

Biomass - Bioenergy

Foundation for Forest Sector Regenerated

Panacea Or Pandora's Box?

**Presented to the
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by

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Presentation Overview

- Context / Driver – Forest Sector Transformation
- Biomass Technologies
 - Overview & Observations
- Biofibre Supply – Myths and Realities
- Transformational Opportunities for Forest Sector
- Conclusions – Panacea *and* Pandora's Box

Forest Sector – Dramatic Change

- Newsprint – North American demand currently at annual rate of < 6 million tonnes – drop of > 50% in five years
 - Newsprint consumption by US daily papers – -25.8% ytd
 - Demand decline continues to accelerate
- Newsprint price June 2009 – USD 430/tonne – 43% decline since March, 40% decline from year ago
- Other price – production - demand indicators
 - Containerboard capacity closures 2008-09 – 1.3 million tonnes
 - US shipments printing and writing grades - -23.7% y-o-y
 - US boxboard production - -10.3% y-o-y
 - Market pulp prices down by 40% since 2006-08 high – demand plummeting
 - Canadian lumber production 2008 – 32% below 2004 level
 - 2009 Q1 Canadian structural panel production one third 2006 production
- Five pulp/paper mills in Ontario currently in bankruptcy or creditor protection – in addition to previous closures
- Newest pulp mills – in South America – >2 million tpy eucalyptus pulp
 - Recently closed Ontario mills – < 200,000 tpy softwood pulp

Forest Sector – Dramatic Change

- NA new home construction less than half 2005 level
 - 2008 S-P-F production down by > 30% since 2005 high
 - 2009 S-P-F production at slightly more than half 2008 levels
 - 2008 S-P-F price down by 30% since 2005 high
 - 2009 S-P-F prices at slightly more than half 2008 levels
- < 25% of Ontario's softwood lumber capacity currently operating
 - Largest independent producer under creditor protection
- US inventory of unsold new homes near all time high – 11-12 months
 - Inventory of existing homes also close to high – 10 months
- Sub-prime mortgage 'rate resets' – > 500,000 in 2009
 - Significant percentage will result in foreclosures –
- *Optimists* look for lumber market recovery later in 2010
 - Could easily be well into 2011 or beyond before recovery takes hold
- Derivative impacts – mill shut downs, reduced harvesting, lower residual product output –
reduced biomass fibre availability

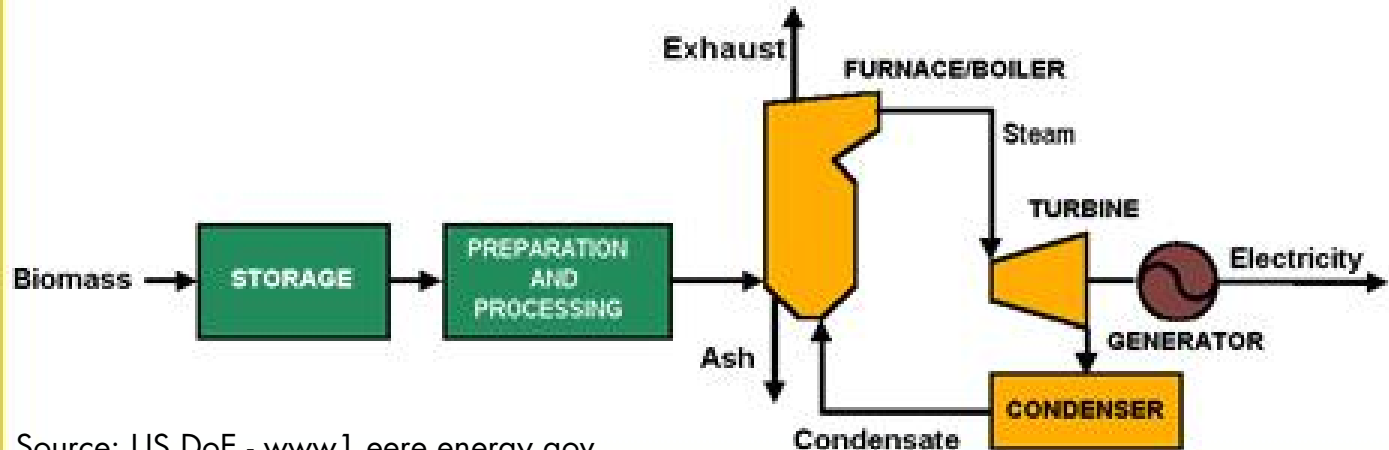
Biomass Technology Opportunities

- Six technologies have promise for regeneration of forest industry sites, especially pulp mills –
 - Combustion
 - Boiler conversion may be required – limited additional equipment
 - Gasification
 - Gasifier required – other mill systems potentially usable
 - Pyrolysis / Flash Pyrolysis
 - Pyrolysis reactor required – other mill systems potentially usable
 - Anaerobic Digestion
 - Effluent treatment and other 'lagoons' can be converted / capped
 - Fermentation / Distillation
 - Digesters, especially batch, convertible for fermentation tanks
 - Densification / Torrefaction variant
 - Existing systems convertible for fibre drying - handling

