Introduction to Woody Biomass Utilization

Woody Biomass Utilization Workshop

Quincy, CA

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What is Woody Biomass?

Portions of woody plants or residues from woody plants that accumulate to levels that pose a hazard or disposal problem or woody plants specifically grown for biomass markets.

- Low quality natural resource
- Low value natural resource

Woody Biomass Comes from Many Sources!

Woody Biomass Sources

Sawmill Residue

Woody Biomass Sources

Woody Biomass Sources

Logging Residue and Slash

Woody Biomass Sources

Dedicated Forest

Woody Biomass Sources

Fuel Reduction Thinning

Woody Biomass Sources

Dead Trees (disease or fire)

Woody Biomass Sources

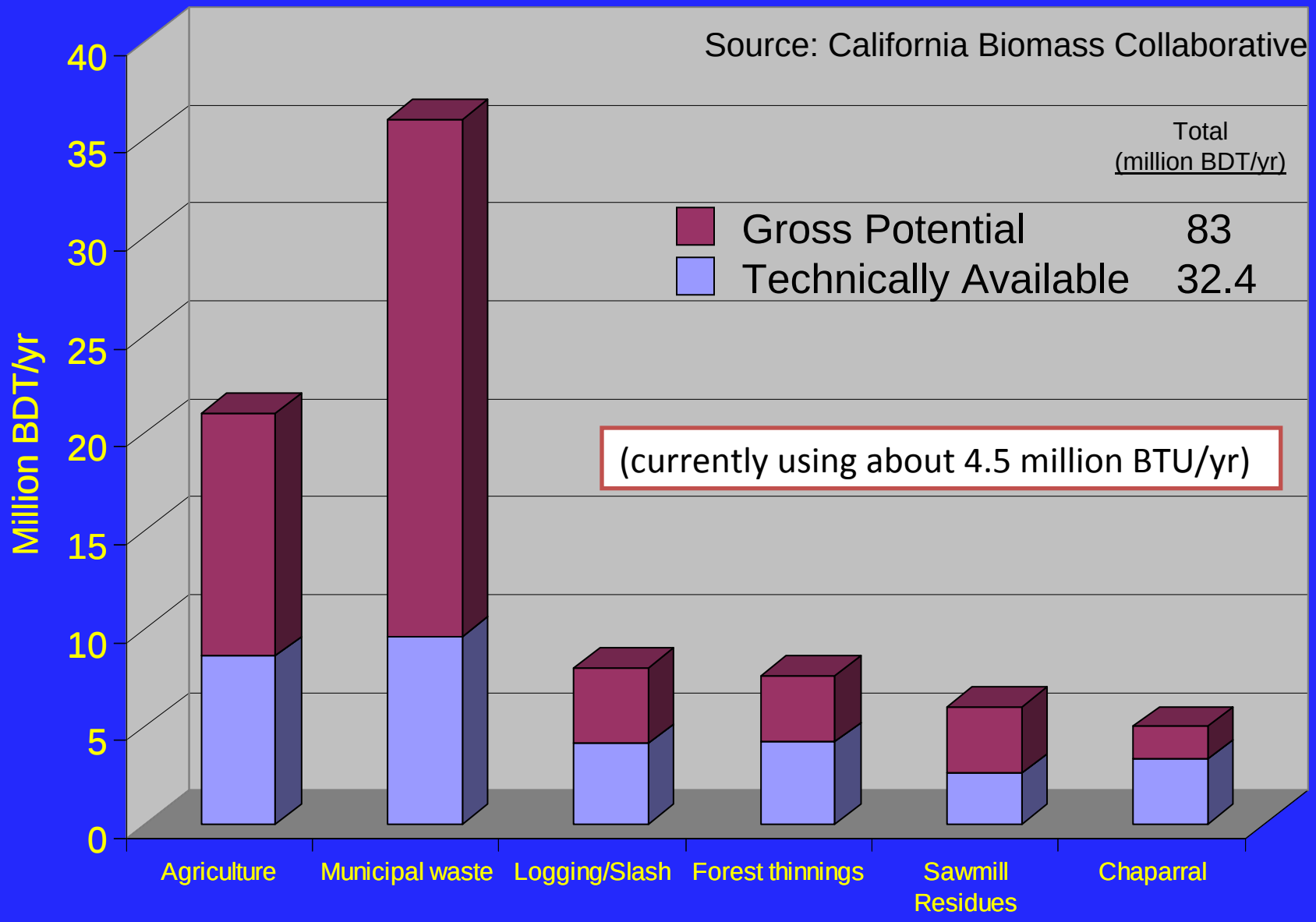
Woody Biomass

- Sawmill Residue
- Landfill Diversion
- Logging Residue
- Dedicated Forest
- Fuel Reduction Thinning
- Dead Trees

