Woody Biomass: Is it a problem or a solution?

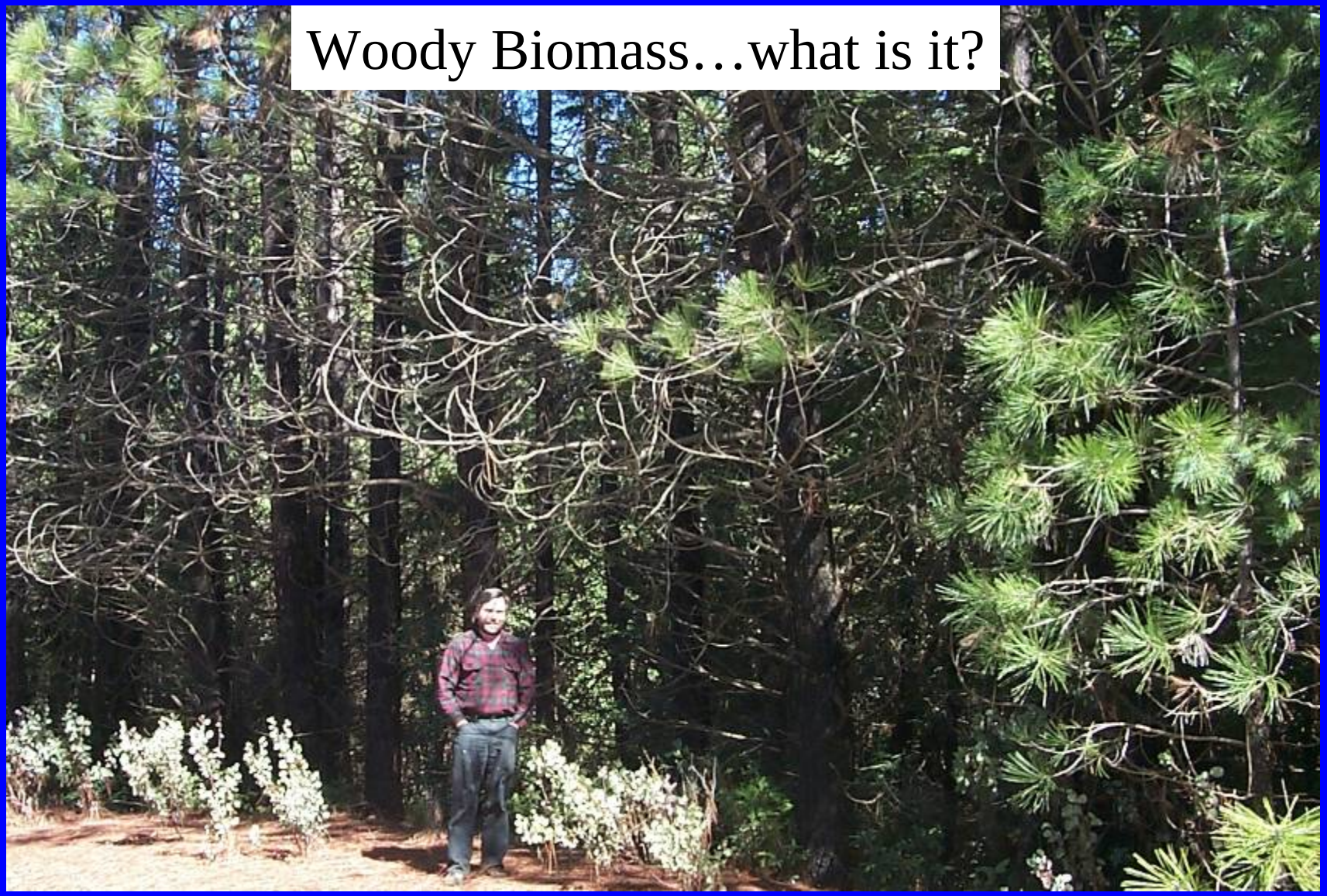
Woody Biomass and Small Log Workshop

Weed, CA

September 19, 2007

John R. Shelly
University of California Cooperative Extension
john.shelly@nature.berkeley.edu

Woody Biomass…what is it?

