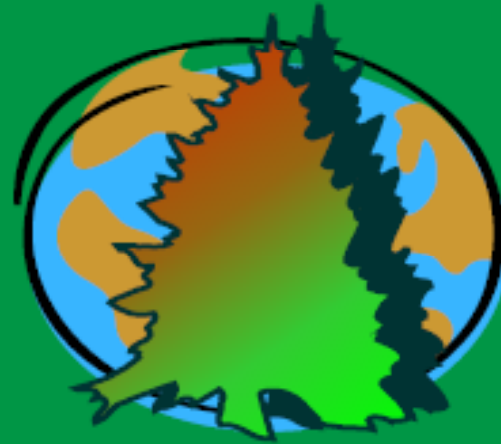


**Pure
Lignin
Environmental
Technology Ltd.**



Conversion of Lignocellulosic Biomass to:

- * Commercial Grade Pulp
- * High Quality Lignin
- * Hemi-Cellulose

Perspective on the Value of Wood

The following slide shows the value chain for wood

- Low end value of wood is burning it as heat
- High end value of wood is turning it into commercial cellulose (pulp) for making paper

Pure Lignin's technology:

- Turns wood into commercial pulp, lignin and hemi-cellulose, which doubles the value over pulp alone
- The next step to even higher value is biorefining of Pure Lignin's products into chemicals or advanced materials

Converted Value of Wood



Note: CHP = combined heat and power

Note: only 45% of wood converts to pulp

PELLETS, HEAT @ \$6/GJ	\$86 Per tonne
POWER @ 9 ¢/kWh	\$124
CHP @ 80%	\$181
SYNGAS @ \$10/GJ	\$143
BIGCC (CHP)	\$230
Pyrolysis ???	\$???
Ethanol @ \$.75/litre	\$263
Pulp @ \$700/t	\$280

Value of Wood from Integrated Forestry Company

- Integrated forestry companies produce both pulp and lumber, which increases the value of wood from producing pulp alone
- 50-60% of a log gets converted to lumber
- 30-35% of a log gets converted to wood chips at the sawmill which ships them to a pulp mill
 - Only 45% of these chips are converted to pulp and the byproducts are burned for energy to run the mill
- 5-20% is waste (bark, off-grade chips & sawdust)

Value of Wood from Integrated Forestry Company (continued...)

- Lumber is valued at \$250 to \$550 per ton depending on market prices
- Pulp is valued at \$700 to \$800 per ton depending on market prices
- Waste products are valued at \$10 to \$100 per ton depending on quality and market
- Weighted average value of a ton of logs therefore ranges from \$250 to \$450 or about \$320 based on long term normal prices

Improving Value beyond Traditional Integrated Forestry Company

- Step 1: With Pure Lignin's technology, get more value for waste at pulp mill or sawmill (instead of only \$10 to \$100 ton, convert it to products yielding a weighted average of \$500/ton)
 - This improves mill economics, but to create the highest value...
- Step 2: Build a stand alone large volume plant to process wood or biomass for further refining

Biorefining to Get More Value

The next two slides show the effect of refining the key components of wood processed by Pure Lignin's technology into other products

(These slides are from other third-party presenters at various conferences on this topic)

Biorefining means converting the cellulose, lignin and hemi-cellulose into other higher value chemicals, which may include simply making ethanol or other fuels from these products

Maximizing Value

Present situation

Product	Price (\$/ODMT)	Yield (%)	Value (US\$/ODMT wood)
Pulp	500	45	225
Wood as fuel	55	55	30
Total		100	255

Value-Added: $255 - 75 = 180$ US\$/ODMT wood

Future Situation Biorefining cellulose, lignin, hemi-cellulose in chemicals

Product	Price	Wood Yield (%)	Conversion (%)	Value (US\$/ODMT wood)
Pulp	\$500/ODMT	45	100	225
Polymer	\$3000/MT	10	50	150
PU foam	\$3000/MT	10	45	135
Diesel	\$630/MT \$2.00/gallon	35	40	88
Total		100		598