Biomass Technology – Combustion

- Primarily energy generation
- CHP / Co-gen
- Refractory lined / fluidised bed
- Scalable from small to large
- In commercial use

Direct Combustion / Steam Turbine System



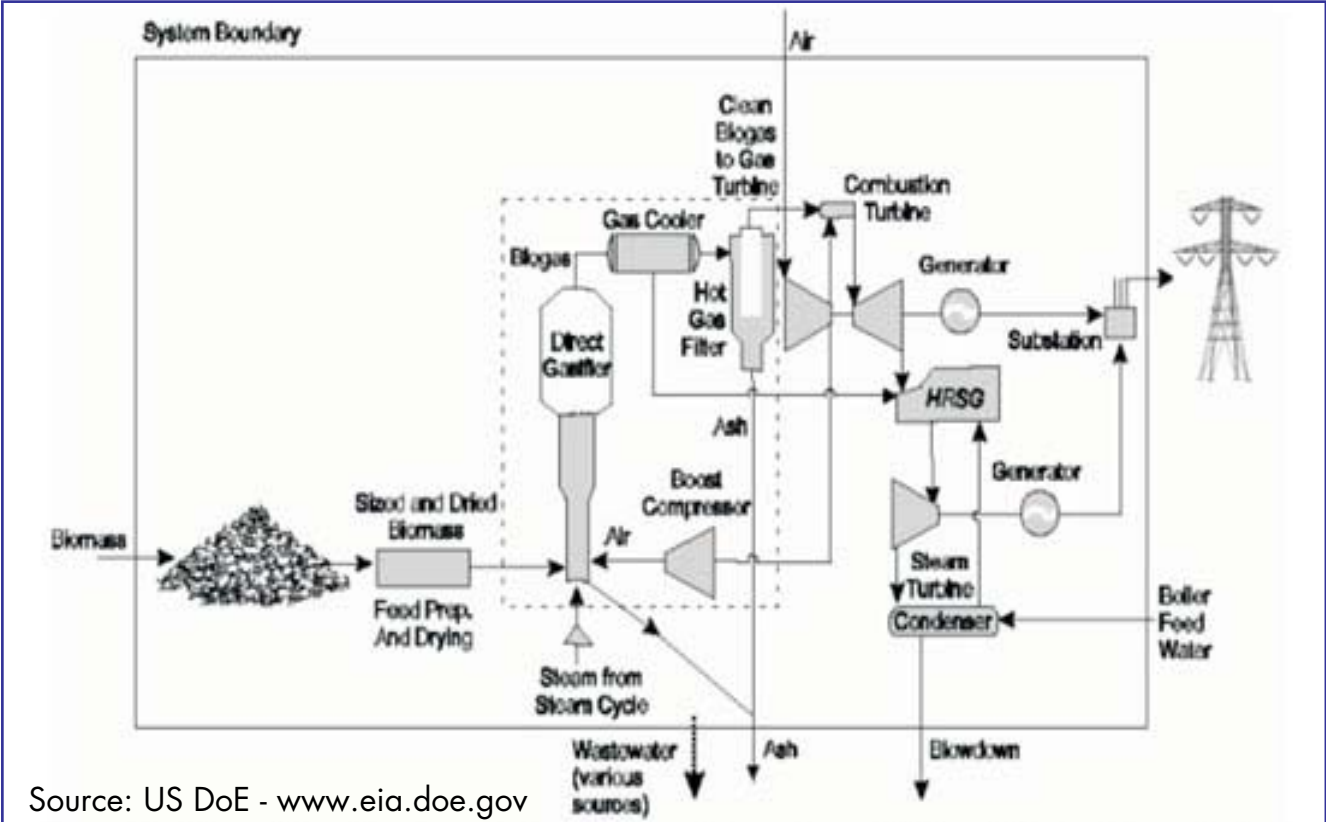
Source: US DoE - www1.eere.energy.gov

Biomass Technology – Gasification

Process involves reaction of solid fuel (biomass) with hot steam and air (or oxygen) and production of gaseous fuel by partial oxidation

Primarily energy generation technology – established commercially.

But, also syngas / chemical production – earlier stage.