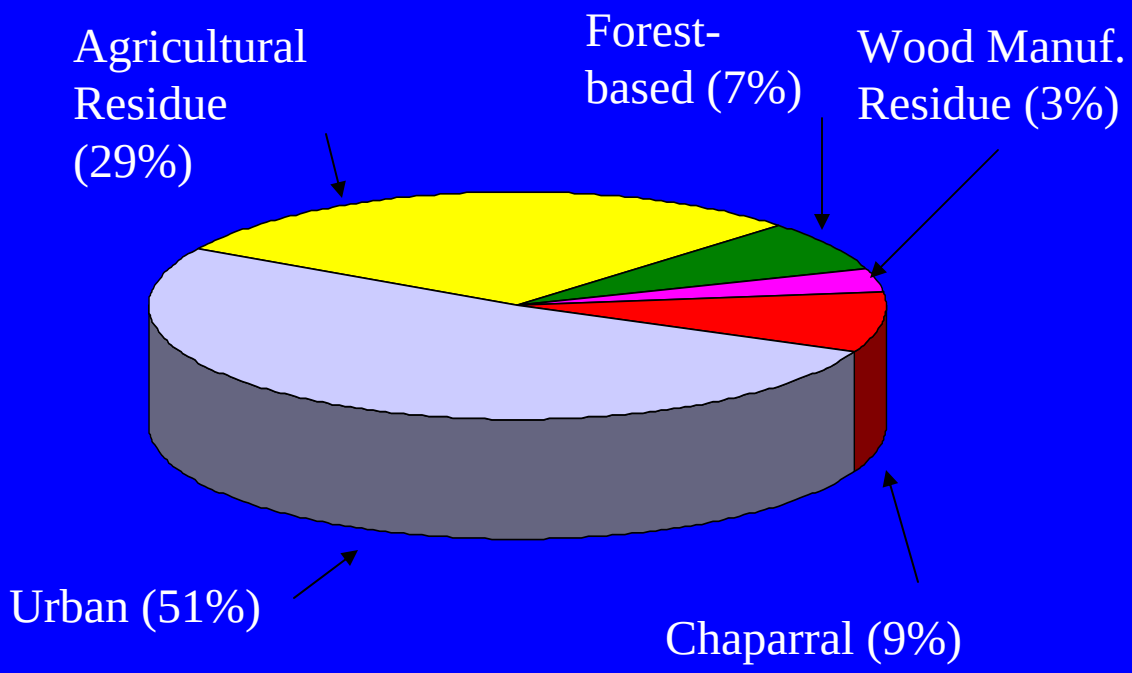


A bad neighborhood?

Woody Biomass – more than just small trees

- Forest-based, non merchantable trees and residues
- Urban Wood Waste stream
  - Construction and demolition wood
  - Post-consumer use wood products
  - Tree removals and trimmings
- Chaparral

California Biomass in 2005



Available

million BDT

AR = 9

F = 12

WM = 2

C = 0

U = 8

Total = 31

Gross Total = 80 million BDT/year

Source: California Biomass Collaborative Forum, 2005

Woody Biomass

- Positive Attributes
  - carbon source
  - habitat
  - raw material
    - Fiber feedstock
    - Energy feedstock
    - Chemical feedstock
    - Solid wood products
- Negative Attributes
  - disposal problem
  - wildfire fuel

What can we Do with Woody Biomass?

What can we Do with Woody Biomass?

What can we Do with Woody Biomass?