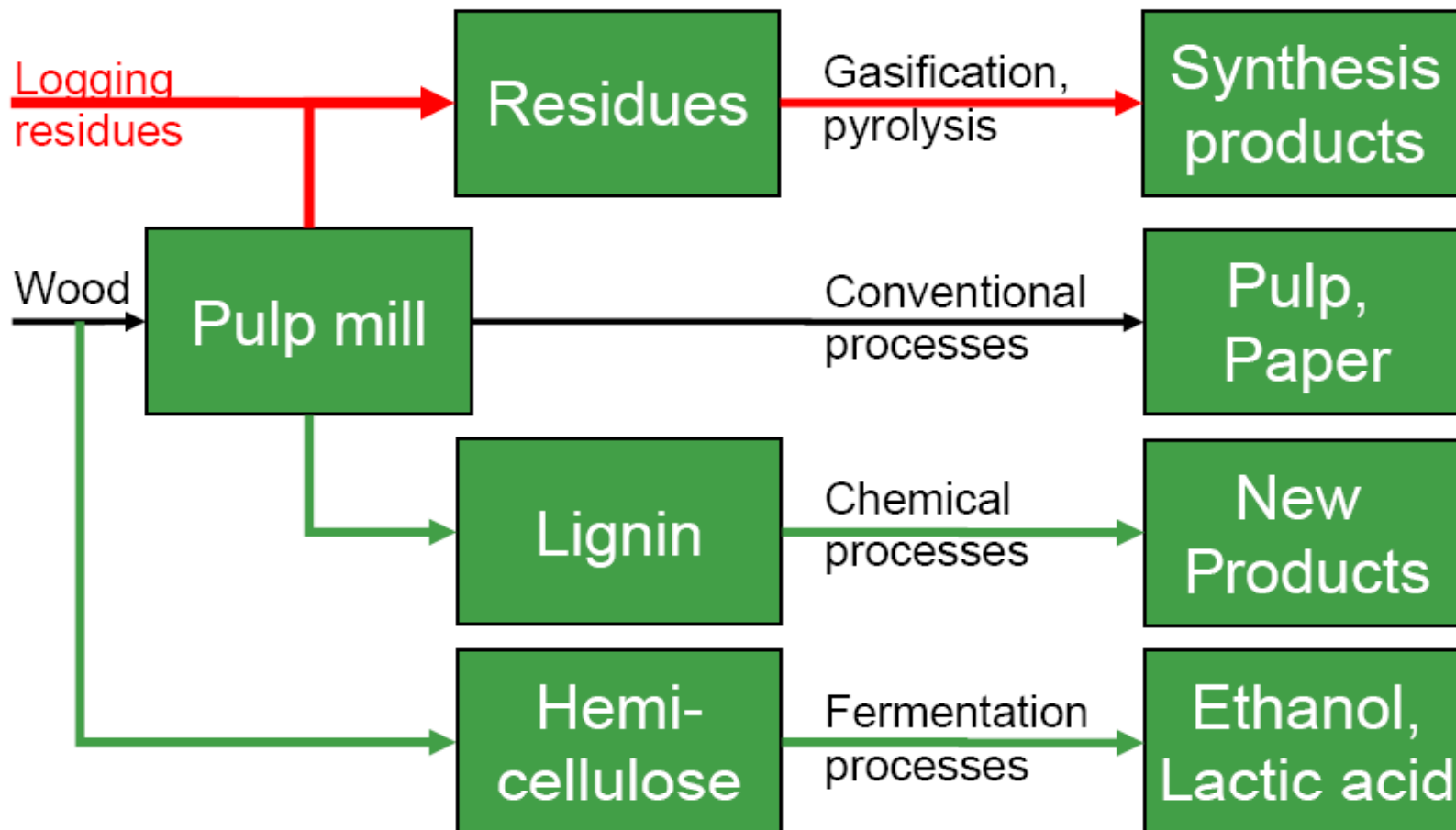
Value-Added: $598 - 75 = 523$ US\$/ODMT wood