Source: US DoE - www.eia.doe.gov

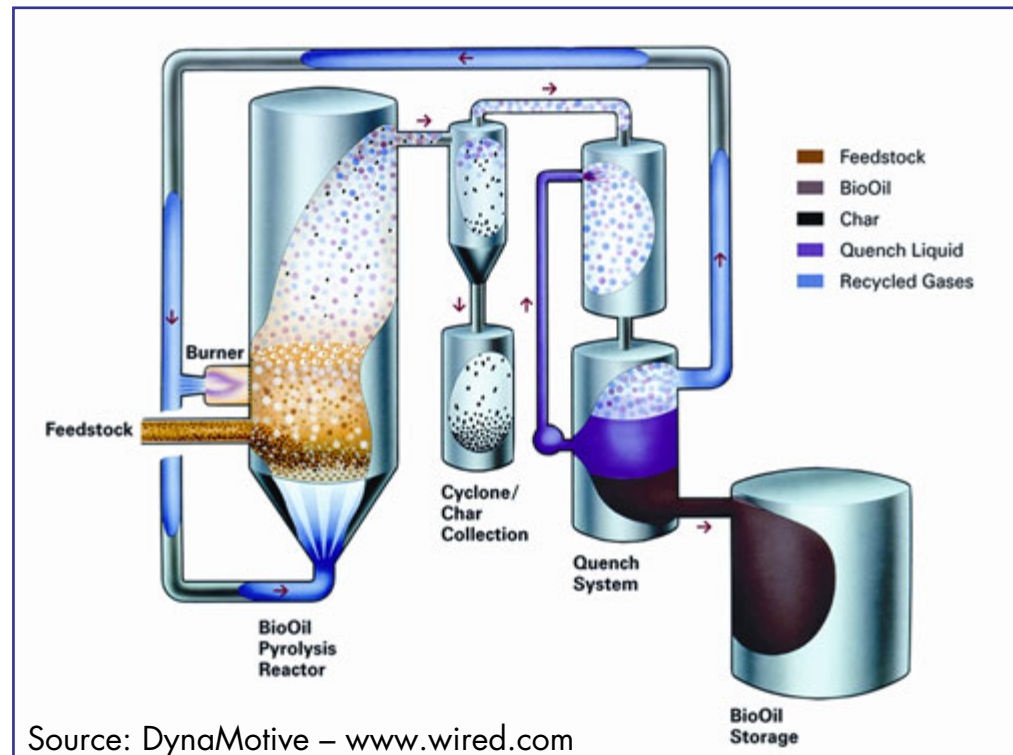
Biomass Technology – Pyrolysis

Process involves heating of biomass in near absence of air – newest technologies up to 900° C – produces vapours / aerosols that condense to bio-oil used for energy or chemical outputs.

Fuel value about half of conventional fuel oil.

Bio-oils also produced for food additive / pharma applications.

Early stage commercial.



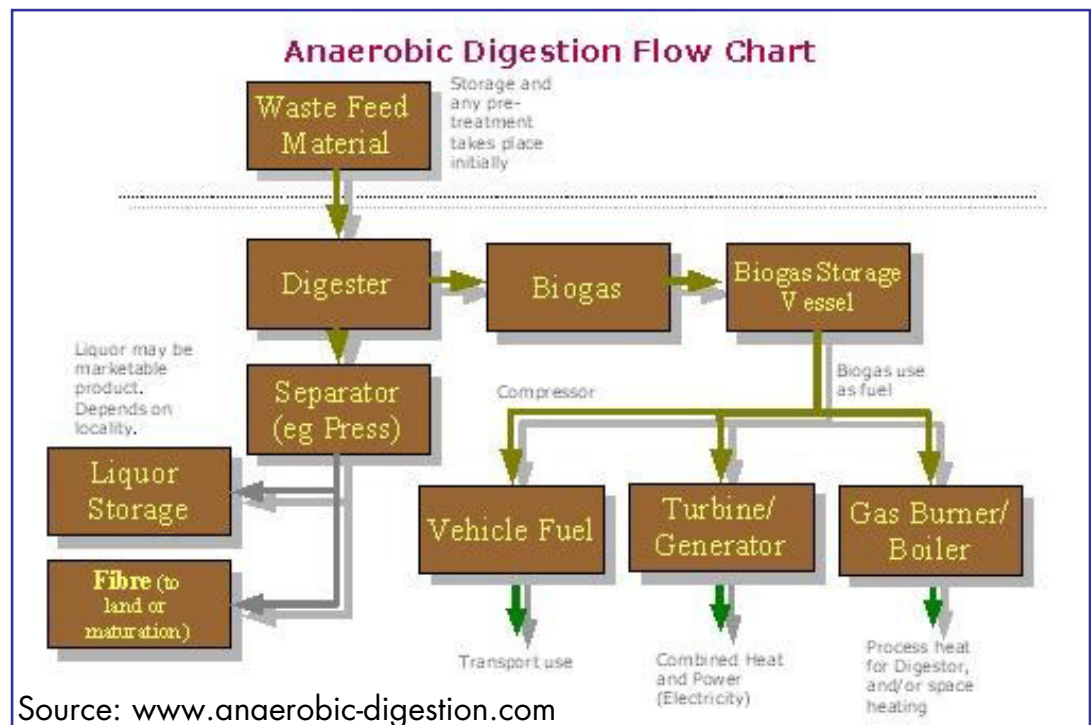
Biomass Technology – Anaerobic Digestion

