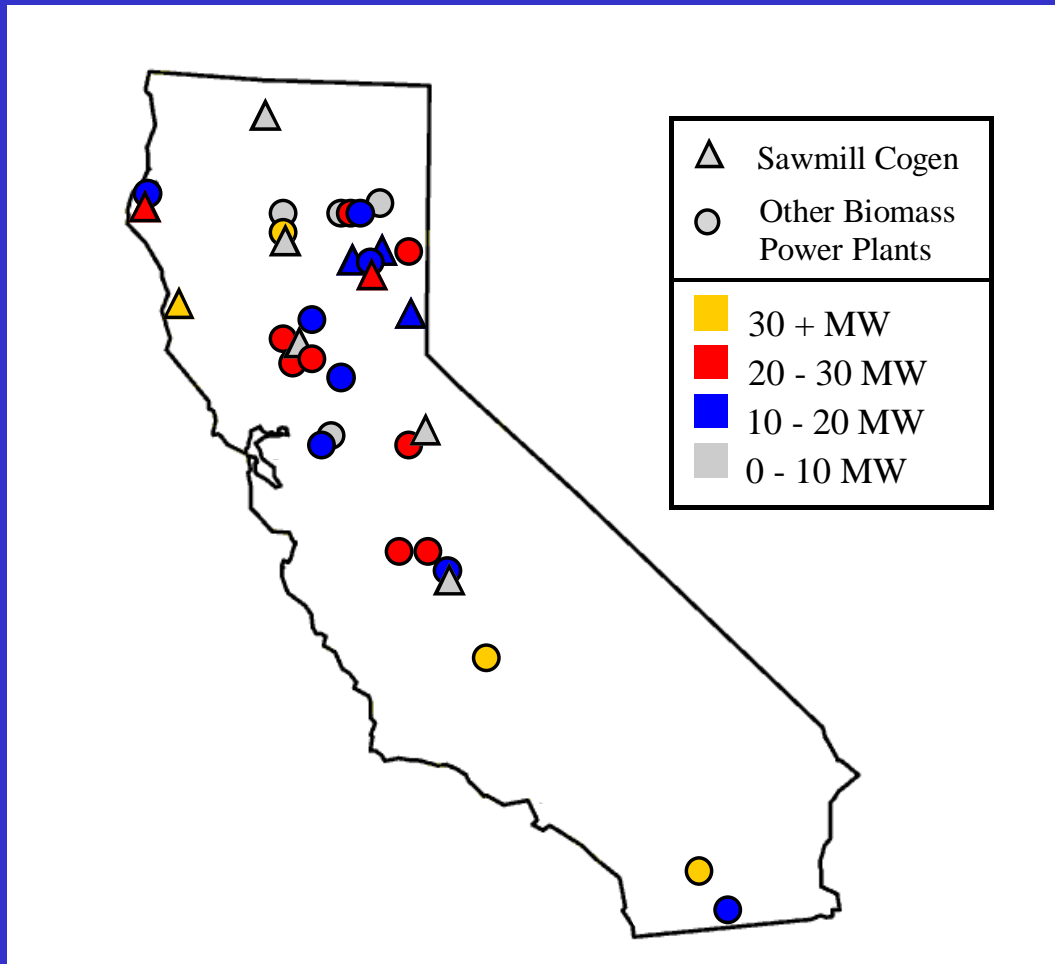


# Biomass to Energy

John R. Shelly  
UC Berkeley

# California Biomass Energy Facilities



A 10 MW (megawatt) generator can supply electricity to about 10,000 homes.

