

Biomass - Bioenergy

Foundation for Forest Sector Regeneration

Panacea Or Pandora's Box?

Presented to the
The Leslie Harris Centre of Regional Policy and Development
Synergy Session

by

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Presentation Overview

Setting The Context – Experiences / Lessons

Biomass Technologies Overview & Observations

Biofibre Supply - Myths, Realities, Conundrums

Economics – Realities? Delusions?

Conclusions – Panacea? Pandora's Box?



Context – Experiences and Lessons

Eastern Ontario Model Forest

- Biorefinery concept attempt to sustain pulp mill operation

Smooth Rock Falls

- Biomass-based industrial regeneration strategy – development concept

Newfoundland Forest Sector Strategy

- Comprehensive sector strategy for Island portion of Province

Town of Marathon – (nearing completion)

- Community-led, biomass-based regeneration of bankrupt pulp mill



Context – Experiences and Lessons

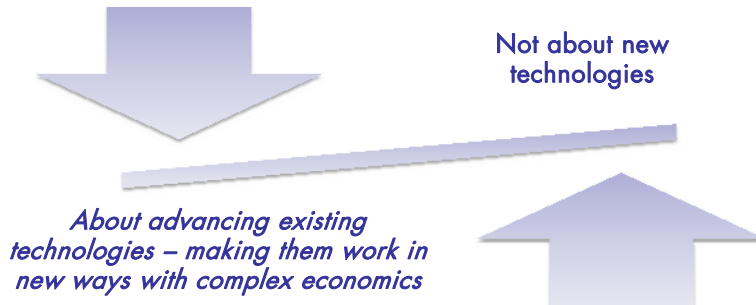
But first – a reality check!



*Biomass Fuelled
Decorative Domestic
Heating Appliance*



Context – Experiences and Lessons



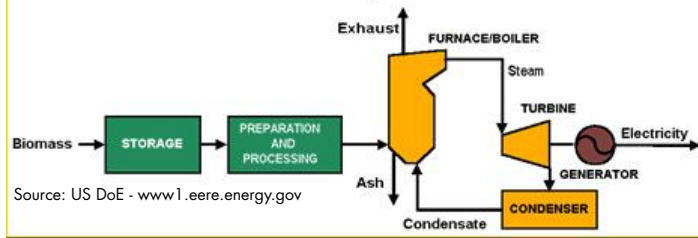
Biomass Technology Opportunities

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

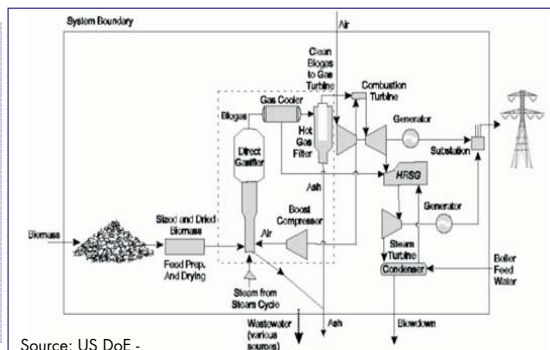


Biomass Technology – Gasification

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.



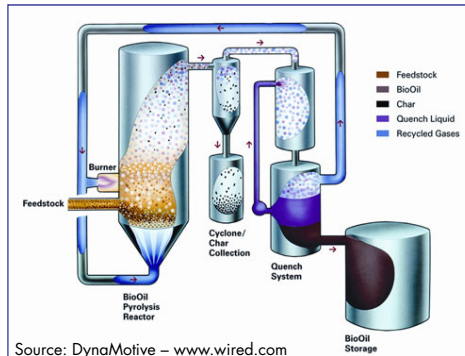
Biomass Technology – Pyrolysis

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.



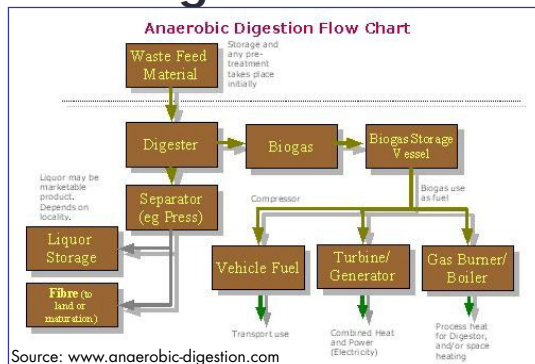
Biomass Technology – Anaerobic Digestion

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.



