# Woody Biomass Training Resources

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# Woody Biomass Training Resources

Topics Covered:

1. Introduction – Background Information
    a. Geographic Areas and Biomass Types
    b. Types of Bioenergy from Biomass
2. Wood to Energy - UFL
3. Forest Encyclopedia
    a. Southern Bioenergy Module
4. MS State University Extension Program

# Woody Biomass Training Resources

What do you envision
when you think about

Forest Biomass/Bioenergy

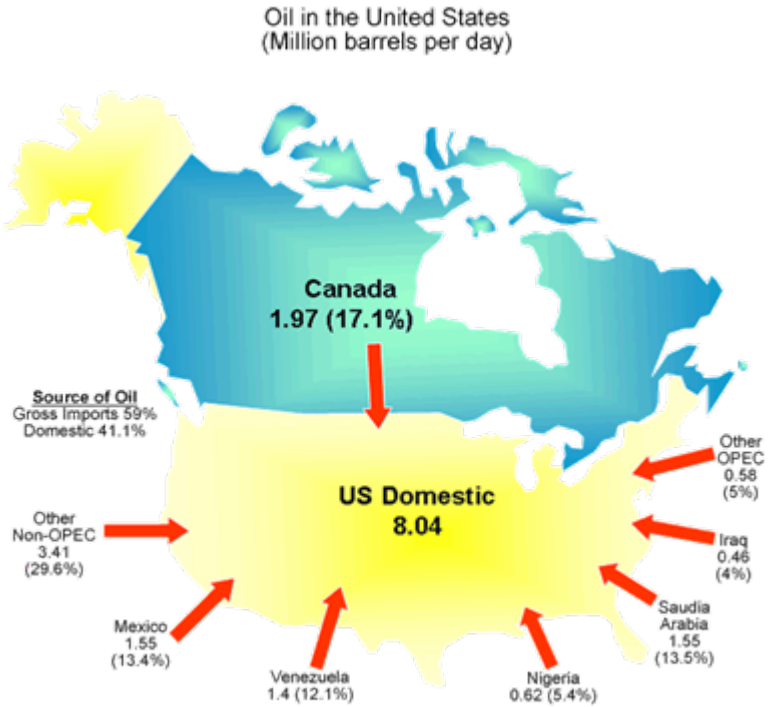
# Woody Biomass Training Resources

# Woody Biomass Training Resources

## Why are we interested in Biomass and Bioenergy?

Lower our dependence on fossil fuels due to increasing costs as well as reducing detrimental environmental effects

- Reduced fossil fuel use
- Renewable source
- Improved energy security



# Woody Biomass Training Resources

Today - Bioenergy - Ethanol

In the US, we may be reaching a breaking point between food and energy source on agricultural lands

If so, then woody biomass resource needs to play a critical role in bioenergy production as there is a vast source of this material in the South

**But – Increased R&D needed across a variety of fronts**

# Woody Biomass Training Resources

The Question which is still unknown is:

Can our southern forests be sustainably managed for a variety of objectives and produce enough woody biomass to generate an economical source of bioenergy?

Need to have a clear understanding of supplies, cost, and forest management strategies

ORNL 2000-00566A/abh

# Woody Biomass Training Resources

The most Promising Areas for Conversion from Woody Biomass to Bioenergy are:

1. Cellulosic Ethanol
    a. Considerable work to be done - How to break down cell walls and drive down the cost of enzyme technology

2. Fast Pyrolysis – Converts woody biomass into bio-oil. This can be produced in existing petroleum refineries
    a. Will compete with oil refineries and the need for 200 refineries

# Woody Biomass Training Resources

The most Promising Areas for Conversion from Woody Biomass to Bioenergy are:

3. Syngas (from gasification of biomass)
    a. Research is being done to make bio-oil from woody biomass while the next priority is to make gasoline from syngas
    b. Bio-oils can be produced by any plant that contains lignin

# Woody Biomass Training Resources

## Outreach – Training - Teaching

# Woody Biomass Training Resources

Outreach and Training Programs on all Aspects of Woody Biomass & Bioenergy are need to:

1. Increase Awareness
2. Provide Educational information - Scientific and Technical Knowledge
3. Invigorate our young people

Our Audience will be quite variable and includes:

a. Natural Resource Professionals
b. Energy Intensive Businesses
c. Landowners
d. Loggers
e. Teachers

# Woody Biomass Training Resources

The Information used in these efforts are derived from a variety of sources but the main sources are:

1. Forest Encyclopedia Network
2. Wood to Energy Training Resources
3. Sustainable Forestry for Bioenergy Products

# Woody Biomass Training Resources

The University of Florida produced a Woody to Energy Guide

This document can be used in a variety of ways such as:

1. Fact sheets, community profiles and case studies can be used for handouts

2. Case studies provide realistic information to decision makers

3. However, the primary use is an outreach tool in training sessions

# Woody Biomass Training Resources

The University of Florida produced a Woody to Energy Guide

Four Types of Fact Sheets have been developed and include:

1. General Fact Sheets – Exploring possibilities, Common Concerns and Comparison of Wood and Fossil Fuels

2. Environmental Fact Sheets – Climate Change and Carbon, Impacts on Air Quality, Sustainable Forest Management

# Woody Biomass Training Resources

The University of Florida produced a Woody to Energy Guide

3. Economic Fact Sheets – Economic impacts of generating electricity, Sources and Supplies

4. Technical Fact Sheets – (More for Decision Makers) but includes Federal Policies and Incentives, Financing Woody Biomass Facilities, Systems that Convert Wood into Energy

# Woody Biomass Training Resources

The University of Florida produced a Woody to Energy Guide

This document can be found on the internet at www.interfacesouth.org/woodybiomass

MS Counties identified as possible candidates for Bioenergy Activities:

DeSoto, Hancock, Jackson, Lafayette, Lamar, Lee, Madison, Neshoba, Rankin, and Warren

# Woody Biomass Training Resources

## Information Developed for Each Community

1. Cost Calculations
    a. Delivered cost, within a 1hr radius
2. Physical Availability
    a. Urban wood waste, logging residue, pulpwood
3. Supply Curve Construction & Analysis
    a. Each energy resources and cost per haul time
4. Economic Impact Analysis

# Woody Biomass Training Resources

## Another Source of Information

Forest Bioenergy Website

www.forestbioenergy.net

Included on the Forest Bioenergy Website are:

1. Variety of presentations concerning woody biomass and bioenergy production
2. Large glossary of terms (A to Z)
3. Links to other sites on this subject

# Woody Biomass Training Resources

Included on the Forest Bioenergy Website are:

1. Variety of presentations concerning woody biomass and bioenergy production – Examples:
    a. Dupont Biofuels: Strategy, Progress and future steps
    b. Woody Biomass Outreach Training PPT presentations

# Woody Biomass Training Resources

Encyclopedia of Southern Bioenergy

1. Included in the Forest Encyclopedia Network (FEN) found at www.forestencylopedia.net

2. This was created as a combined effort of the Forest Service Southern Research Station and the Southern Regional Extension Forestry Office

3. As FEN expanded the southern forestry university communities became active participants

# Woody Biomass Training Resources

## The Educational Initiative for Forestry Biomass/Bioenergy

In 2007, Efforts resulted in an effective training tool that can be used for a variety of audiences

Provides an updated look at Sustainable Forestry for Bioenergy and Bio-Based Products

# Woody Biomass Training Resources

This program relies heavily on the Encyclopedia of Southern Bioenergy

Comprised of 6 Interrelated Modules:

1. The Bioenergy Resource
2. Forest Management
3. Harvesting and Transportation
4. Socio-economic Issues
5. Environmental Sustainability
6. Utilization

# Woody Biomass Training Resources

## The Educational Initiative for Forestry Biomass/Bioenergy

The Modules can be used:

Individually to address specific issues for targeted audiences

Collectively, as a general educational curriculum

# Woody Biomass Training Resources

## The Educational Initiative for Forestry Biomass/Bioenergy

Each Modules includes:

1. Introduction to the topic and highlights
2. Fact sheets -
    a. Summarize important points
    b. In-depth detail
3. PowerPoint Presentation -
    a. In-depth coverage of the topic

# Woody Biomass Training Resources

## The Bioenergy Resource

The information in this module includes:

1. Definition of forest biomass and bioenergy
2. Explain the biomass potential of the Southern forests
3. Describe the role of forest biomass as a sustainable renewable energy source for the Southern US

# Woody Biomass Training Resources

The Bioenergy Resource (Cont'd)

The 1st Section of this Module includes:

1. Understanding Bioenergy Oppurtunities
   a. Focuses on the bioenergy industry
   b. Also includes challenges of the bioenergy industry
   c. Status of biomass in the US

# Woody Biomass Training Resources

The Bioenergy Resource (Cont'd)

The 2nd Section of this Module includes:

1. The Southern US and Potential for Bioenergy
   a. This potential is defined by forest types, physiographic region, climate and soils
   b. Bioenergy potential is described by class of biomass, SRWC, residues and small diameter woody biomass

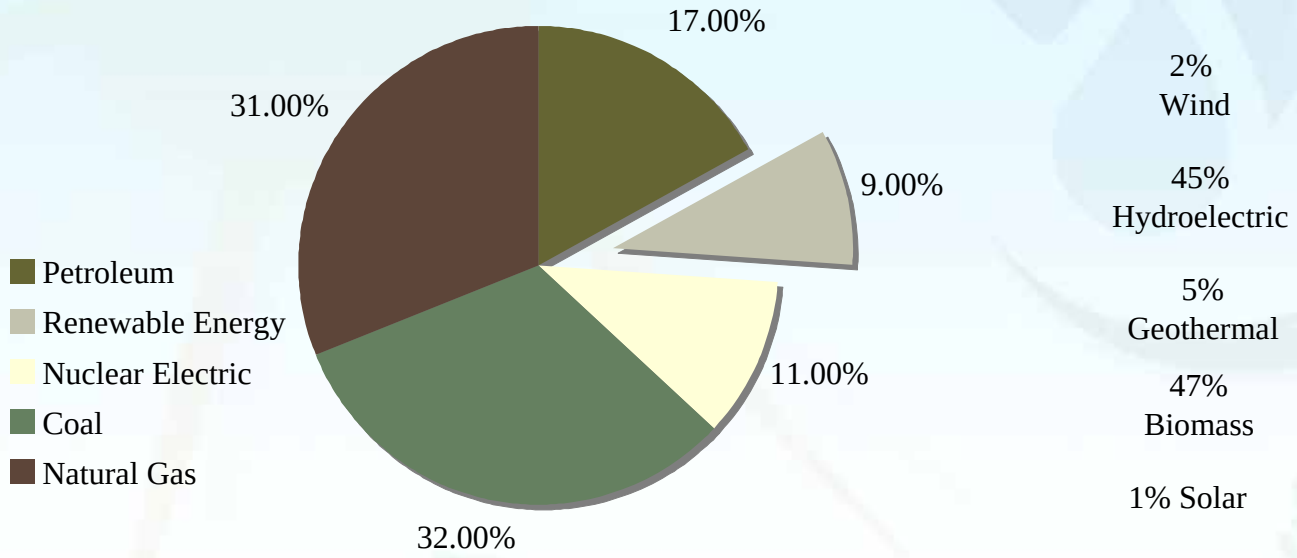
# Module 1: Understanding Bioenergy Resources

# Objectives

- Define woody biomass
- Define bioenergy
- Explain the benefits of using woody biomass for bioenergy
- Describe the role woody biomass plays in global bioenergy production

# Biomass in the United States

- Domestic energy production
- 9% renewable: 47% biomass: 72% wood-based



# Woody Biomass Training Resources

## The Forest Management Module

Module focuses on how resource managers & landowners can integrate biomass production for bioenergy into a management plan.

a. Helps the landowner decide if biomass for bioenergy production fits into their objectives

# Woody Biomass Training Resources

## The Forest Management Module Cont'd

Module separated into 3 sections:

1. Factors to consider when examining the possibility of produced Bio-Based products
   a. These include – objectives, site characteristics and profitability

2. Forest Management and Silviculture
   a. Explains sustainable ecosystem mgmt – How biomass for bioenergy is a renewable resource

3. Biomass Production by Forest Type
   a. 5 forest types and SWRC – Types include PP, NP, OP, LHWD, UHWD

# Woody Biomass Training Resources

## MSU Extension Biomass/Bioenergy Program

The previous information will be the cornerstone of the MSU Biomass and Bioenergy Program

The program is divided into 3 Phases:

Phase 1 – Training of County Extension Personnel and Extension Specialists from the 4 Extension Districts

# Woody Biomass Training Resources

## MSU Extension Biomass/Bioenergy Program

Phase 2 – General Awareness Program

a. Will include CFA, MS Board of Supervisors, MFA, MS Rural Economic Council, Forest Managers and Consultants

b. Sessions will consists of seminars and field days

# Woody Biomass Training Resources

## MSU Extension Biomass/Bioenergy Program

Phase 3 – Development of a Short Course

a. Develop a short course for Mississippi that will cover an array of biomass/bioenergy topics

b. Hopefully, this will be offered through a variety of outlets, such as DVDs, interactive video, distant learning course as well as on paper

# Woody Biomass Training Resources

## SUMMARY

1. Information available on the web
    a. Can be used for technical info, teaching and understanding possibilities for bioenergy production
2. MSU Extension Short Course
    a. Customized to MS and will start with County Directors, Extension Specialists and later available to all through various media

# Woody Biomass Training Resources

## SUMMARY

Still Great Challenges to Biomass/Bioenergy

Training will provide everyone a greater knowledge of biomass and bioenergy

Providing insights into how Bioenergy might fit into specific situations and/or communities