Process typically associated with processing of agriculture waste. But any organic material will decompose in wet, warm, airless conditions.

Involves bacterial decomposition in absence of air.

Outputs include methane / biogas and solids.

Commercially established.



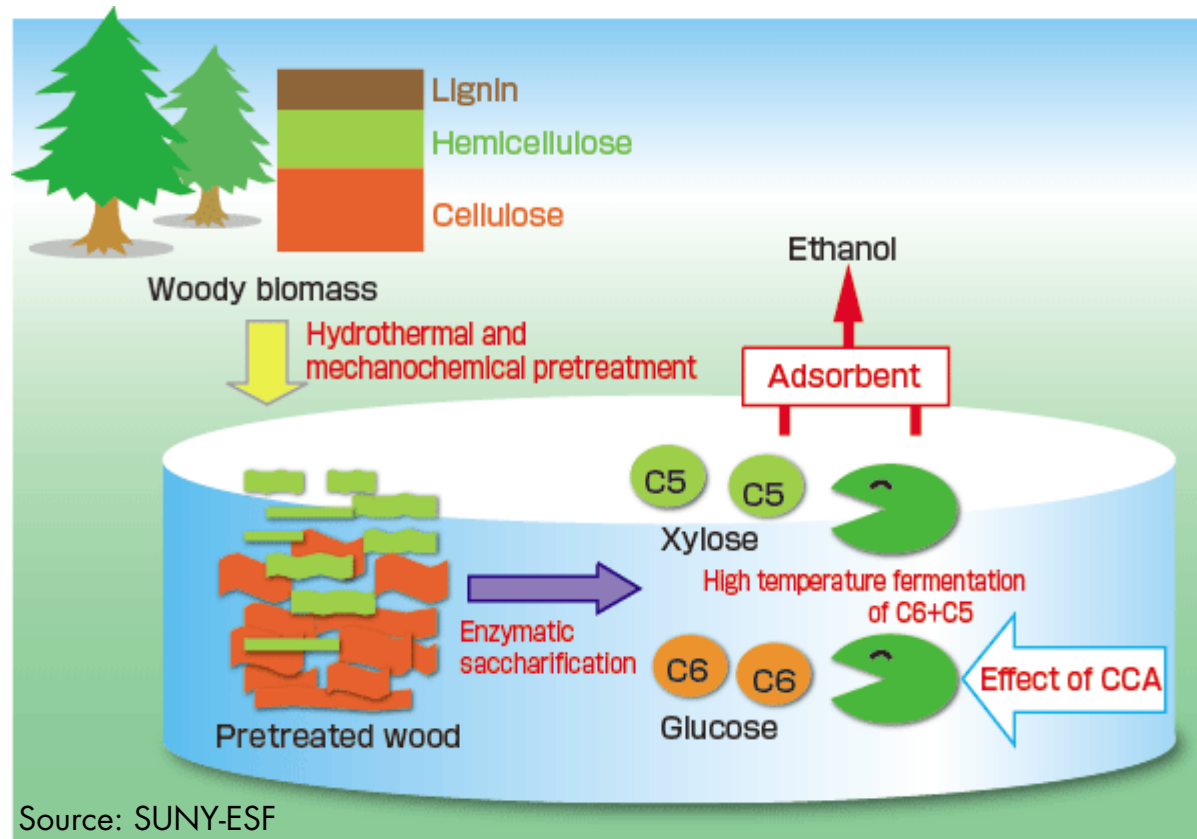
Biomass Technology – Fermentation / Distillation

Process involves heating of biomass in hot water – 160° C – under moderate pressure to separate hemicellulose from lignin / cellulose.