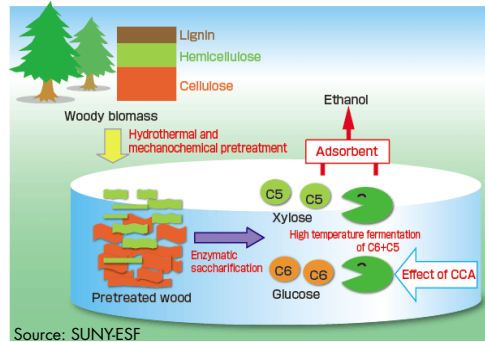
Biomass Technology – Fermentation / Distillation

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

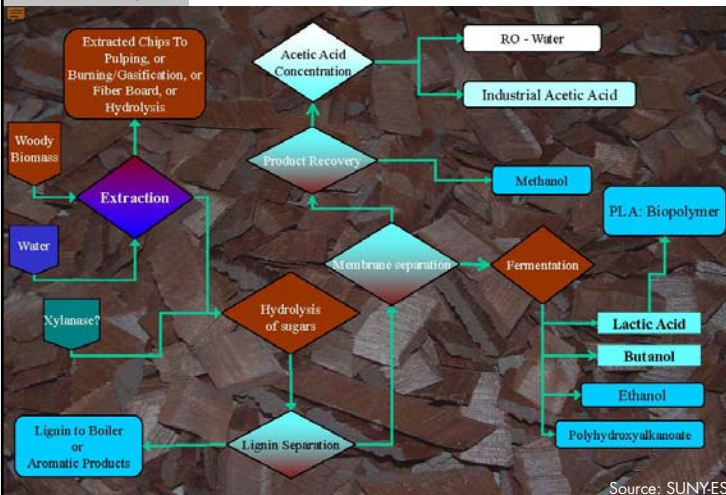
Pre-commercial – currently best suited for hardwoods



Source: SUNY-ESF



Biomass Technology – Fermentation / Distillation



Source: SUNY-ESF

Significant flexibility in range of potential product outputs

Established markets exist for all products

Replacing conventional products hydrocarbon-based



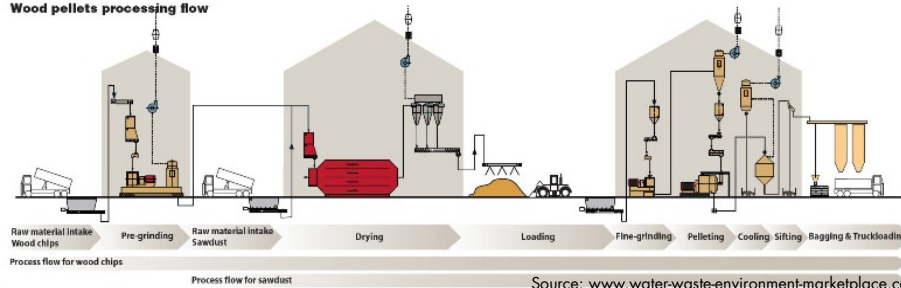
Biomass Technology – Densification (Torrefaction)

Densification – most commonly production of 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