# Woody Biomass Training Resources

## Questions

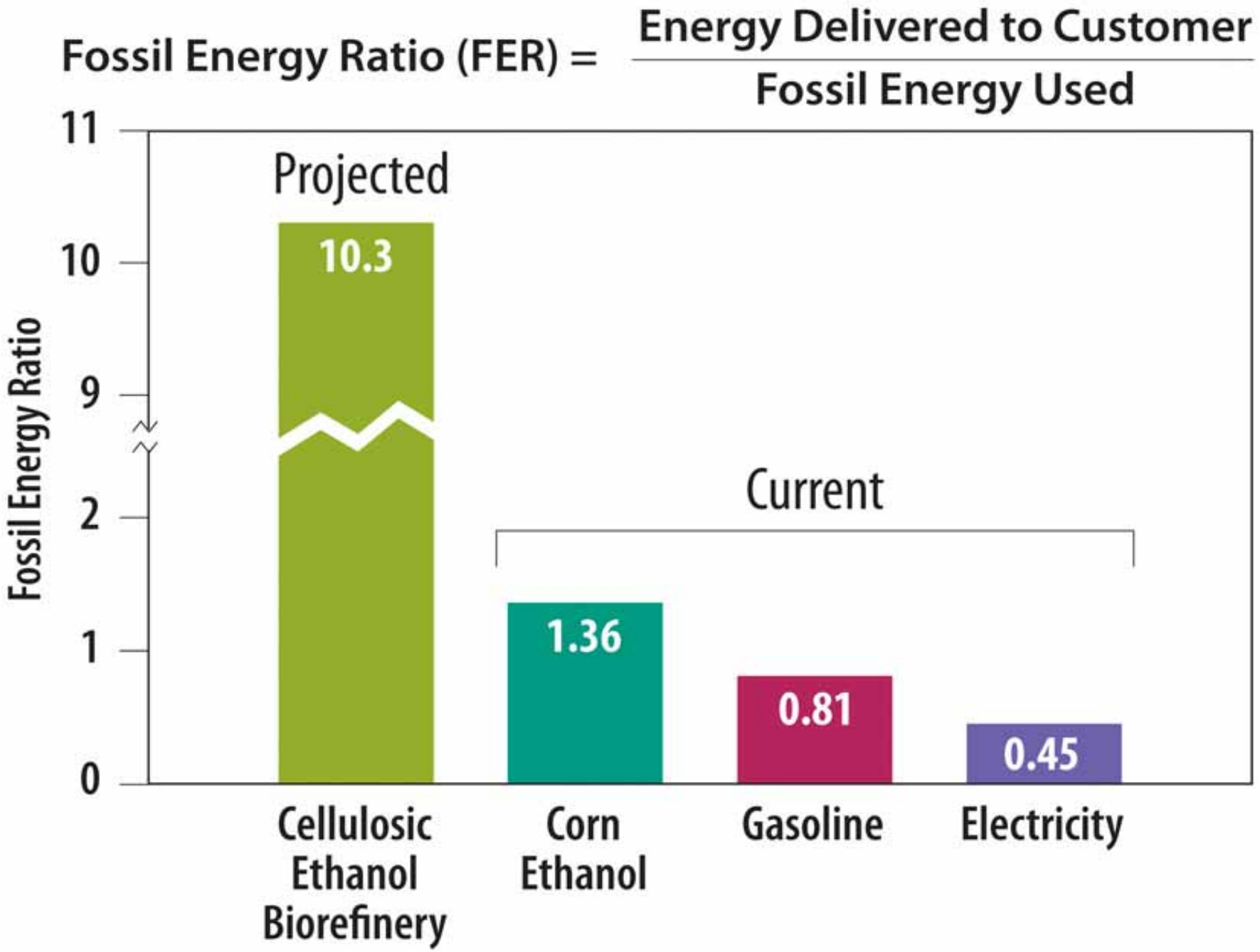
# Woody Biomass Training Resources

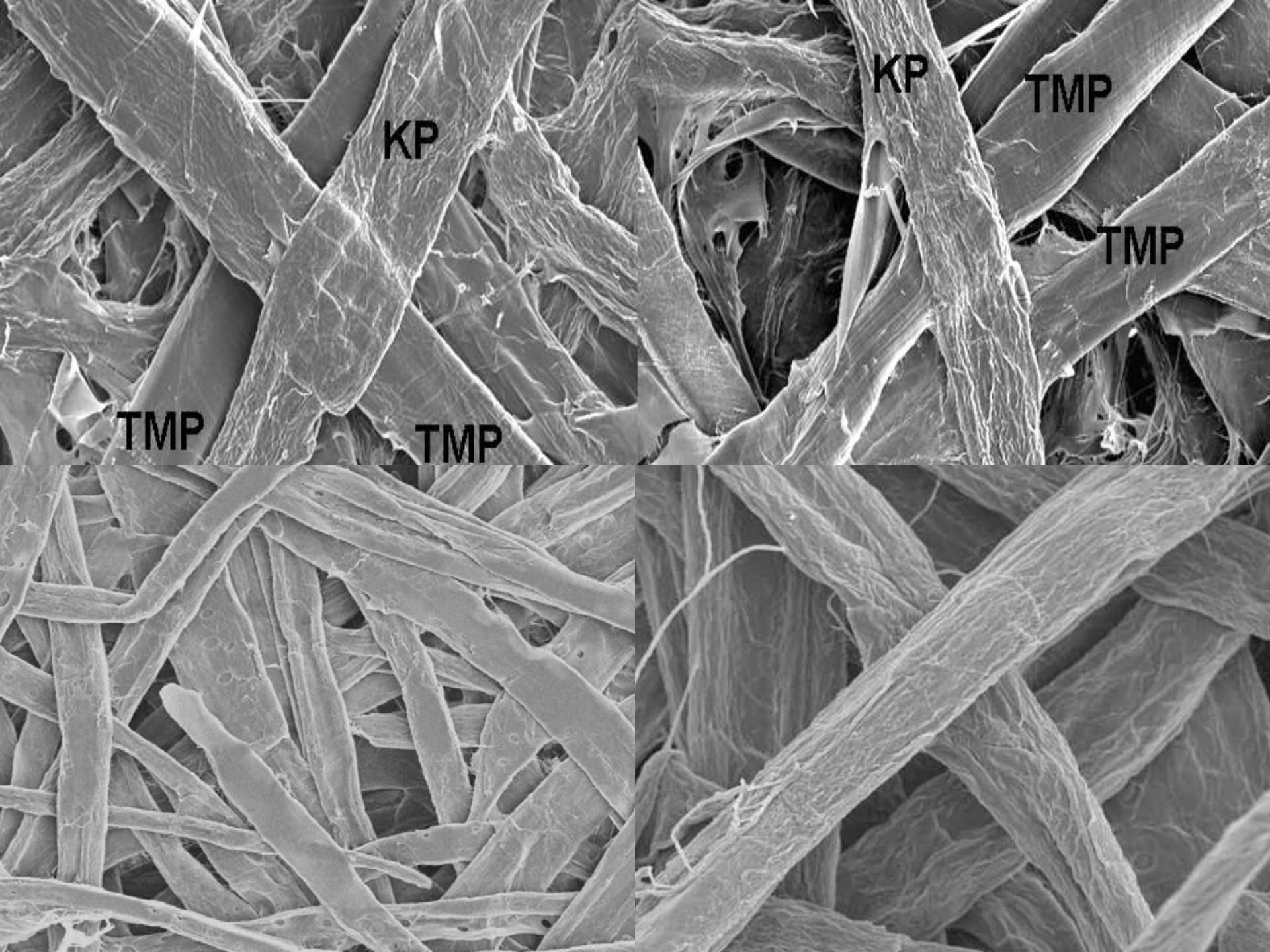
Southern Forest Research Partnership (SFRP)