**Total Capacity**

~ 625 MW

**Biomass Consumption**

4.5 million BDT per year

of which

22% is forest-based

# Innovation

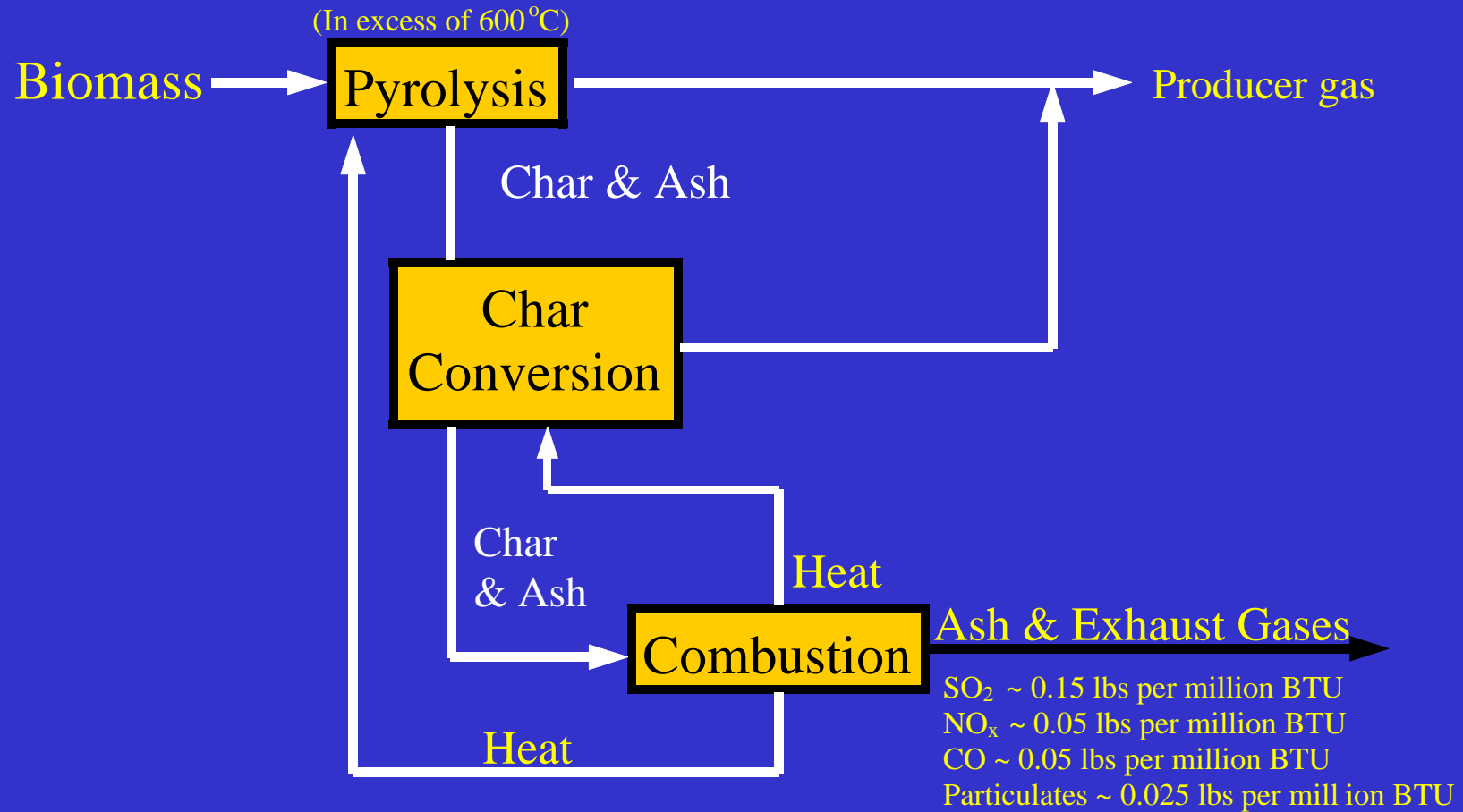
	Softwoods	Hardwoods
Cellulose	40-44 %	43-47 %
Hemicellulose	25-29	25-35
Lignin	25-31	16-24
Extractives	1-5	2-8
Ash	< 1	< 1