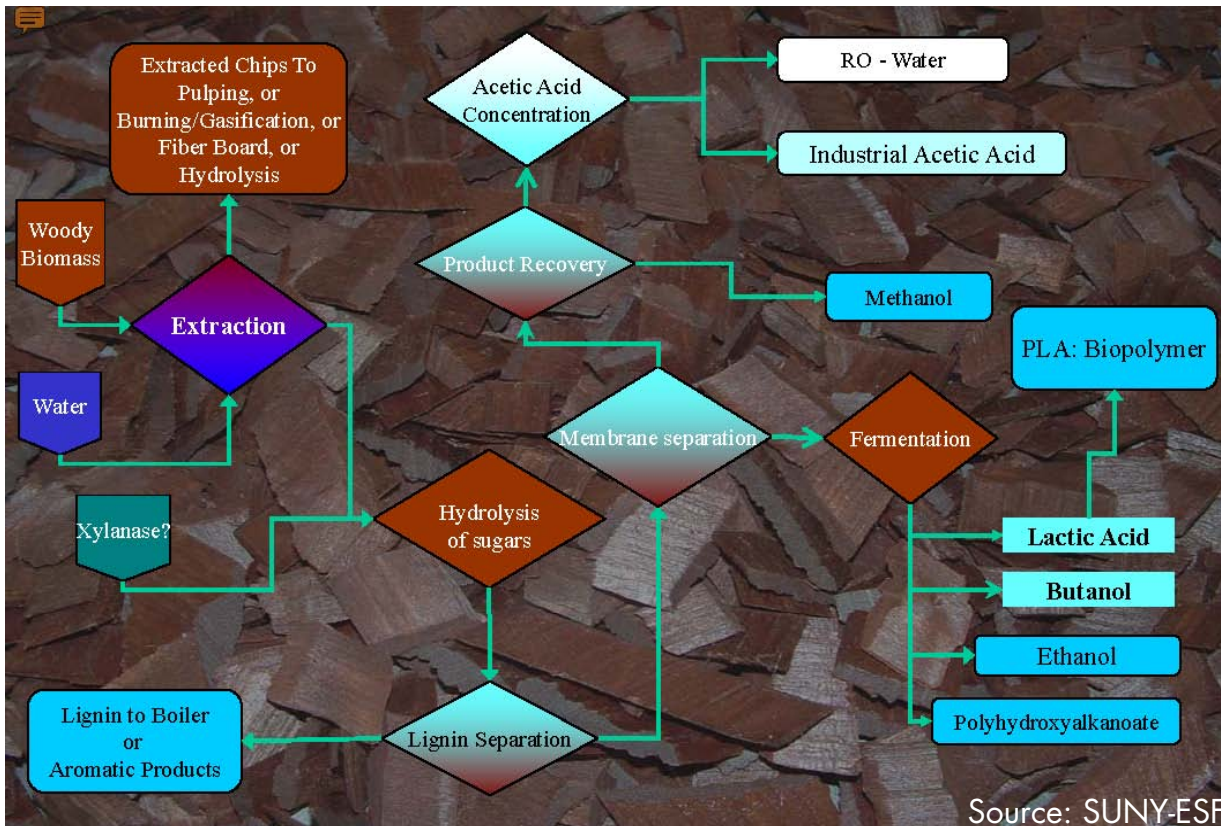
Hemicellulose – C6 and C5 sugars – processed to ethanol, acetic acid, or PHA's

Designed as 'pre-treatment' for hardwood pulp chips – with lignin / cellulose continuing to pulping