Other Biomass

- Agricultural Residues
- Chaparral

Estimated California Biomass Potential in 2007



Potential Uses and Competition

- Energy feedstock (heat and electricity)
- Landscape materials & soil amendments
- Extra steps in feedstock preparation elevate woody biomass to a higher value resource
  - Fiber resource – pulp or composites (particleboard, wood-plastic lumber, etc.)
  - Bio-refinery – organic chemicals including biofuels

Woody Biomass

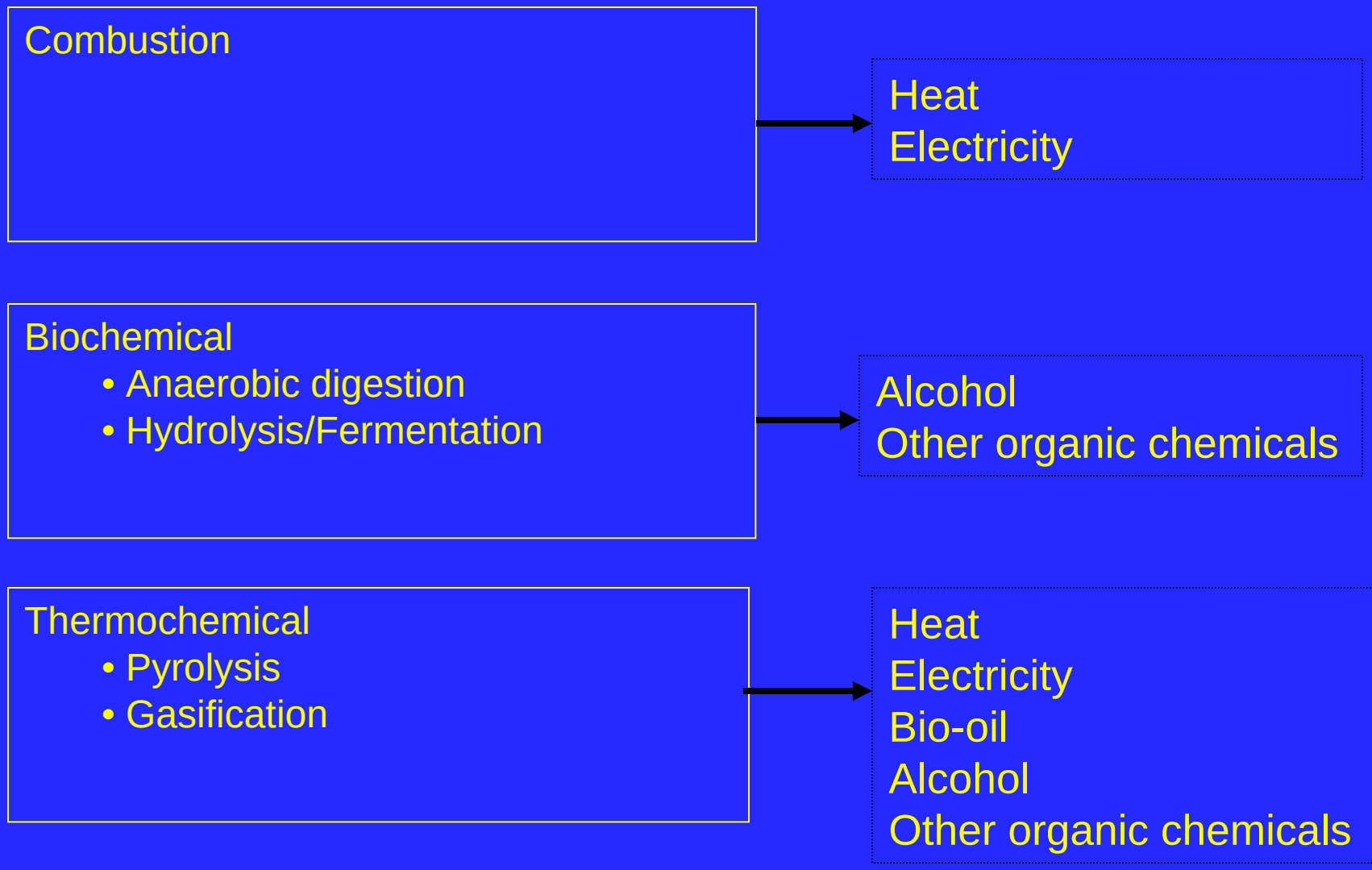
- Positive Attributes
  - carbon source
  - habitat
  - raw material
    - Fiber feedstock
    - Energy feedstock
    - Chemical feedstock
    - Solid wood products
- Negative Attributes
  - disposal problem
  - wildfire fuel
  - Small diameter trees have lots of defects
  - High processing costs

Feedstock Preparation -- Breaking wood down into uniform sized particles

Increases surface area – needed step for most chemical or biological processing

Minimizes the impact of inherent property defects (knots, juvenile wood, etc.)