**CONVERTING A KRAFT PULP MILL INTO AN INTEGRATED
FOREST PRODUCTS BIOREFINERY**

Product	Price	Wood Yield (%)	Conversion Yield (%)	Value (US\$/ODMT wood)
Alkaline Pulp	US\$600/ODMT	45	100	270
Poly Itaconic Acid	US\$3000/MT US\$1.25/Gallon	10	50	150
Carbon Fibers	US\$7000/MT	10	45	315
Diesel fuel	US\$630/ODMT US\$2.00/Gallon	35	40	88
Total		100		823

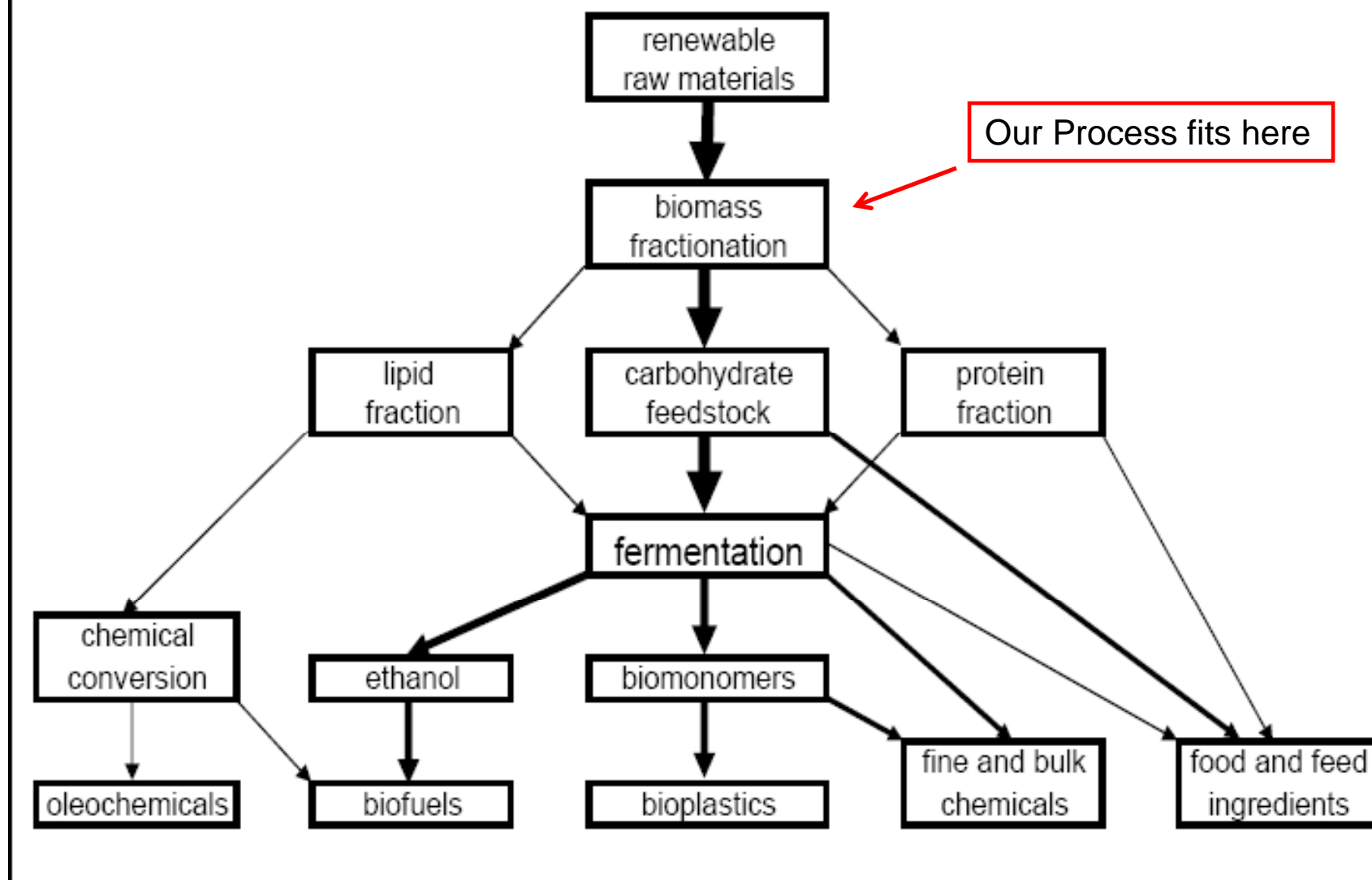
Table 7. Value of IFBR Producing Pulp, Structural and Diesel Fuel Products