Grind it

Chip it

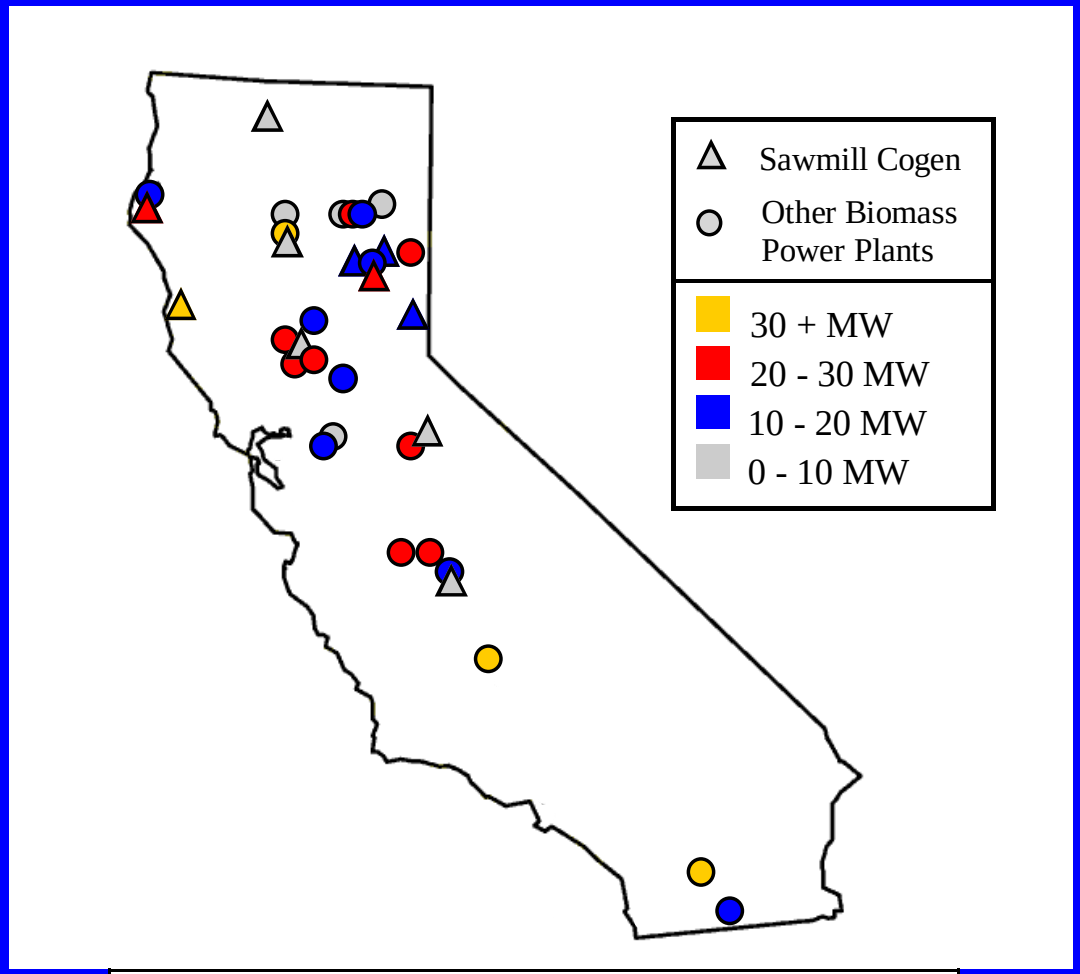
What can we Do with Woody Biomass?