Energy Conversion Pathways



What Can We Do with Woody Biomass?

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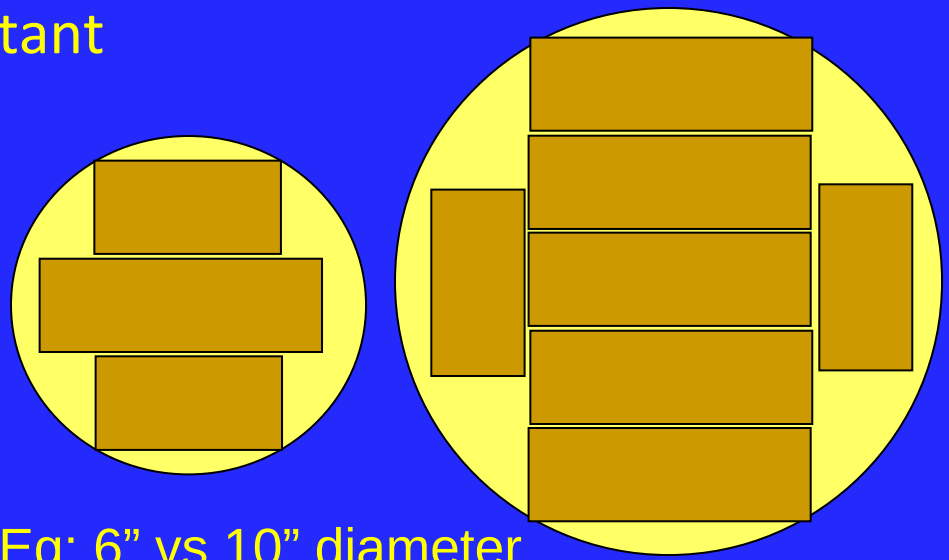
What Can We Do with Woody Biomass?

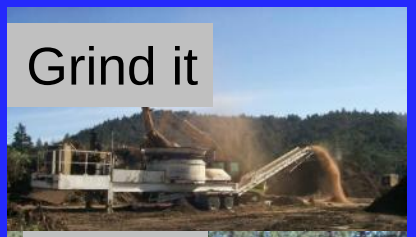
Processing small logs

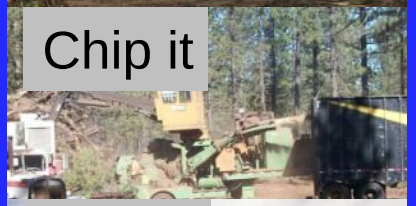
- More logs to process for same output
- Higher transportation costs
- More handling in mill
- Less valuable products
- Defects have a greater impact (knots, juvenile wood etc)
- Efficiency is very important
  - Speed and volume

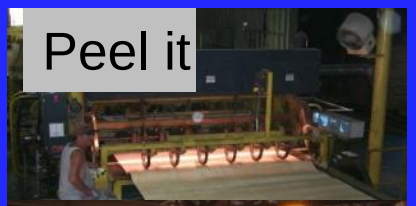


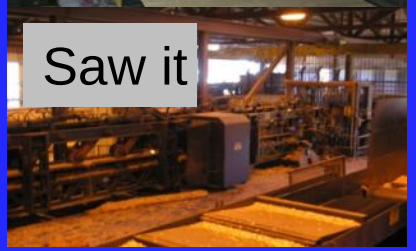
Eg: 6” vs 10” diameter

What Can We Do with Woody Biomass?