The Forest Biorefinery: What is it?



Tom Browne, Fpinnovations Sep/2007 presentation

General concept of a biorefinery



Pure Lignin's Technology is the Critical Front-end for a Biorefinery

- Pure Lignin's technology is the most cost effective pretreatment process to convert wood into its basic parts: cellulose, lignin and hemi-cellulose
- The cellulose, lignin and hemi-cellulose can be sold in open market or fed to a biorefinery for further processing
- There are other common pretreatment technologies but an April 2008 scientific paper stated that none are suitable yet

Competing Pretreatment Processes

- Steam explosion
- Dilute acid
- Ammonium fibre expansion
- Aqueous ammonia recycle
- Lime
- Organosolv
- Mild alkaline

Conclusions on Pretreatment Options from Scientific Journal

“So far, there is no commercially feasible solution to efficient pretreatment of softwood materials for the production of biofuels and biobased products (Ahring et al., 1999; Chang et al., 2001; Reith et al., 2002). Breakthroughs in pretreatment are still needed for both scientific and economic reasons”

Biotechnology and Bioengineering, Vol. 99, No. 6, April 15, 2008 (Wiley Periodicals)

Forest Bio-Refinery: Why Now?

- Society is demanding renewable products
 - Chemical and fuel companies are noticing
- The forest sector needs new products to make better use of existing resources and infrastructure

Quoted from:

Tom Browne, Fpinnovations (Pulp Industry Assoc).

How to Get to Higher Value?

Quotes by pulp industry strategy experts in 2008

Design or retrofit the facility so it can "shift the carbon" available from woody biomass, pulp and paper products, energy products and bio-refinery products to dance with the shifting markets and thus maximize those margins. The mill becomes proactive, rather than reactive. "It's a completely different way of thinking," says Stuart. "It's the way pharmaceuticals and [oil] refinery companies think."

Dr. Paul Stuart, head of the NSERC Environmental Design Engineering Chair in Process Integration in the Pulp and Paper Industry and professor with the Chemical Engineering Department of École Polytechnique in Montreal

Pulp Industry Strategist Quotes

“Crude oil is chemically and thermally fractured into different products, from high-value aviation fuel to plebian road asphalt. Ditto for forest biomass,” says Browne. “Every fraction has a value and you maximize the value of as many of these fractions as you can.”

Dr. Tom Browne, Program Manager Mechanical Pulping and Sustainability for FPInnovations (formerly Paprican)

Pulp Industry Strengths and Weaknesses

- Why Venture Capitalists need Pulp Industry
 - Secure access to renewable biomass
 - Good plant locations and permitting
 - Tested supply chains
- Why the Pulp Industry needs outsiders
 - No product development culture (“we fired everyone”)
 - Do not have the research ability or knowledge to bring on new products

Canadian Pulp Mill Advantages

- The Canadian pulp and paper industry has small, aging mills in comparison to the large modern mega-mills drawing fibre in from plantation forests.
- When it comes to converting some capacity to bio-refining, certain advantages may go to smaller mills.
- Smaller mills may be tailored to create profitable bio-products.
- Canada is close to the large U. S. markets, thus cutting transport costs.