Biofibre Supply – Myths, Realities, Conundrums

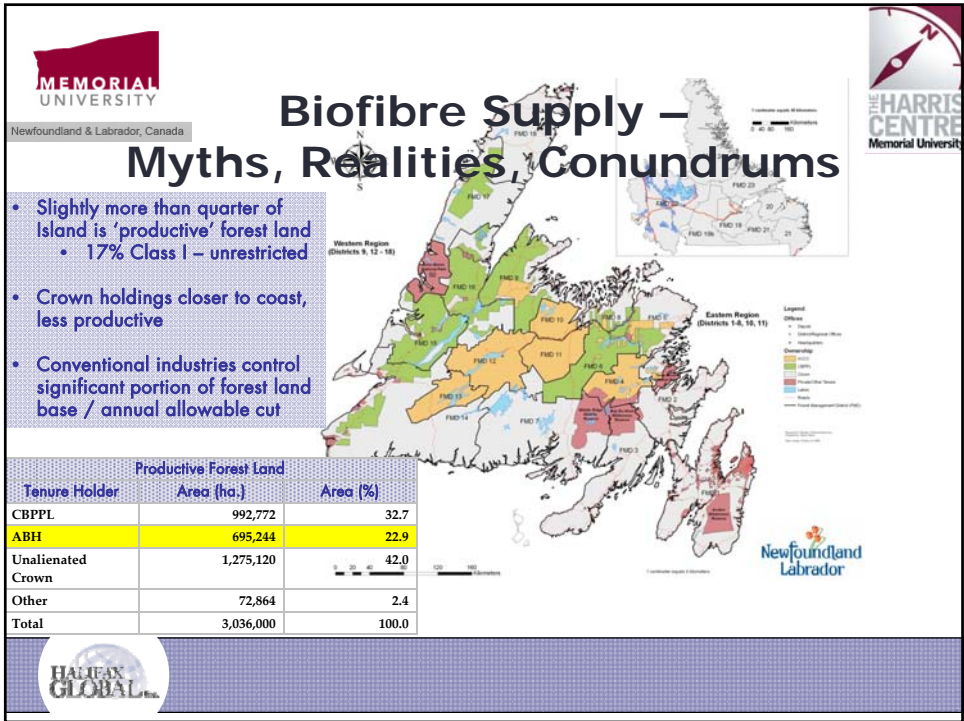
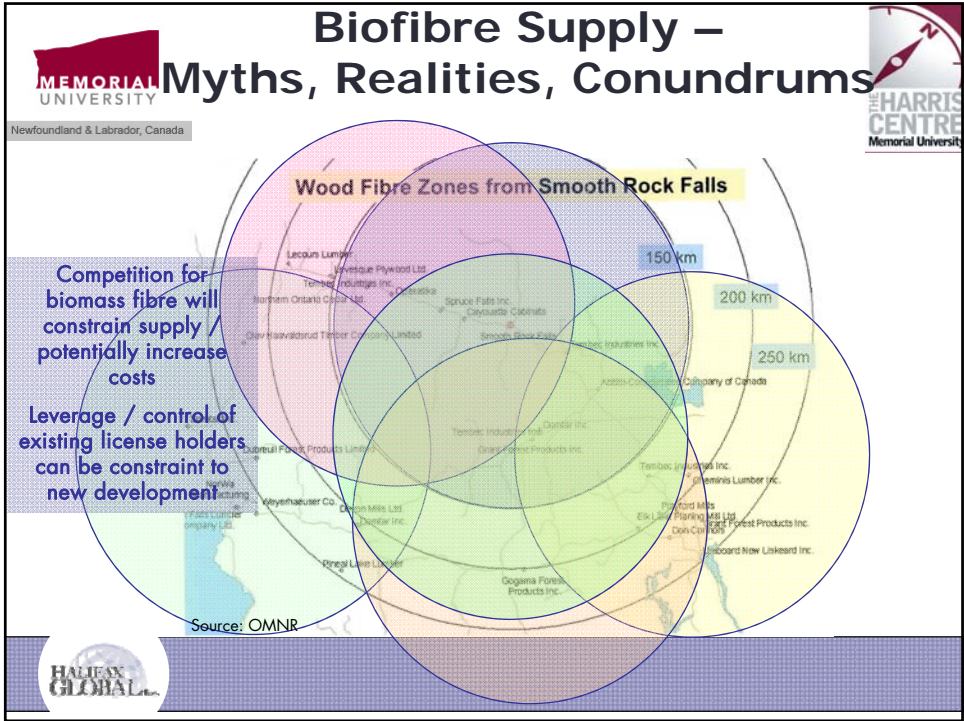
Theoretical Forest Biofibre Supply Around Smooth Rock Falls

	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

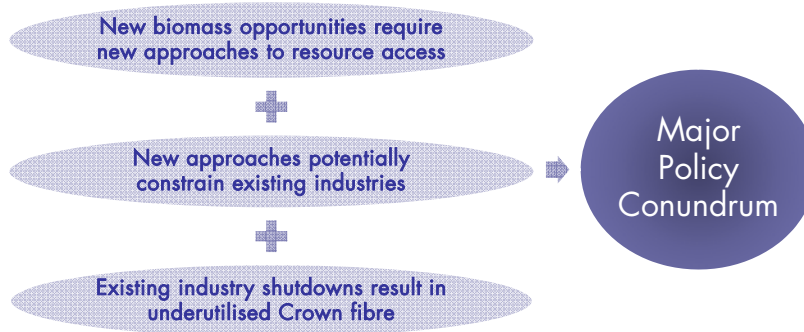
All Species (m³)