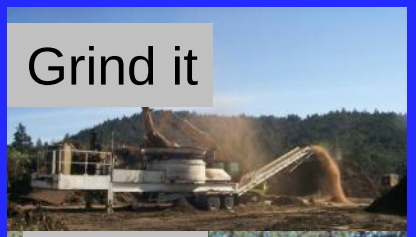


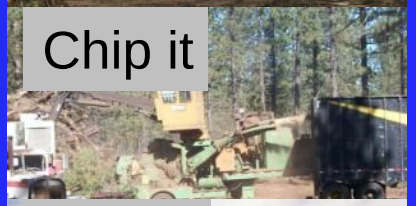
Post and Pole key figures

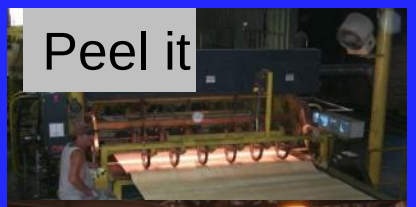
- Equipment - typically 1 peeler and 1 doweler (production ~1,200 - 2,000 pieces per day)
- Raw material
  - lodgepole pine and ponderosa pine preferred (treatability, availability, lower taper and smaller knots)
  - White fir and Douglas-fir less desirable (treating and shipping weight issues)
- Small diameter wood resource needs ~ 10,000-20,000 tons/yr
- Employees – 10-15
- Site size - 3-5 acres
- Investment - $750,000+ (without land and permits)
- Market Issues
  - Very competitive national market, but local markets may be opportunity
  - Canadian imports often dominate the market (Canadian dollar conversion and lower fuel and production costs)
- Other considerations:
  - Peeling residues good for animal bedding and hog fuel markets
  - Posts and poles need wood preservative treatments

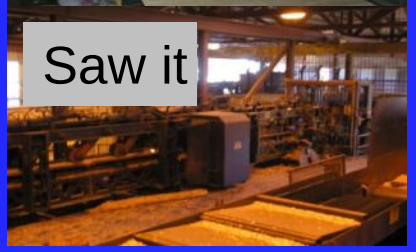
Source: Larry Swan, USFS

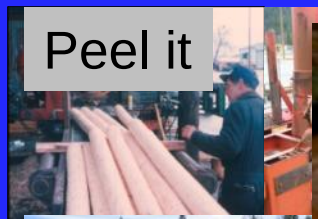
What Can We Do with Woody Biomass?

