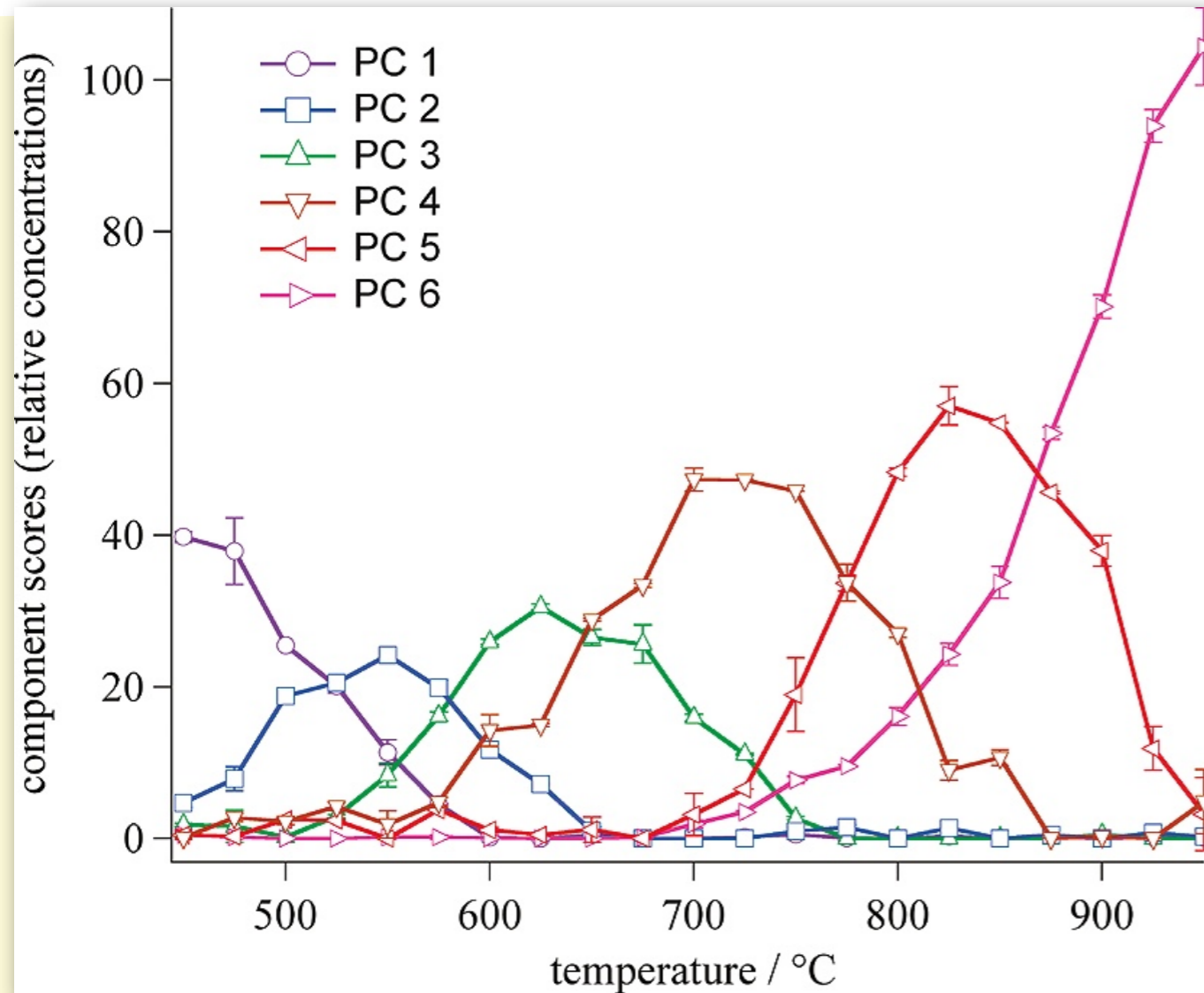


Defining Feedstock Performance







- ❏ Biomass samples evaluated using py-MBMS include: 1) 400 pine samples, 2) 200 eucalyptus, 3) 100 poplar, and 4) 100 switchgrass
- ❏ Response of switchgrass significantly different from pine...due to molecular species related to tar formation
- ❏ Thermochemical conversion processes, i.e., catalyst performance and lifetime, negatively impacted by these molecular species

“Simulating” Biomass Gasification



The evolution of molecular species during gasification of biomass can be assessed through a modified MBMS experiment.

The TC Focus

-  20 tpd biomass gasifier now operational (500 hours)
-  Harvested, preprocessed, and shipped SR biomass
 - Hybrid poplar (20 dry tons)
 - Loblolly pine (60 dry tons)
-  Addressed material handling issues
 - Size reduction approach
 - Moisture content
 - Particle flow
-  Bio-syngas to FT reactor

Fischer-Tropsch Reactor
BECE – Commerce City, CO