Is it Time For Change in Pulp Industry?

- Two years ago Dr. Brown was less optimistic about forest industry biotech industry, **but now:**
- “Some technical successes in the lab have convinced people there are some opportunities here.”
- "The industry is beginning to move and I think it is going to start moving pretty quickly in the next little while.”
- "There's something of a gold-rush mentality here; there's an awful lot of money floating around and an awful lot of people jockeying for position.”

Evidence of Action in 2008

- Weyerhaeuser and Chevron formed Catchlight Energy JV to focus on cellulosic ethanol
- Dupont Danisco to produce cellulosic ethanol
- Lignol Energy & Suncor get DOE funding to build cellulosic ethanol pilot plant in USA
- Government incentives and policy are pushing for action from industry (SDTC funding in Canada, USA has \$1.07/gallon incentive plus cost sharing on projects and loan guarantees)

How should Pulp Industry Proceed?

Dr. Brown of FPInnovations:

- Trade secure sources of cellulose for outside capital and smarts
- Find savvy partners or allies in oil or chemical industries
- Identify waste or under-utilized biomass streams
- Start with small scale uses of side-stream

Why Pulp Mills will Partner with Pure Lignin

- Pulp mills must lower energy consumption, lower their capital costs and find other revenue streams
- Pure Lignin has low capital and operating costs due to a simple process operating at low temperatures and low pressure that recycles all chemicals and water
- Our pretreatment process can use lower quality chips, lower cost chips or sawdust without degrading pulp
- Our process can eliminate the costly recovery boilers
- Reduces water, air pollution and landfill sludge
- Three revenue streams: pulp + lignin + hemi-cellulose = more profits
- Lower capital cost + higher profits = higher ROI

Other Potential Partners

- Sawmill Owners
- Entrepreneurs and Investors
- First Nations
- Governments & Municipalities
- Cellulosic Ethanol Producers

Sawmill Owners

Reasons to Partner with Us

- Our process will yield higher value for both pulp grade and non-pulp grade chips, fines/sawdust
- Very cost effective stand-alone plant as sawmills already have wood handling equipment and AAC
- An onsite plant allows you to choose whether to process the log through your plant or ours, depending on market prices or log quality
- If lumber prices are too low then chip the whole log and sell marketable pulp and lignin to stay profitable
- Increase value of log or wood residues from \$100/ton as waste or \$250/ton as lumber to \$550/ton by selling multiple products from our plant

Entrepreneurs & Investors

- Fast payback on stand-alone plant using beetle-kill wood
- Ongoing return on plant from other biomass after beetle-kill timber is gone
- Plant size is economic on smaller scale (25 ton to 500 ton/day input vs. 1,000 to 3,000 ton/day)
- Multiple feed stocks and multiple end products result in lower risk than pure corn ethanol plant
- Incremental investment in advanced bio-refinery yields higher returns on total capital invested
- Generate additional revenue from GHG credits



First Nations

Reasons to Partner with Us

- Build your local economy
- Smaller scale plants economic
- Economic use of your beetle kill AAC
- Economic use of forestry waste in your area
- Local employment for range of skill sets leading to career paths in your community