Pre-commercial – currently best suited for hardwoods



Biomass Technology – Fermentation / Distillation



Source: SUNY-ESF

Significant flexibility in range of potential product outputs

Established markets exist for most – conventional products hydrocarbon-based

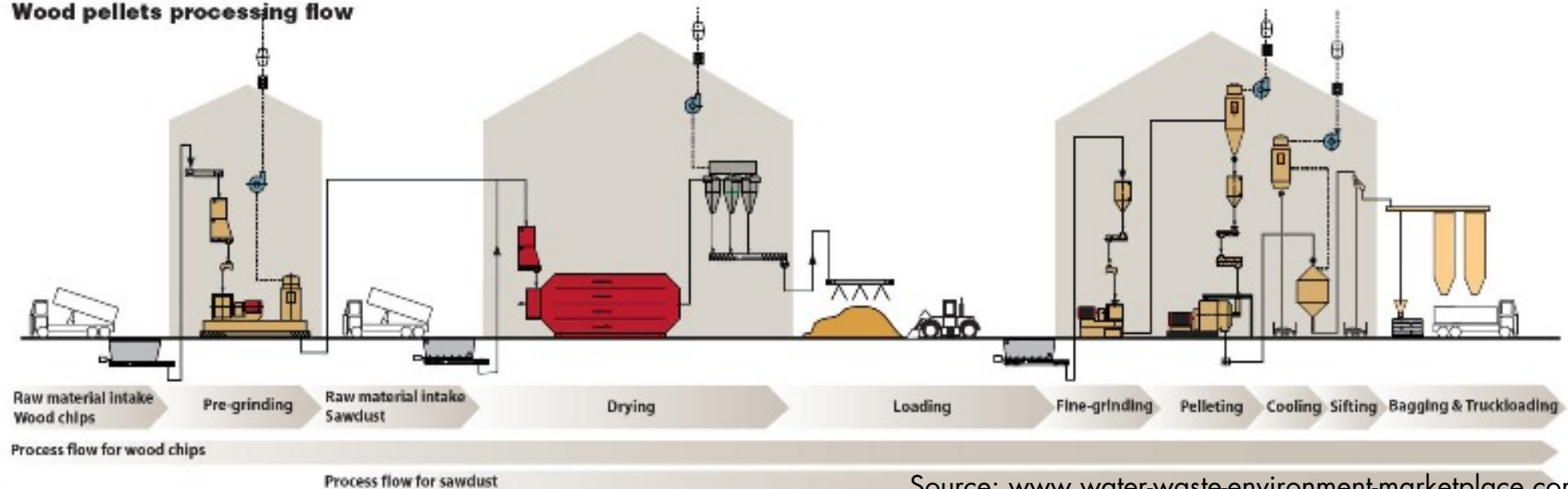
Biomass Technology – Densification (Torrefaction)

Densification most commonly seen as technology producing pellets / briquets

Torrefaction produces pellets through high temperature oxygen removal process similar to making charcoal



Wood pellets processing flow



Source: www.water-waste-environment-marketplace.com

Ontario Biomass Fibre Supply

- MNR data shows that apparently significant volumes of biomass fibre can exist in various areas – exclusive of any existing allocations
 - Can be within 150 km – 250 km radius – but may overlap with volumes calculated for other areas
 - Includes unharvested volumes and associated tops / limbs
 - Average cost estimated by Halifax Global \approx \$60 / OD tonne
 - Assuming other, primary harvesting activity underway in area
- Current licensing system gives control to SFL holders
 - No substantive incentive for SFL licensee to facilitate access by new ventures
 - Even if deals can be reached with SFL holders, current reduced level of sector activity creates uneconomic harvest cost for biomass venture
- Process to change licensing system lengthy – multi-multi-year
 - Creates major raw material / time constraints for development of biomass processing industry

Ontario Biomass Fibre Supply

Summary of Estimated Available Forest Biofibre Based on Distance from Smooth Rock Falls

Theoretical Forest Biofibre Supply Around Smooth Rock Falls

	150 km	200 km	250 km
Top/Branches from Current Harvest	469,091	707,058	972,362
Unharvested Volumes	824,250	1,354,150	2,068,850
Tops/Limbs from Unharvested Volumes	146,809	261,359	410,211
Total Volume	1,440,149	2,322,566	3,451,423

All Species (m³)

Source: OMNR

Ontario Biomass Fibre Supply

Wood Fibre Zones from Smooth Rock Falls

Competition for biomass fibre will constrain supply

150 km

200 km

250 km

Source: OMNR

Ontario Biomass Fibre Supply

- Time required to pursue / bring about tenure licensing system change requires re-examination of raw material supply options for individual opportunities
- A 'different' approach needed
 - Previously 'agricultural' land base in such areas as clay belt potentially a key resource
 - Findings from Phase One NCBAN Report
 - Potentially up to 1 million acres of land available for development of biomass fibre plantations
 - Classed as 'private' – but much under Crown control
 - But, not legally 'Crown Land' – not within SFL's

Ontario Biomass Fibre Supply – Purpose Grown Fibre

- Development of biomass plantation – fastest path to viable biomass raw material supply in some areas
 - Short rotation willow offers most flexibility for processing
 - Expected harvest rotation – four years
- Land assembly appears to be practicable
 - Likely requires some Provincial facilitation / enabling support
- Process from start to first plantings – likely 2 - 3 years
 - Some existing fibre harvested during development likely usable

Ontario Biomass Fibre Supply – Purpose-Grown Fibre

- Choice of short rotation willow offers:
 - High biomass production
 - Easily established with un-rooted cuttings
 - Re-sprouts vigorously after harvest
 - Harvest cycle of 3 to 4 years
- Multiple product / processing options
- Production of 15,300 trees per hectare (6,200 trees / acre)
 - Baseline yield of 5 tonnes/acre/year (green)
 - Halifax Global cost estimate – < \$60 / OD tonne
 - Lower over time with improved plantation productivity and efficiency
 - Plantation operation would generate 60+ jobs