Forest Bioenergy Training Manual

Seven Modules:

1. Understanding Bioenergy Resources
2. The Southern Bioenergy Resource
3. Forest Management for Bioenergy Production
4. Introduction to Harvesting, Transportation, and Processing
5. Utilization of Woody Biomass
6. Economics of Forest Biomass
7. Environmentally Sustainable Bioenergy Production Systems


Fossil Energy Ratio (FER) = Energy Delivered to Customer / Fossil Energy Used
Fossil Energy Ratio
11
10
9
2
1
0
Projected
10.3
Current
1.36
0.81
0.45
Cellulosic Ethanol Biorefinery
Corn Ethanol
Gasoline
Electricity


KP
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**Biomass Pyrolysis, Characterization and Stabilization**

- Convert lignocellulosics into liquid fuels
  - Start with softwood
- Understand the chemical transformations in pyrolysis
  - **Emphasize catalytic pyrolysis**
- Economics
- Product tailoring
- Stabilize bio-oils
- Compatibilize refinery bio-oils

# Woody Biomass Training Resources

## Utilization of Biomass for a Variety of Bio-Products

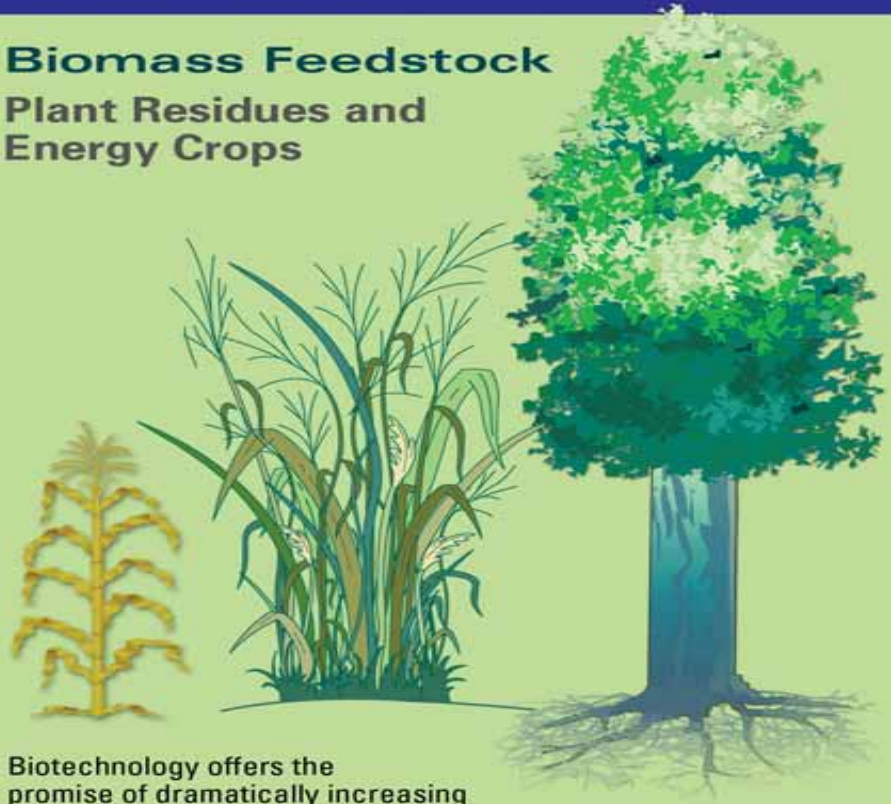
Module provides information on:

1. Chemical extractives
2. Biorefineries

# From BIOMASS to CELLULOSIC ETHANOL

## Biomass Feedstock

### Plant Residues and Energy Crops



Biotechnology offers the promise of dramatically increasing ethanol production using cellulose, the most abundant biological material on earth, and other polysaccharides (hemicellulose). Residue including postharvest corn plants (stover) and timber residues could be used, as well as such specialized high-biomass "energy" crops as domesticated poplar trees and switchgrass.

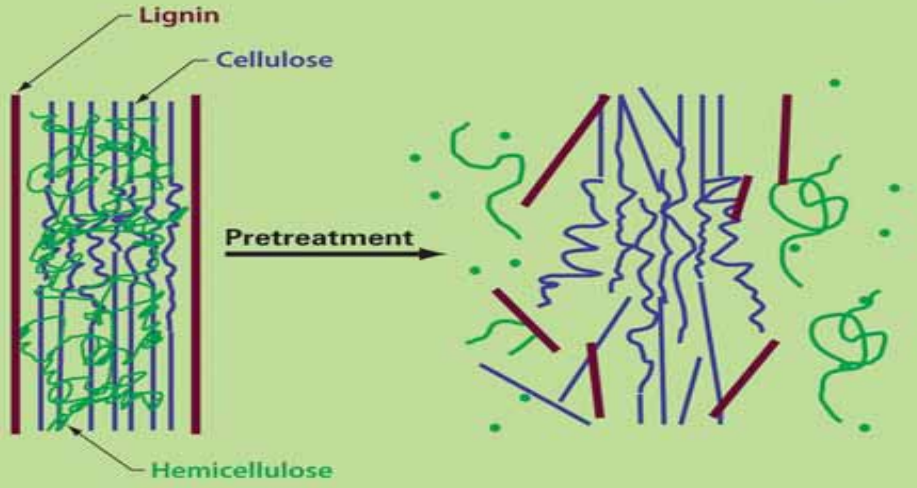
Biochemical conversion of cellulosic biomass to ethanol for transportation fuel currently involves three basic steps:

- **Pretreatments to increase the accessibility of cellulose to enzymes and solubilize hemicellulose sugars**
- **Hydrolysis with special enzyme preparations to break down cellulose to sugars**
- **Fermentation to ethanol**

Making cellulosic biomass conversion to ethanol more economical and practical will require a science base for molecular redesign of numerous enzymes, biochemical pathways, and full cellular systems.

## Pretreatment

**Goal:** Make cellulose more accessible to enzymatic breakdown (hydrolysis) and solubilize hemicellulose sugars

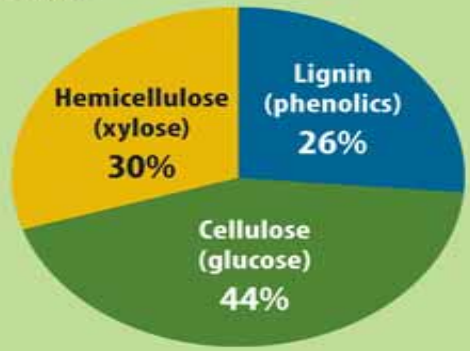



Cellulose exists within a matrix of other polymers, primarily hemicellulose and lignin. Pretreatment of biomass with heat, enzymes, or acids removes these polymers from the cellulose core before hydrolysis.