Governments & Municipalities

Reasons to Partner with Us

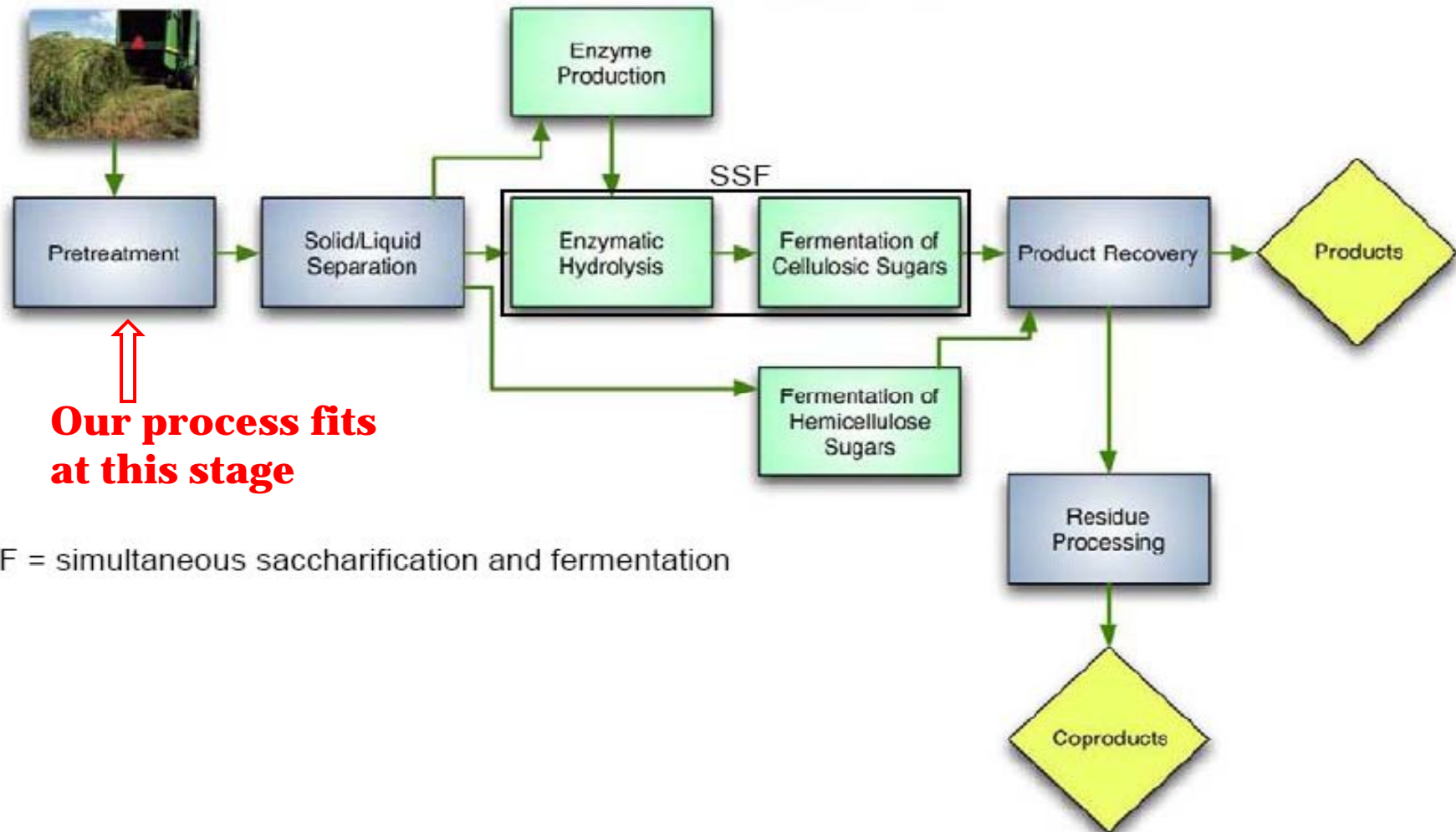
- Diversify your economy
- Invest in initial plant in JV with your local pulp mill help it stay in business
- Re-open closed pulp mills with new lower cost processes and lower pollution processes
- Keep your tax base
- Keep your population base employed
- Build multiple mid-sized plants instead of one massive plant leading to more sustainable communities

Cellulosic Ethanol Producers

Reasons to Partner with Us

- The industry needs better pretreatment options and we have this improved process now
- Low capital costs and low operating costs due to simple closed loop design operating at lower pressures and lower temperatures
- Full recovery of chemicals and negligible pollution due to closed loop process
- Multiple revenue streams from selling high quality lignin by-product
- Works with multiple feed stocks: wood chips, sawdust, sugar cane bagasse, corn stover, etc.
- Multiple feedstock choices protect your profits if one feedstock gets too expensive