Source: www.esf.edu (SUNY-ESF)



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Transformational Biomass Opportunities

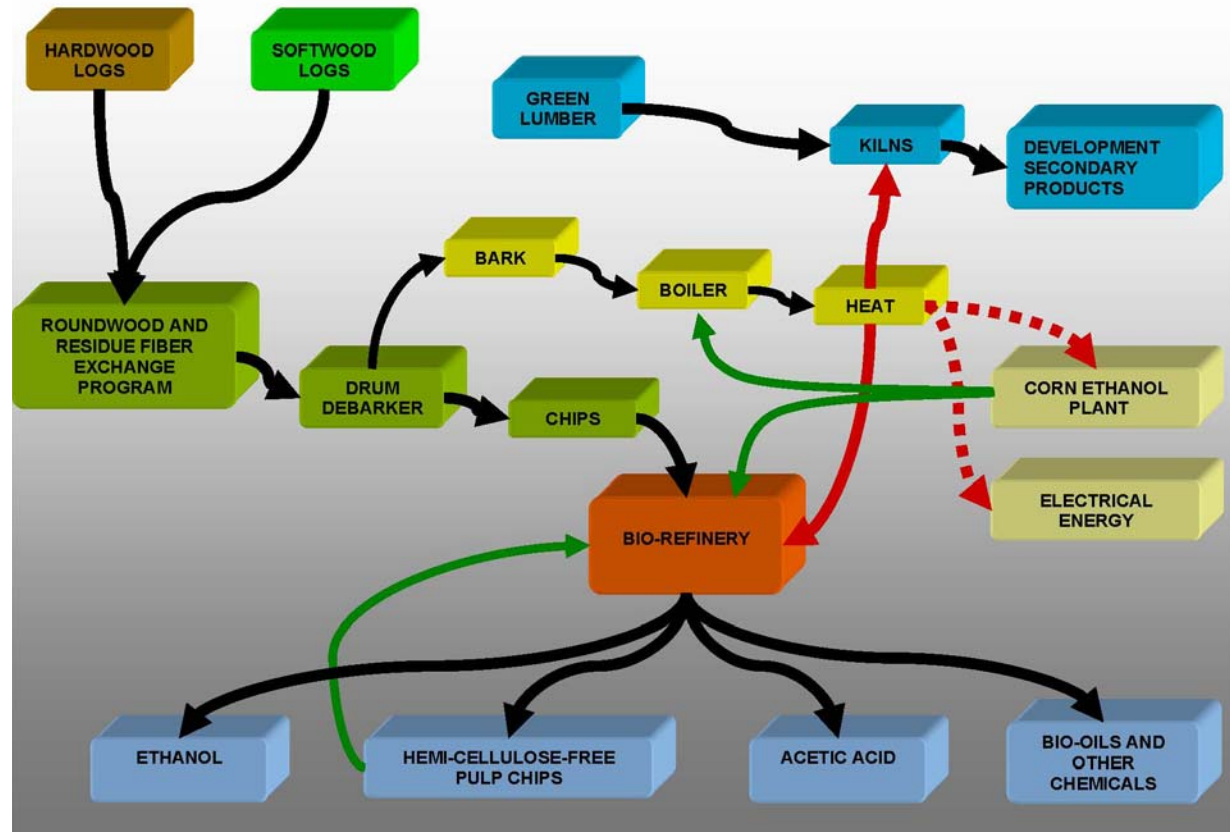
Integrated bio-refinery / biofuels production will almost certainly be part of future opportunities in forest sector



Source: www.esf.edu (SUNY-ESF)