Grind it

Chip it

Burn it

California Biomass Energy Facilities



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

Total Capacity

~ 625 MW

Biomass Consumption

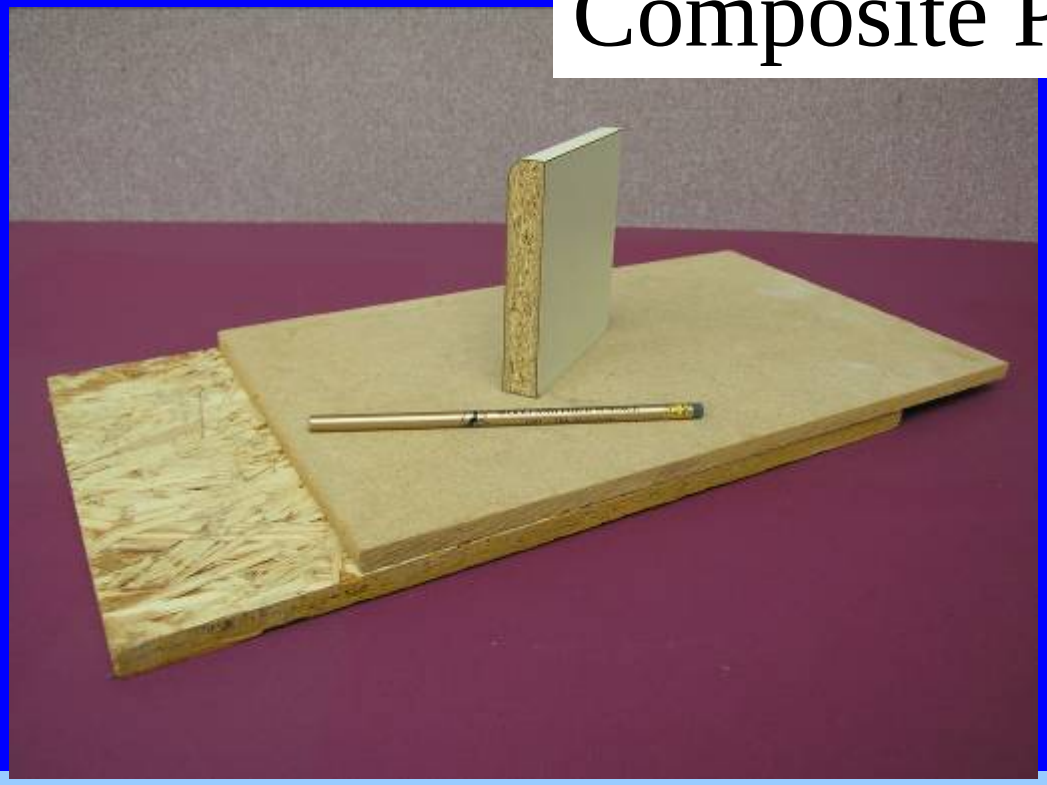
4.5 million BDT per year

of which

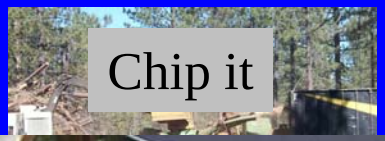
22% is forest-based

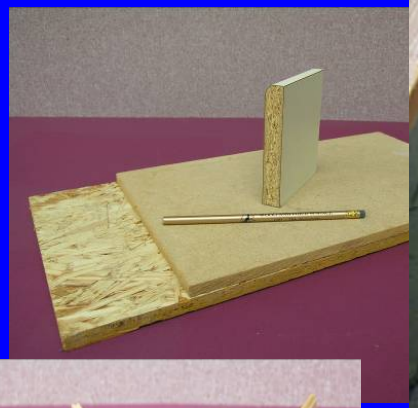
What can we Do with Woody Biomass?

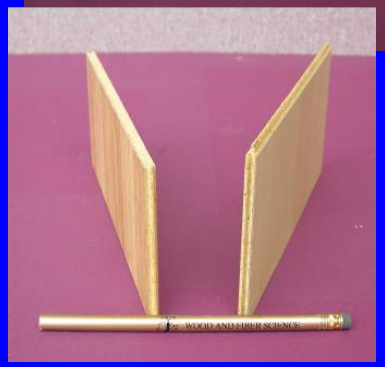
Composite Panels



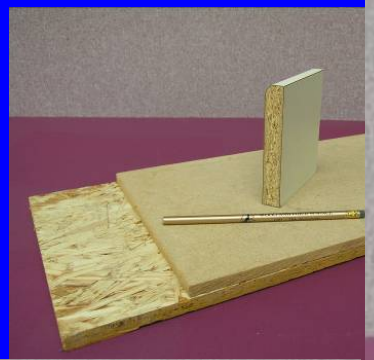
What can we Do with Woody Biomass?