Biomass to Ethanol Process at a Glance



SSF = simultaneous saccharification and fermentation

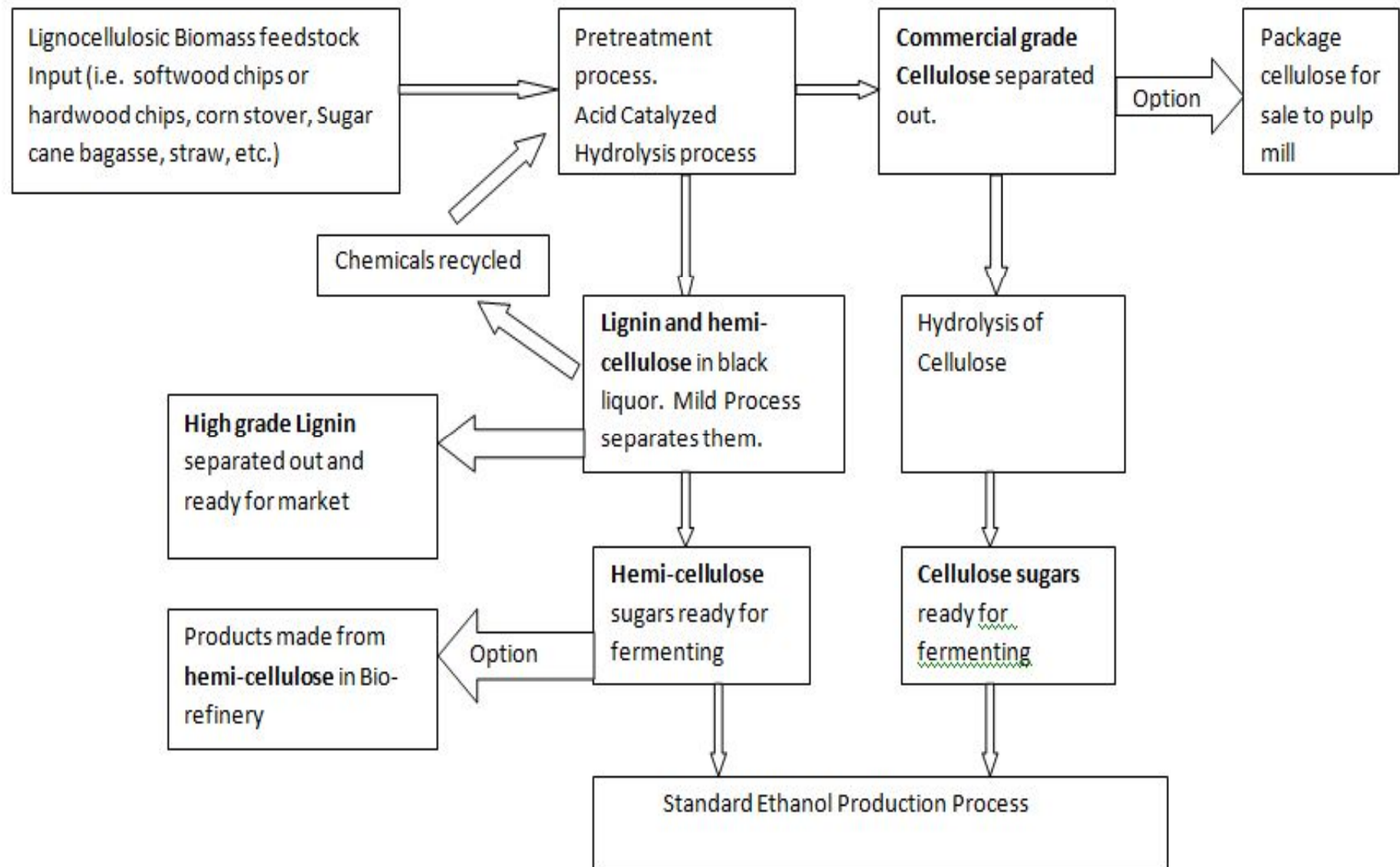
Key Attributes of a Pretreatment Process for Lignocellulosic Biomass