Source: OMNR





Biofibre Supply – Myths, Realities, Conundrums



Biofibre Supply Solution – Purpose-Grown Fibre

- Option - short rotation willow:
 - High biomass production
 - Easily established with un-rooted cuttings
 - Re-sprouts vigorously after harvest
 - Harvest cycle of 3 to 4 years
 - Not competitive with food crops
- 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
 - 40,000 ha. plantation operation would generate 60+ jobs



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



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



Biomass - Bioenergy Opportunities

Integrated bio-refinery / biofuels production – likely part of future opportunities in forest sector



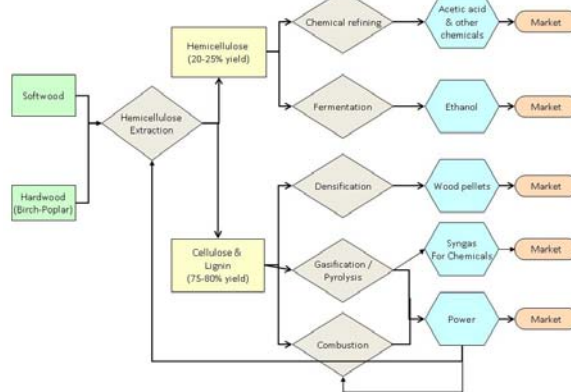
Source: www.esf.edu (SUNY-ESF)



Economics – Realities? Delusions?

Viability requires combination of several biomass technologies – no one best solution

Single product streams – eg. pellets – not viable – too much other value 'wasted'



Economics – Realities? Delusions?

Electricity Revenue

- \$19.5 million
- 17 MW @ \$140 / MWhr

Bioproducts

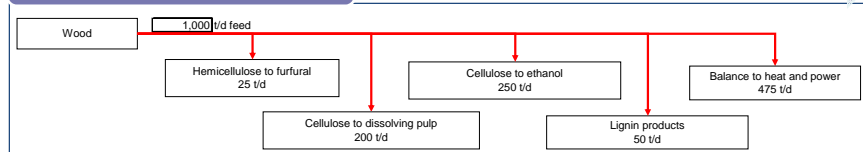
- \$40 million
- Mix of ethanol, furfurals, acetic acid, etc.

Estimated Capital Costs

- \$35 - \$40 million

Contribution / Margin

- \$65 - \$75 / OD tonne, before depreciation, finance costs, labour
- Significant numbers of knowledge-intensive green jobs



Economics – Realities? Delusions?

Densified Wood / Pellets

- \$45 - \$50 million
- Wood cost - \$35 mill
- Mill residue sourcing needed to reduce cost
- Mills not operating
- Capital cost - \$60 million

Contribution / Margin

- \$25 - 30 / OD tonne
- Before capital cost depreciation, finance costs and labour
- Limited, unskilled labour requirements



Conclusions - Future Directions

New thinking about trees needed -

- Storehouses of biochemicals, bioenergy
- 'Biomass' more valuable than pulp, lumber
- 'Biomass' uses reduce GHG's

Apply science and technology -

- Grow more and better quality trees / fibre
- Extract higher value
- Improve processing / extraction technologies

Biomass – A Panacea?

Products

- Potential regeneration opportunities for idled mills

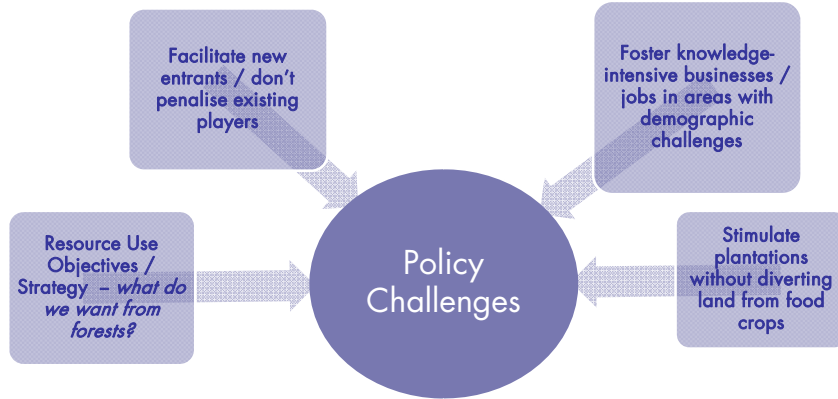
Energy

- Energy / economic self-sufficiency for 'forest dependent communities

Employment

- Community sustainability – 'green', knowledge-intensive jobs in smaller communities

Biomass – A Pandora’s Box?



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