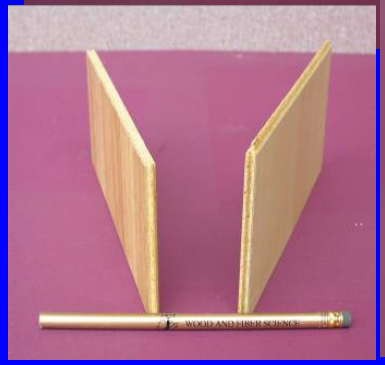


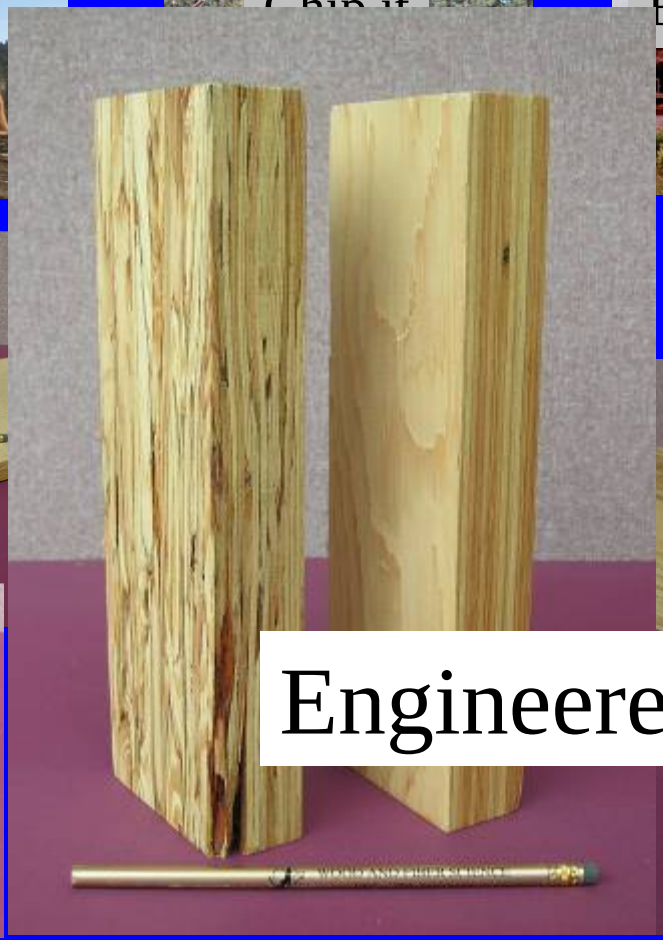




What can we Do with Woody Biomass?







What can we Do with Woody Biomass?

Make Organic Chemicals

Wood = C + O + H

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

What can we Do with Small Diameter Trees?

What can we Do with Woody Biomass?

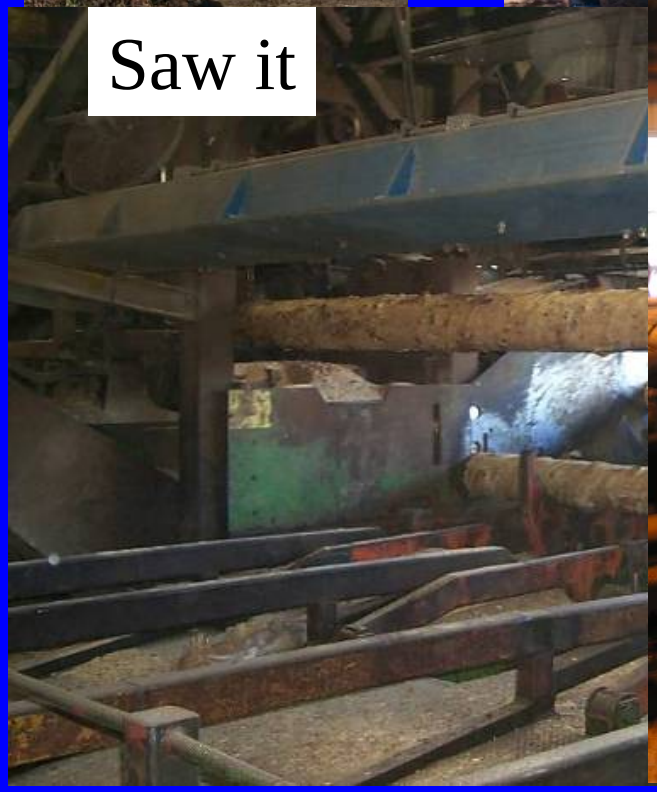
Grind it

Chip it

What can we Do with Small Diameter Trees?

What Can We Do with the Small Diameter Resource?

What Can We Do with the Small Diameter Resource?



What Can We Do with the Small Diameter Resource?

Grind it

Chi

Saw it

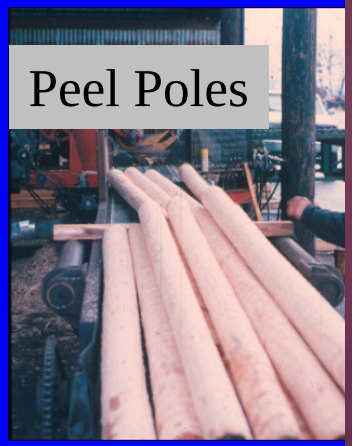
Peel it for posts

Small Diameter Round Wood Construction… It Can Be Done!