# Organic Chemicals from Biomass

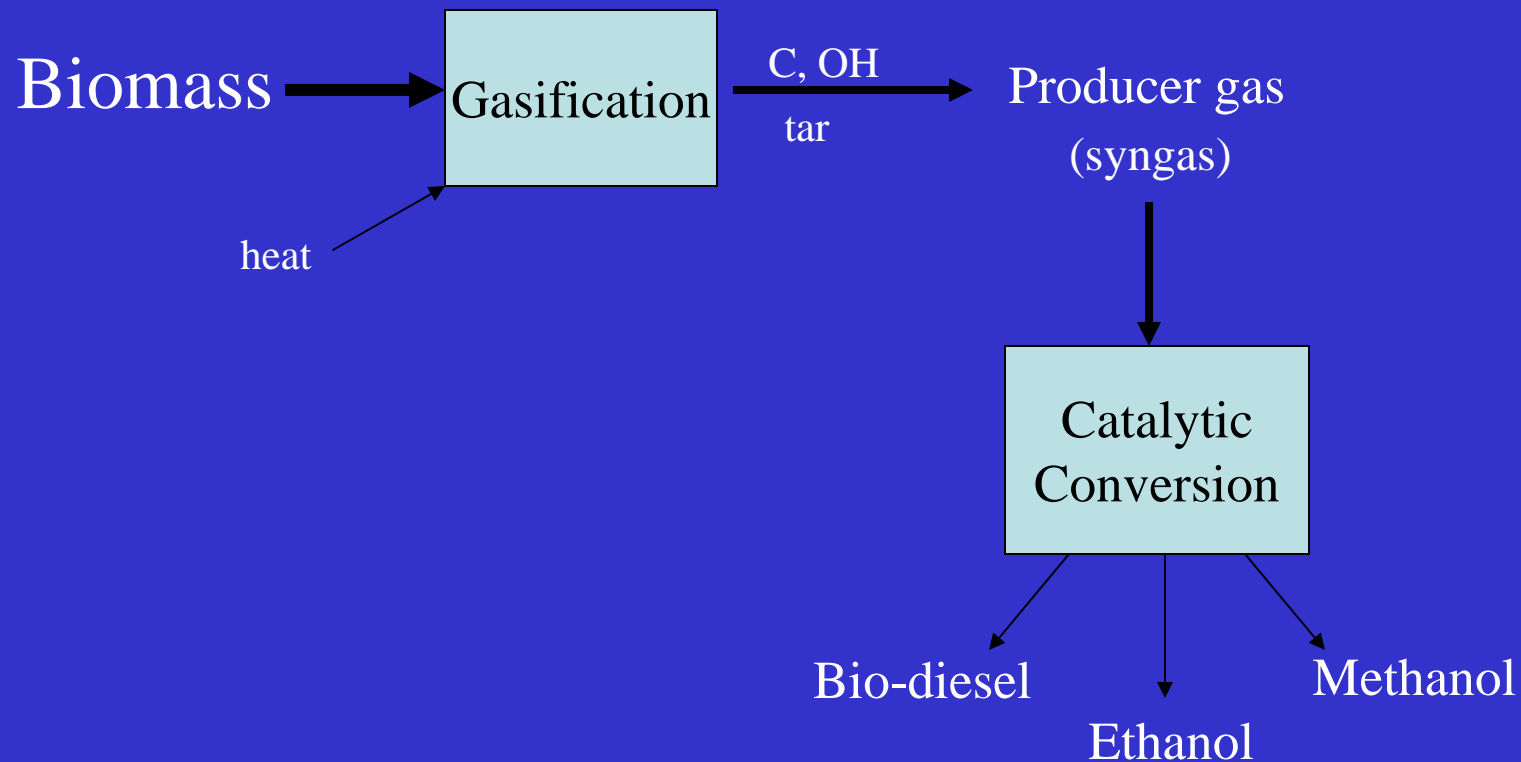
*Many Valuable Chemicals can be Made from Wood*

- **Pharmaceuticals and Fragrances -- Extraction**
- **Charcoal, phenolic oils, methanol -- Pyrolysis**
- **Bio-Gases (low BTU, high CO) -- Gasification**
- **Levulinic and Lactic acid (“building blocks”) –  
– Hydrolysis/Conversion**
- **Ethanol -- Hydrolysis/Fermentation or Thermal  
Reduction/Catalytic Conversion**

# Gasification Process



# Thermal Reduction/Catalytic Conversion



# Biomass to ETOH Technologies

- Hydrolysis/Fermentation
  - Concentrated Sulfuric Acid
  - Dilute Sulfuric Acid
  - Dilute Nitric Acid
  - Enzymatic
- Thermal Reduction/Chemical Conversion
  - Gasification/Catalytic Conversion (Fischer-Tropsch)