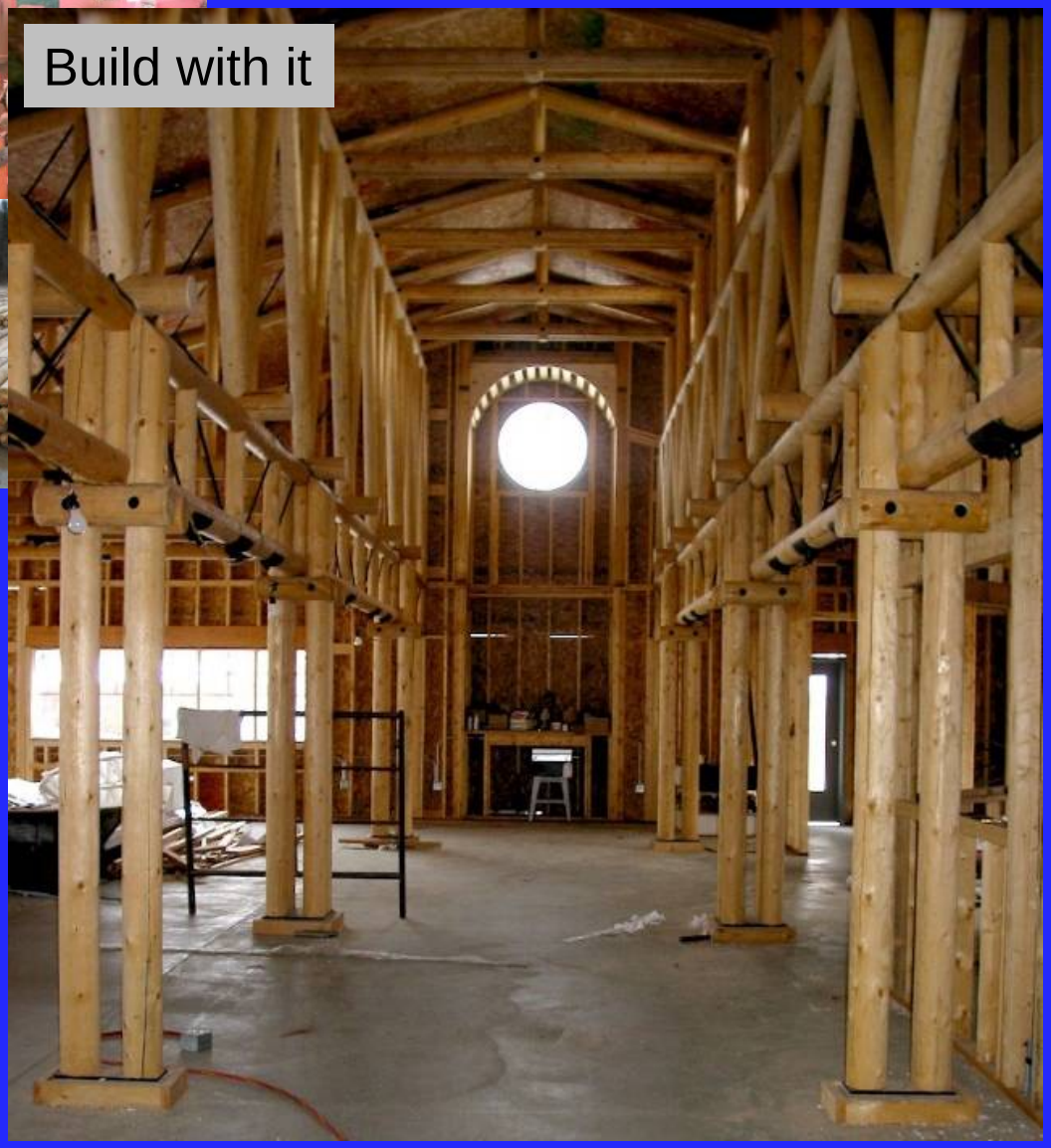








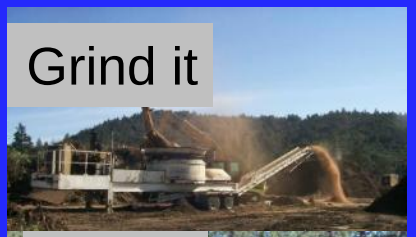


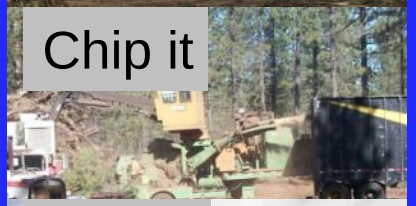


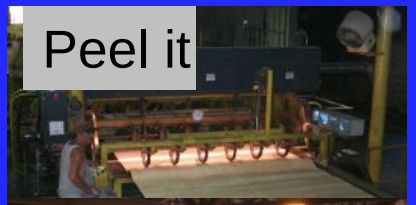
House logs - specifications

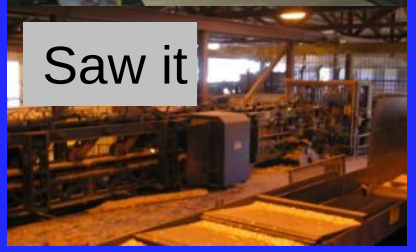
- Typical species: Spuce, Douglas Fir, Cedar, Lodgepole Pine
- Log size – 10” small end diameter, low taper, straight, 35 – 40 ft long
- Avoid spiral grain, checks/cracks, damage from harvesting/handling equipment
- Dried to 20% MC

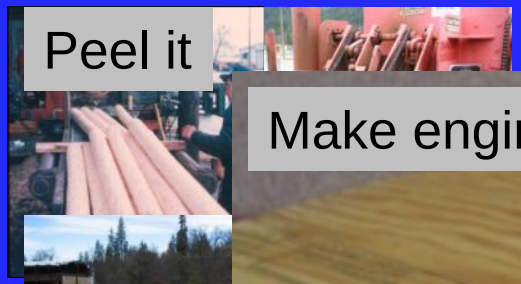
What Can We Do with Woody Biomass?

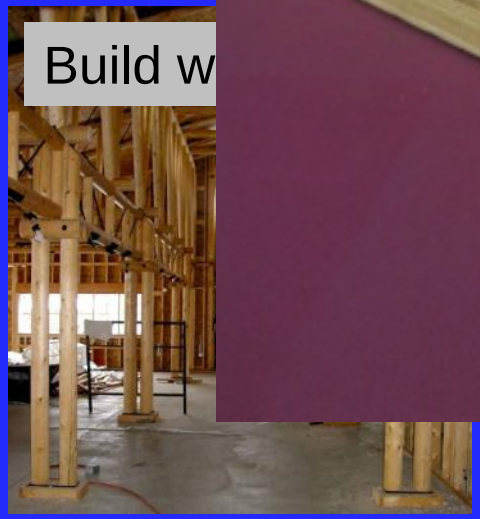












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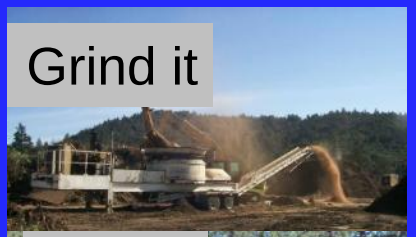
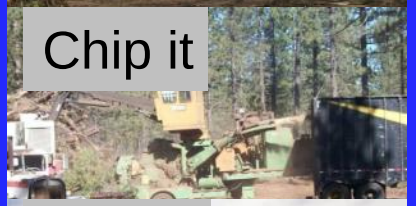
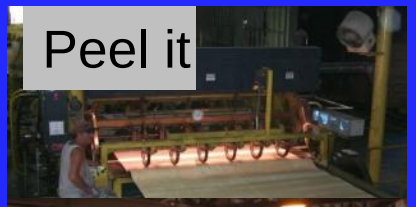
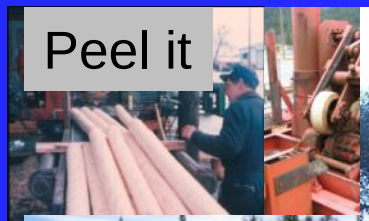