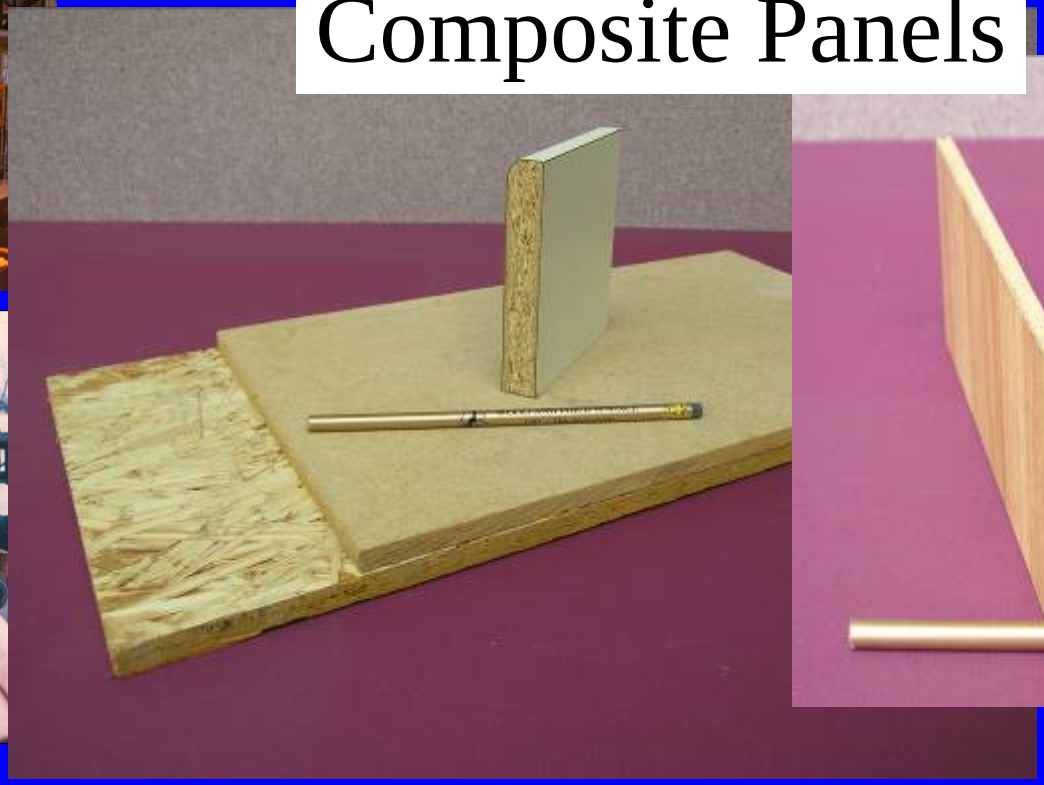
Verification of design values is necessary to obtain building code approval

Photo courtesy of USDA Forest Products Lab

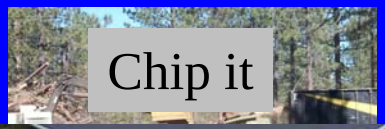
What Can We Do with the Small Diameter Resource?