# Hydrolysis/Fermentation

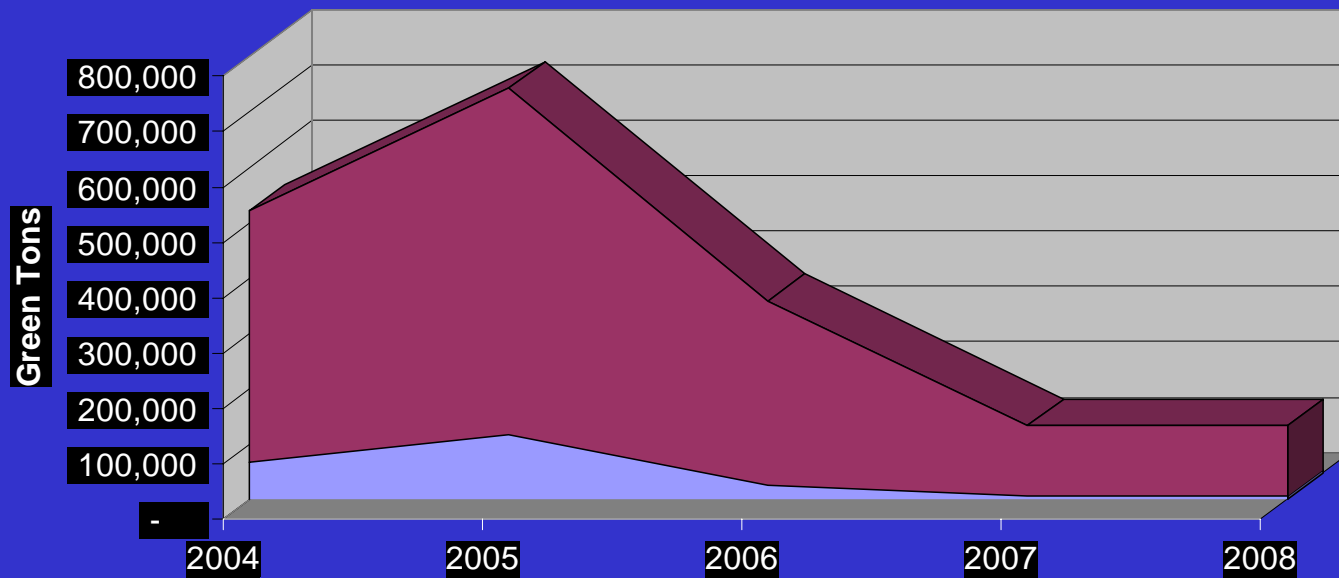
- Dilute nitric acid hydrolysis
  - Separates the 5 and 6 carbon sugars from the lignin
- Yeast Fermentation
  - Converts sugars to alcohol



# Challenges for Manufacturing Biomass-Based Products

- Insure a Long-Term Supply of Biomass Raw Material
- Overcome Material Property Limitations (biomass is a low quality raw material)
- Reduce the High Handling and Production Costs
- Improve Processing Knowledge
- Develop New Markets or Market Share

# Estimated Change in Sawlog Portion of Total Biomass, 2004-08



- Total Biomass (includes commercial sawlogs, other sawlogs, limbs, tops etc.) (green tons)
- Commercial Sawlog Component (MBF converted to green tons @ 6 tons/MBF)

<b>Estimated Annual Resource Availability</b>				
	percent	Green Tons		
commercial sawlogs	10	12,700		
Biomass Energy	16	20,320		
Remanufacturing/pallets	28	35,560		
Mulch/Soil amendments	34	43,180		
micro-mills	1	1,270		
speciality roundwood	4	5,080		
firewood	7	8,890		
<b>TOTAL</b>		<b>127,000</b>	<b>78740 GT</b>	<b>~ 8 MW</b>
Total Sawlog availability		13,970		
<b>Estimated Sawmill Production</b>				
	MBF/yr			
Micromill	500	83		
Small-size mill	10,000	1,667		
Moderate size mill	25,000	4,167		
<b>Total</b>	<b>35,500.00</b>	<b>5,917</b>		