Lignol's Biorefinery Technology
IEA Bioenergy Conference Vancouver
August 25 2009

www.lignol.ca

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Introduction to Lignol

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- Emerging cellulosic ethanol / biorefining company
- BC, Canada-based, public company LEC:TSX-V
- 50 employees
- $21 million of equity raised
- Government funding to date $23 million
- Planning stages for commercial demonstration plant with support from US-DOE

Our goal is be the lowest cost producer of cellulosic ethanol with the greatest environmental benefits

Lignol's Unique Biorefining Process

Lignol's Process Overview

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Process Features and Benefits

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- Versatile biorefinery with multiple products such as CE, HP-L™ lignin and furfural
  - *Process economics enhanced by multiple revenue streams – process can be economic at smaller scale*
- Well-proven organosolv pre-treatment process provides very clean cellulose substrate and unique lignin-based co-product
  - *Enzymatic saccharification enhanced by clean substrate – smaller enzyme dose, faster bioconversion*
  - *High value HP-L™, compared with other "lignins"*
- Co-products displace petrochemicals
  - *Significant GHG emissions reductions beyond just transportation fuel benefits*

Technology Status

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- Core technology comes from of well proven sources.
- Pretreatment, lignin, solvent co-product recovery were demonstrated in a five year campaign as a novel pulping process.
- Hydrolysis and fermentation use well known process equipment used in the starch ethanol industry today.
- Particulars of processing cellulosic substrates are being tested at pilot scale testing.
- Distillation, dehydration and stillage evaporation are well proven standard processes in ethanol processing.
- Design criteria for demonstration plant currently being developed.

Lignol's Biorefining Co-products

High Purity Lignin HP-L™

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- A family of unique native lignin derivatives
  - High purity due to extraction process
  - Petrochemical substitute - resin ingredient
- HP-L lignin applications a major focus of Lignol's technical and business development programs
  - 30 applications developed with more than 3000 tonnes sold by Repap/Alcell
  - Business and application development with major partners, JDA's e.g. HAI, Huntsman
  - Development of higher value end uses
- Market valued in excess of US$2 billion estimated by Euro Lignin Institute(2005)

Co-products continued

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- Furfural is a natural byproduct of pentose degradation
- Multiple applications as an industrial solvent used in
  - *Petroleum refining*
  - *Synthetic fibre manufacturing*
  - *R&D towards higher BTU Furan based fuels*

- Industrial sugars for feedstock into bio-polymers, bio plastics

- Extractives, dependant on feedstock
  - Various unique chemicals have been identified

Path to Commercialization

Technology Deployment Path

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Classic staged roll out:

Stage	Capacity (feed) Capacity (ethanol)	Status
Lab	Grams/hour	✓Complete
Small Pilot Plant	Kilos/hour	✓Complete
Industrial Pilot	1tonne/day	✓Progressing
Demonstration	100-300 tonnes/day 10 – 30 million liters/yr	✓Developing
Commercial	400-2000 tonnes/day 40 -200 million liters/yr	✓Planning

Lignol's Pilot Biorefinery

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Lignol's Pilot Biorefinery

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- Capacity: 1 tonne per day (dry basis)
  - Fully integrated mini-biorefinery
  - Fully instrumented
  - Industrially proven equipment
  - Nameplate Capacity 100,000 l/yr ethanol

- Feedstocks: Hardwood & softwood, agricultural residues, energy crops
- Products: Ethanol, HP-L™ lignin, furfural, other chemicals
- Operation: 24/7 in campaigns

Lignol Pilot Biorefinery

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Lignol's Demonstration Biorefinery

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- Capacity 100 300 tonnes per day
- Feedstock
  - *Aspen*
  - *Beetle Killed Pine*
  - *Some Ag residues*
- Products
  - *Ethanol 10-30 M liter/yr*
  - *HP-L™ lignin*
  - *Furfural*
- Location
  - *TBD*

Economic Turmoil and Changes in Energy Prices

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Today's Reality for Gen 1 Biofuels

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- $25 Billion of value destroyed in Corn Ethanol Sector
  - valuations of $2.60/gallon in 2007 and $0.70/gallon today

- 3 Billion gpy capacity either idling or running below capacity
  - 12 Plants (1.1 Bg/y) – Uunder new management
  - 8 Plants (830 Mg/y) – Bank owned
  - 14 (+3) Plants (1.03 Bg/y) – Chapter 11

  - Ethanol Bankruptcies & Acquisitions Conference
    - July 30 –31, 2009 Houston, Texas

Today's Reality for Gen 2 Biofuels

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- Financial crisis and global economic slowdown
  - Major players with strong balance sheets few and far between
  - Tight credit markets, capital constraints, limited risk capital
  - Lower energy prices – ethanol prices low

- Lignol's Adapted Approach
  - Consortium approach vs Single partner
  - Multi-sector involvement - feedstocks, chemicals, energy players
  - Brownfield sites – co-locate with pulp mills, ethanol plants
  - Expanding capacity to extend the useful life of demo plant
  - Leverage other technologies to add value

Thank you and questions?

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