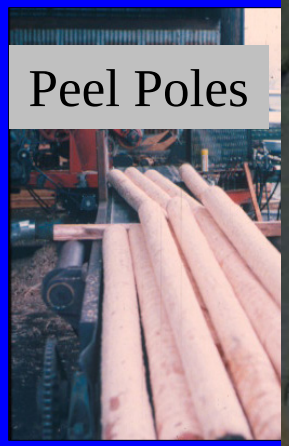


Composite Panels

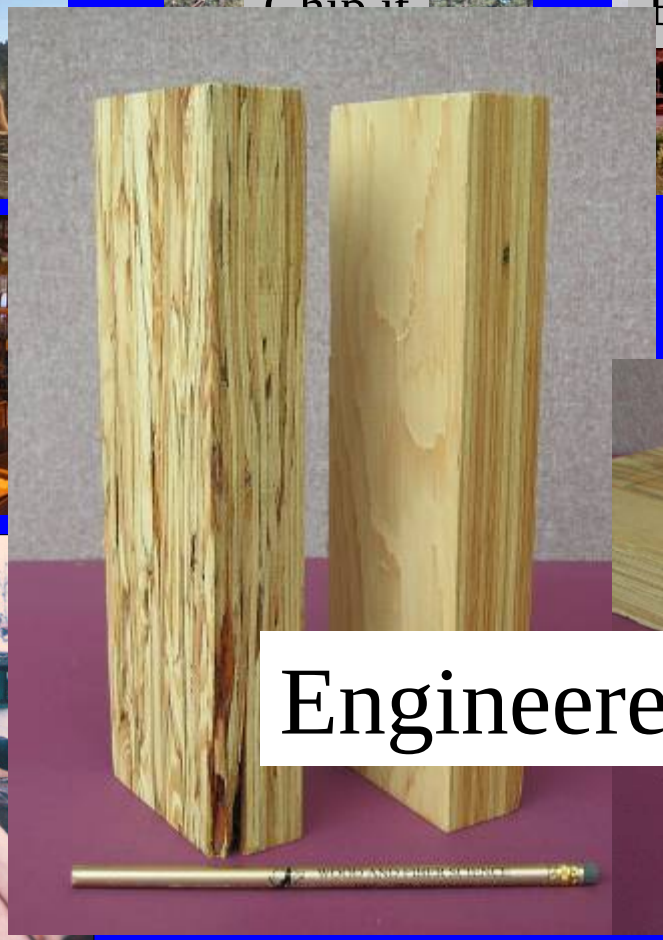


What Can We Do with the Small Diameter Resource?





What Can We Do with the Small Diameter Resource?



Make Plastic

Engineered Lumber

What Can We Do with the Small Diameter Resource?

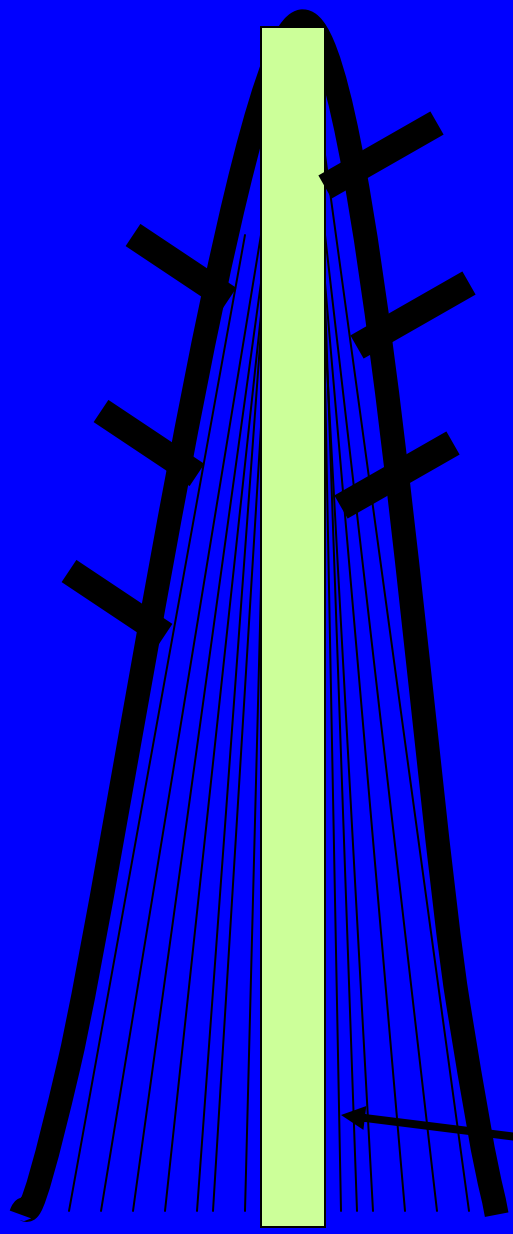
Make Organic Chemicals

Wood = C + O + H

So What's the Problem?

So What's the Problem?

- Resource Availability
- Processing Cost
- Feedstock Quality
  - High bark/fiber ratio
  - knots
  - juvenile wood