Grind it


Chip it


Burn it


Peel it


Saw it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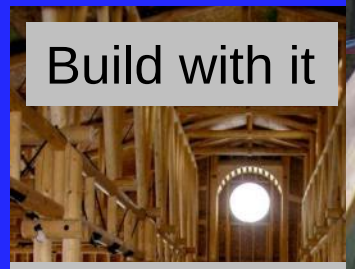
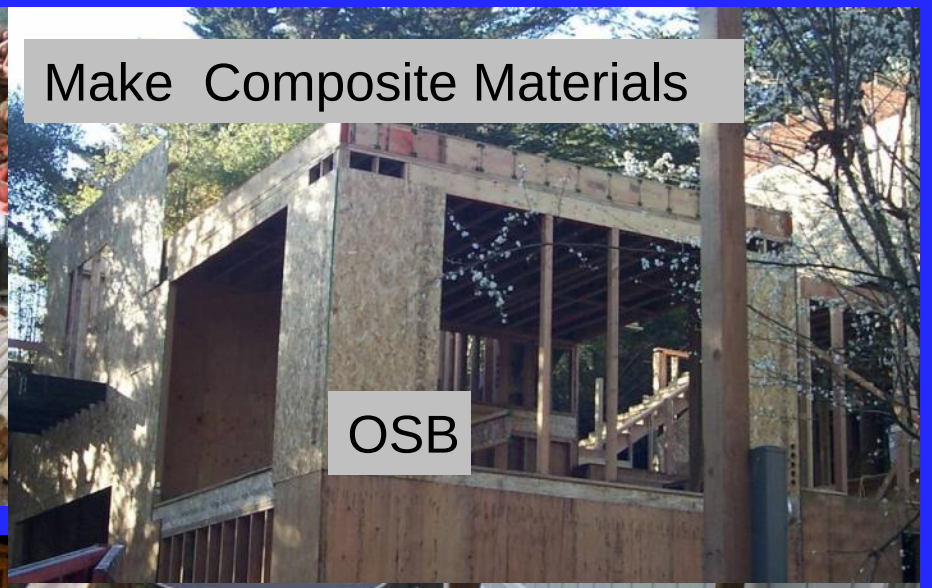

Build with it

engineered lumber


Make Composite Materials

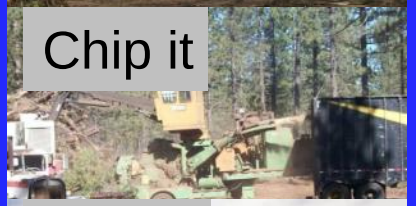
OSB


Wood/Plastic Lumber

What Can We Do with Woody Biomass?

Grind it

Chip it



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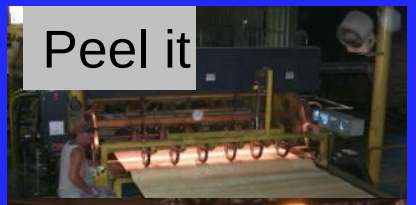

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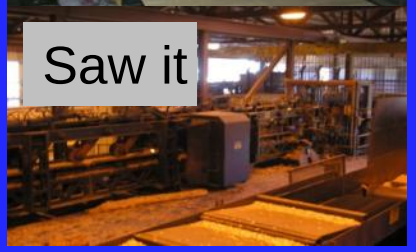

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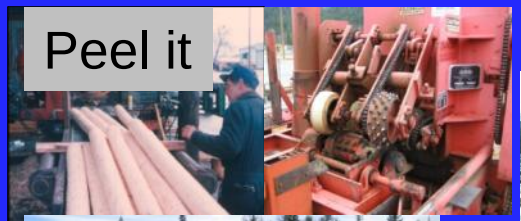