Pretreatment, one of the most expensive processing steps, has great potential for improvement through R&D.

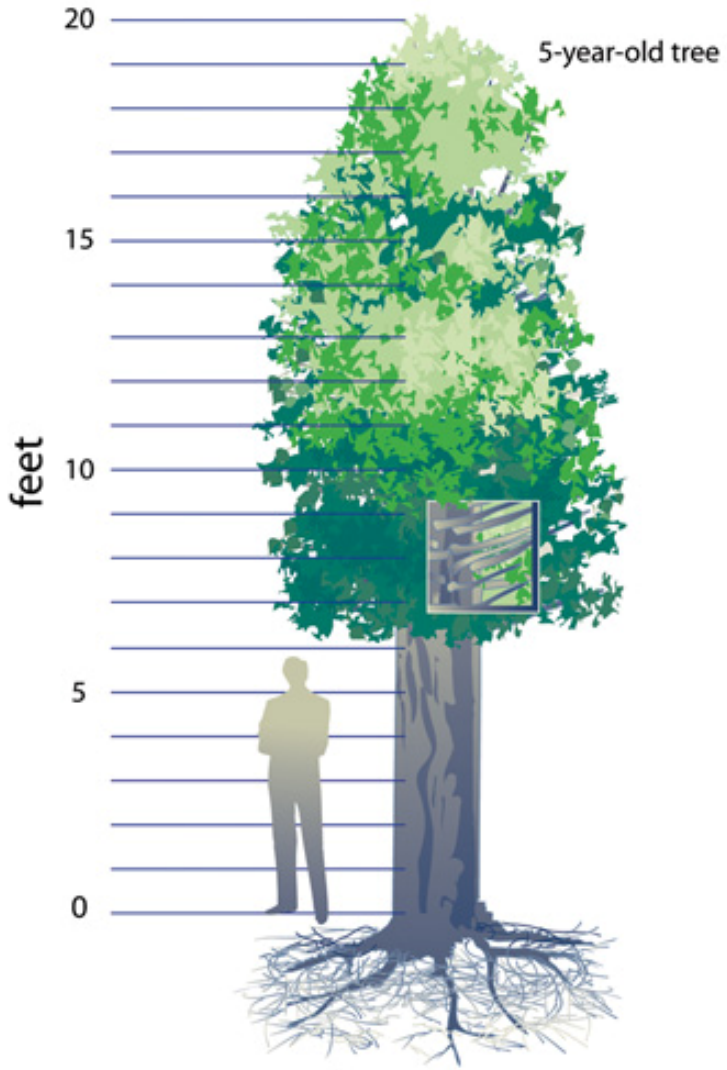
*[Figure adapted from N. Mosier et al. 2005. "Features of Promising Technologies for Pretreatment of Lignocellulosic Biomass," Bioresource Technology **96**(6), 673–86. Reprinted with permission from Elsevier.]*

**Composition of Biomass** (lignocellulose)



## Capture and Allocation of Carbon

- Increased photosynthesis
- Optimized photoperiod response
- Optimized crown and leaf architecture
- Greater carbon allocations to stem diameter vs height growth




## Biomass

- Controlled and readily processable cellulose, hemicellulose, and lignin
- Tailored biomass composition with value-added chemicals
- Enhanced biomass production per acre by manipulation of photomorphogenic responses

## Tolerance and Sustainability

- Pest and disease resistance
- Drought and cold tolerance
- Floral sterility
- Regulated dormancy
- Delayed leaf senescence
- Optimal nutrient acquisition and use
- Rhizosphere and microbial community health

# How Can Biomass Be More Competitive?

- Reduce fuel costs by improving the efficiency in growing, procuring, transporting, and processing forest biomass
- Reduce non-fuel costs through improving efficiency in energy conversion (from biomass to secondary energy)
- Tax $CO_2$ emissions or provide incentives/credits for carbon displacement

# Logging Residue