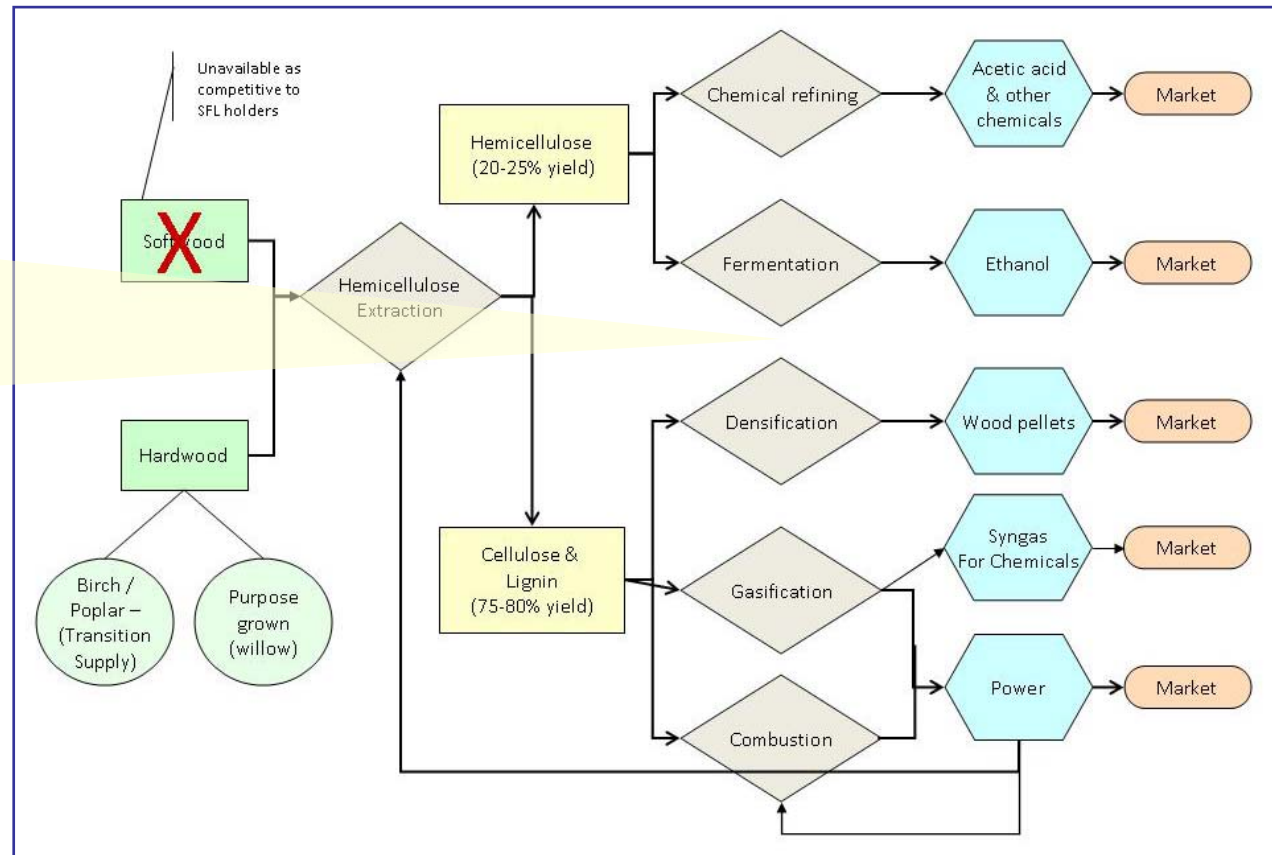
Transformational Biomass Opportunities

Bio-refinery can be integrated with other operations in eco-industrial park, as planned in Edwardsburgh-Cardinal, east of Kingston



Transformational Biomass Opportunities

For pulp mill and similar site regeneration, most workable opportunities involve application of combination of several biomass technologies – no one best solution



Transformational Biomass Opportunities

Science & Research –
leading to many new opportunities – things that can be made from wood

Acids

Dyes

Gas

Animal Fodder

Explosives

Fabrics

Plastics

Protein supplement

Glues

Vitamins

Food additives

Resins

Emulsifiers

Pharmaceuticals

Sugars

Liquid Fuels

Essential Oils

Toys

Diapers

Furniture

Dietary fibre

Films

Filter tips

Membranes

Dust control

Source: Fengel & Wegener, 1984 Courtesy – Dr. Sally Krigston, UoT

Conclusions - Future Directions

- Change in traditional forest industries is fundamental – not just cyclical downturn
- North American producers of traditional 'forest products' will have increased difficulty competing in 'commodity' grades
 - Scale needed for commodity competitiveness will be very difficult to achieve
- Time to start thinking about trees as something more than just furnish for pulp and S-P-F lumber
 - 'Biomass' uses of trees may be more valuable than pulp, paper or lumber
 - 'Biomass' energy uses viable way to reduce GHG's
- We need to apply science and technology to –
 - Grow more and better quality trees / fibre
 - Extract significantly higher value from every tree
 - Develop better processing / extraction technologies

Conclusions

- *Panacea* –
 - biomass processing technologies and bio-product output combinations represent potentially viable regeneration opportunities for forest industry manufacturing facilities
 - 'green' jobs in smaller communities – enhanced rural / northern community sustainability

AND

- *Pandora's Box* –
 - Significant policy changes needed to resolve (or at least mitigate) biomass fibre supply challenge

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