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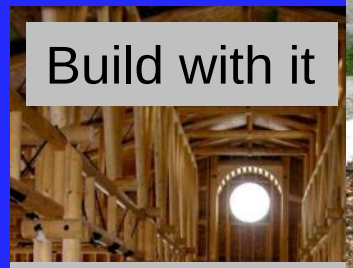
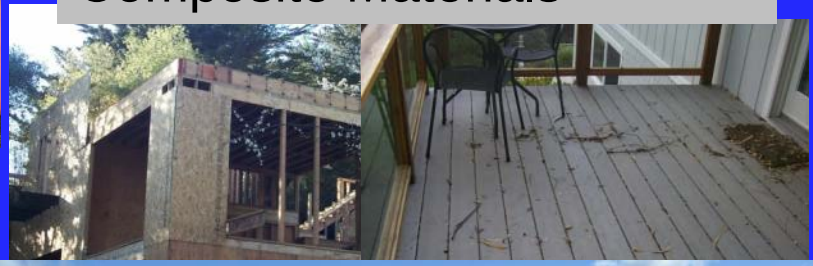


engineered lumber

Composite Materials

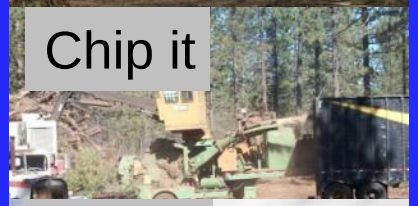


Soil Amendment / Landscaping

What Can We Do with Woody Biomass?

Grind it

Chip it



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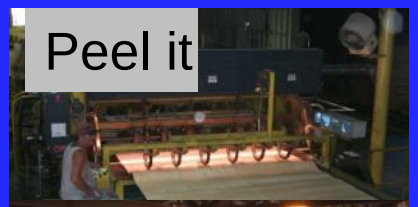

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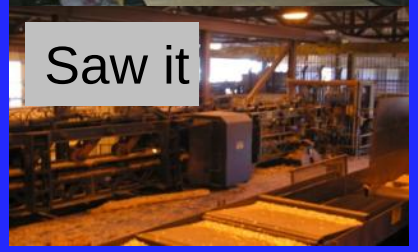

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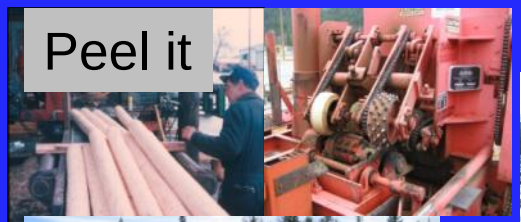

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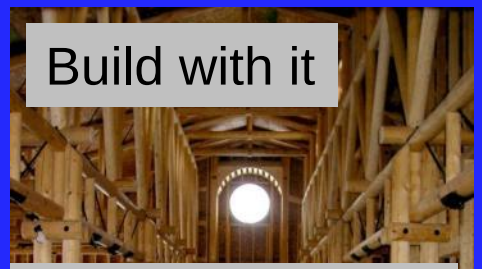
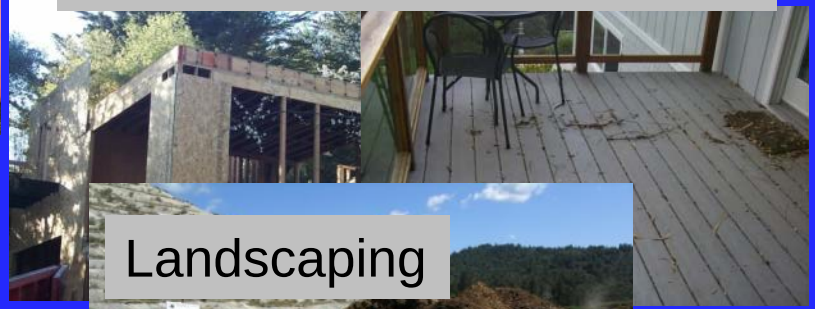


engineered lumber

Composite Materials



Landscaping

Make Organic Chemicals

Wood = C + O + H

Biochemical Potential

	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 -- Extraction
- Fragrances -- Extraction
- Charcoal, phenolic oils, -- Pyrolysis
- Alcohols - Thermochemical, Hydrolysis/Fermentation
- Bio-Gases (low BTU, high CO) -- Gasification
- Levulinic and Lactic acid ("building blocks") –
  - Hydrolysis/Conversion

So What's the Problem?

- Resource Availability
- Feedstock Quality and Cost
- Transportation and Processing Cost
- Feedstock Competition
  - Competing uses for woody biomass
  - Competing feedstocks for energy products
- Often Not Economically Viable