- Conclusions from Pacific Northwest National Laboratory October 2007 Lignin research
 - **Of highest importance is the need to remove lignin early and mildly in biomass fractionation processes**
 - **Use mild processes to preserve the structure**
- Our patented technology achieves this now!!
 - Lab tests done
 - 1st generation pilot done
 - 2nd generation mobile pilot complete in Spring 2009

Key Aspects of Our Process

- Cost-effective fractionation of a wide variety of lignocellulosic biomass using a mild pretreatment process
- Pretreatment method that does not degrade key properties of cellulose, lignin and hemi-cellulose
- Marketable cellulose, lignin and hemi-cellulose allows economic stand-alone plant
- Alternatively, feed products through ethanol or advanced bio-refining processes

Pretreatment Process that Results in Marketable Pulp and Lignin or allows for further processing to Ethanol



Is a Cellulosic Ethanol Plant Profitable?

- Other companies are forecasting profitability even with higher capital and operating costs than corn ethanol plants
- Profitability comes from extra revenue from lignin and hemi-cellulose by-products
- Government incentives on cellulosic ethanol production in USA \$1.07/gallon, plus subsidies for biomass transport, plus loan guarantees
- Governments are also sharing the risks by subsidizing costs of commercialization (SDTC)

Sample Ethanol Plant Economics

- Levelton Consultants did a study for Alberta Research Council on cellulosic ethanol plant economics (see next page for proforma)
- Levelton used preliminary data from Lignol Energy, a local Vancouver company, that show the importance of having lignin as a second revenue stream to make the economics of a cellulosic ethanol plant work
- The proforma on the next page shows that a plant can have a 14% ROI even while paying a higher than market price for input biomass

Balance Sheet and Ability to Pay for a Lignol Innovations Ethanol Plant

Prepared by Levelton Consultants for Alberta Energy Research Institute

Size in litres ethanol/yr		93,000,000
	Cdn\$ per year	Comments
Capital cost	\$ 300,000,000	
Salaries	\$ 5,500,000	
Maintenance	\$ 7,093,000	
Insurance	\$ 900,000	
Property tax	\$ 1,500,000	
Fuel pre-treatment	\$ 3,500,000	100% of fuel is de-barked/chipped
Electricity	\$ 4,081,000	
Enzymes	\$ 6,192,000	
Water	\$ 1,098,000	
Ethanol losses	\$ 4,495,000	
Denaturant	\$ 2,552,000	
Natural gas	\$ 1,712,000	
Chemicals	\$ 1,244,000	
Ethanol transport (train)	\$ 2,343,600	700 km
14% ROI	\$ 42,000,000	
Annualized Cost	\$ 84,210,600	
Ethanol revenue	\$ 68,820,000	\$0.74 per litre (ethanol)
Lignin revenue	\$ 67,979,678	\$0.88/kg
Furfural revenue	\$ 6,532,643	\$0.29/kg
Annualized Revenue	\$ 143,332,321	
Income above ROI	\$ 59,121,721	
Ability to pay for fuel (\$/bdt)	\$ 169	350,000 bdt/yr

Summary

- Urgent needs from three industries
 - Pulp industry needs new revenue sources
 - Sawmill industry needs new revenue source
 - Cellulosic Energy producers need better treatment processes now
- Pure Lignin's patented technology aligns with:
 - Timing of industry needs
 - Society's demand for non-petroleum based products, i.e. renewable cellulosic alternatives
 - Government policy

Contacts:

Pure Lignin Environmental Technology Ltd.
www.purelignin.com

Kelly O'Flynn Founder & Co-inventor
Lani O'Flynn, Founder
info@purelignin.com