Juvenile Wood Core – first 5 to 20 growth rings

Juvenile Wood…and

Compression Wood

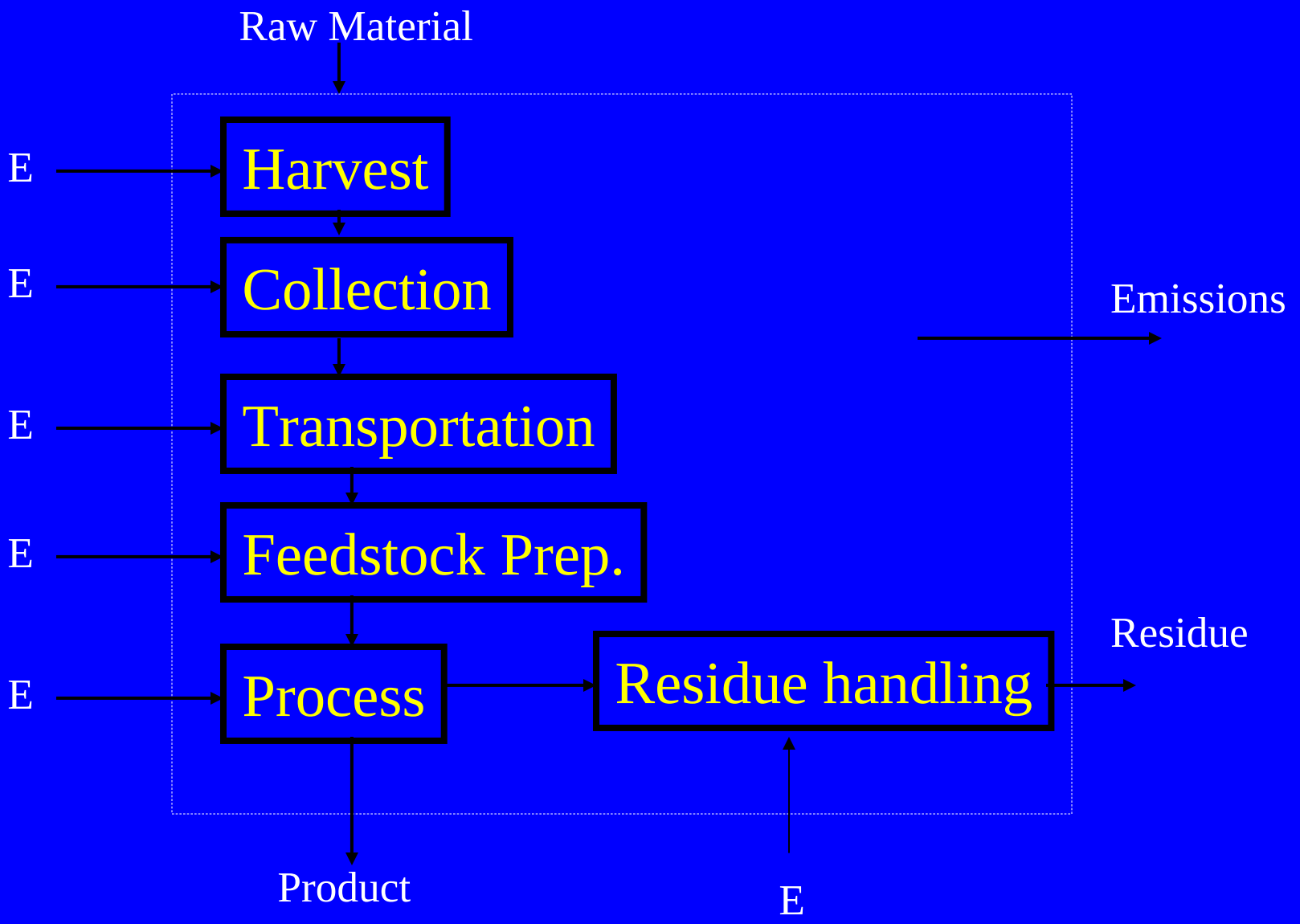
Juvenile Wood often leads to Warp

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.)

Life Cycle Inventory Analysis



Emissions by type of Combustion in pounds emitted per ton of Woody Biomass consumed

	PM- 2.5	NO_x	CO	VOC	N_2O
Industrial (dry fuel)	0.7 – 6.5	8.8	10.8	0.31	0.23
Industrial (wet fuel)	0.4 – 5.0				
Residential Stove	6 - 23	45 – 100	2 – 14		
Prescribed Burn	12 - 34	3	300	19.0	0.46
Wildfire	17	4.0	140	12 - 24	0.46

Competing Feedstocks

	Cellulose	Hemi-Cellulose	Heat Cont. (BTU/lb)	Yield (tons/acre)	Bulk Den. (kg/m^3)	Million BTU/m^3	Conversn ratio
Switch-grass	45%	45%	7,000	20	108	1.7	
Miscanthus	45	24	7,700	60	80	1.4	5
Corn Stover	35	25	7,300				~1
Bagasse	40	22	7,500		60	1	
Wood	42	25	8,000	10	450	8	2 – 5
Coal			10,000		800	17.6	

transportation costs and energy conversion ratio are impt.

Future Biomass and Small Tree Innovation

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

Global Carbon Cycle (billion metric tons)

+ 3.2 Billion tons per year to atmosphere

88

90

119

120

6.3

Oceans

Vegetation and Soils

Caused by human activity