Competing Cellulosic Feedstocks

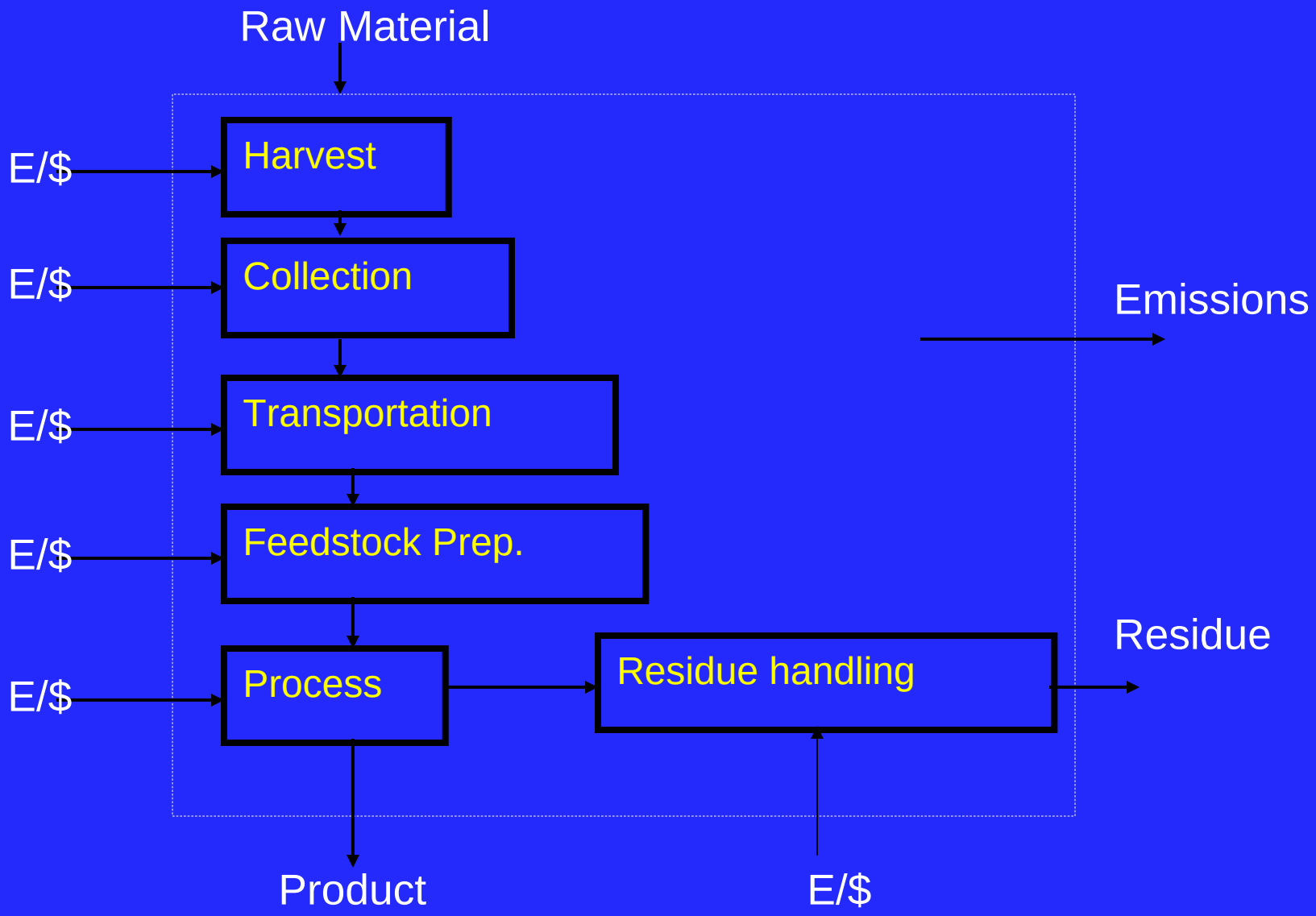
	Cellulose	Hemi-Cellulose	Energy Cont ent (BTU/lb)	Yield (tons/acre)	Bulk Den. (kg/m^3)	Million BTU/m^3
Switch-grass	45%	45%	7,000	20	108	1.7
Miscanthus	45	24	7,700	60	80	1.4
Corn Stover	35	25	7,300			
Bagasse	40	22	7,500		60	1
Wood	42	25	8,000	10	450	8
Coal			10,000		800	17.6

transportation costs and energy conversion ratio are impt.

Example of Competing Uses

The Co-generation plant produces 8 MW of electricity and steam to operate the lumber dry kilns. The sawmill residues are more valuable for soil amendments than fuel for the boiler. The sawmill purchases lower value fuel in the biomass market.

Life Cycle Inventory Analysis



Encouraging Biomass Utilization

1. Reduce handling and processing costs
2. Improve conventional technology
3. Improve conversion efficiency
4. Develop new processes
5. Develop new products
6. Develop new markets
7. Educate public to benefits of utilization

A Wood Scientist's Opinion

Trees for the most part grow without intensive cultivation and are more adaptable to environmental changes than most plants. They consume CO_2 and produce wood – a basic building block for many products.

The importance of woody biomass as a raw material will increase dramatically through the 21st century becoming the raw material of choice for many carbon-based materials.