Presentation to the NZ Conference

*Future BioPathways*

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Outline of Presentation

- Context
- Background – who/what/why/how
- Results
- Take-home messages
- Policy Implications
- Canadian Federal Support
- Next Steps
What are the major economic and social drivers for next-gen bioenergy?

- **Financial and Economic Drivers**
  - Energy security through energy diversification
  - Development of innovative Canadian technology
  - Forest Sector Economics – revitalization!

- **Environmental Drivers**
  - Climate change
  - Improved air quality
  - Food vs. Fuel

- **Socio-economic Drivers**
  - Rural economic development
    - Economic diversification
    - Job creation
    - Sustainable communities
Countries/regions have established or intended biofuels mandates…

Canada
5% (e.g. ethanol) 2010
2% (e.g. biodiesel) 2012

USA
10.21% 2009
20% 2022

Brazil
23% (ethanol) 2008
5% (biodiesel) 2010

Argentina
5% 2010

2010
EU 5.75%
France 7%
Germany 5.75%
2020
EU 10%

India
20% 2017

China
10% (ethanol) 2020

Malaysia
5% (biodiesel) 2008

Queensland
5% (ethanol) 2010

New Zealand
3.4% 2012??

Canada’s Natural Resources – Now and for the Future
Canadian Forest Sector Snapshot

- Economic challenges in sector – both cyclical and structural:
  - Employment: 267,300 jobs in Aug 2010
    - 136,000 jobs have been lost since 2003
    - (34% decline)
  - Economy: $24 B contribution to GDP in 2008 (in 2002 $)
    - down from $31 B in 2005 (in constant 2002 $)
    - Bankruptcy of Canadian firms
  - Exports: $30.1 B in exports in 2008 (current $)
    - down from $37 B in 2003 (current $)
  - 60% decline in North American newsprint consumption since 1999, eliminating 840,000 tonnes/yr
Drivers for Transformation in the Forest Sector

- Need for a new business model

- Shift to green energy and products happening globally, nationally, regional (climate change, energy security, etc.)
  - Foreign subsidies and mandates have major impacts

- High interest in Canada in forest bioenergy … but decisions are being made with little information
  - Harvesting licenses for biomass removal for bioenergy
  - Long-term contracts for pellet plants, to ship pellets to Europe

- Many technologies being developed and promoted
  - Need to separate fact from fiction
  - What are the best options for the sector and communities?
Bioenergy technologies are at different stages of development

BioPathways Project

- What are the real opportunities for new technologies and emerging products from wood fibre?
- Will these new products and technologies have similar financial and socio-economic contributions compared to traditional forest products?
- How might public policies and programs help support the forest sector in this transformation?
How: Six Lines of Inquiry

1. Assess the “market readiness” of the emerging technologies.
2. Quantify key economic, social and environmental metrics associated with the main existing and emerging bio-products;
3. Analyze economic fibre supply;
4. Examine the market potential of emerging bio-products;
5. Explore new approaches to managing the value chain and development of partnerships; and,
6. Build capacity to manage innovation in the Canadian forest products sector.
Who: Collaborative Process

- **Steering Committee**
  - Leadership of FPI, NRCan (CFS, Energy, CANMET), BCMF, OMNR/OMNDMF, MRNQ, Ivey Foundation and FPAC.

- **Project Team**
  - Co-chaired by CFS and FPAC
  - FPInnovations
  - NRCan
  - FPAC
  - Don Roberts (CIBC)

- Selected bioenergy companies
- Large network of experts
What: The Forest Biorefinery

- Feedstocks:
  - Forest Residues
  - Construction and Demolition Waste
  - Disturbances
  - Dedicated Plantations

- Densification - Drying - Transportation

- Biorefinery

- Mixing - Transportation - Storage

- Range of possible value-added co-products:
  - Biofuels and Bioenergy
    - Cogeneration
    - District heating
    - Pellets
  - Traditional Products
    - Pulp and paper
    - Lumber
  - 2nd Generation Fuels
    - Cellulosic ethanol
    - Renewable diesel
  - High-Value Co-products
    - Biochemicals
    - Biomaterials
    - Advanced products

Canada’s Natural Resources – Now and for the Future
How: Sensitivity analysis using case studies

27 Products/technologies were originally examined in the 1st Phase of the Project – 16 traditional and 11 emerging
## How: Metrics Analyzed

<table>
<thead>
<tr>
<th>Financial</th>
<th>Social</th>
<th>Environmental</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue/ODMT</td>
<td>GDP Multiplier</td>
<td>Carbon Footprint (In process)</td>
</tr>
<tr>
<td>EBITDA/ODMT</td>
<td>Employment Multiplier</td>
<td>Others to follow (LCA)</td>
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<tr>
<td>Return on Capital</td>
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Canada’s Natural Resources – *Now and for the Future*
How: Bioenergy Pathways Analyzed

- **Thermo-Chemical**
  - Combustion
    - Excess air
    - Heat & Power
  - Gasification
    - Partial air
    - Fuel Gases (CO + H₂)
    - SNG, Hydrogen
  - Pyrolysis
    - No Air
    - Char & Liquids
    - Liquid transport fuels

- **Bio-Chemical**
  - Hydrolysis & Fermentation
    - Heat & Power
    - Liquid transport fuels

- **Physical**
  - Pelletization

This project is examining all routes except (3) and (7).
Quebec

Earning Their Cost of Capital

ROCE: Traditional + Emerging Technologies

both worlds?

Results: What is the best from
What is the best from both worlds?
What is the best from both worlds?

- Some of the emerging products are better, but we have to be selective.
  - E.g., Small-scale gasification and pyrolysis oil for power looks attractive, while the pure production of ethanol via the bio-chemical process does not.

- The most promising future involves:
  - solid wood mills integrated with bioenergy at the back-end
  - pulp mills evolved into biorefineries, which produce a range of pulp/bioenergy/biochemical products

- Moving to the production of commodity bioenergy products is a necessary step in the forest industry transformation
  - Commodity bioenergy should be part of the biorefinery platform (i.e. integrated facility producing a range of products)

- Increased emphasis on those higher valued bio-chemical markets in future
Standalone or Integrate?

- Although there are a few exceptions, the emphasis should be on integration.

- Integration generally provides:
  - Higher ROCE
  - Higher employment base
  - More secure and lower cost supply of fibre (key issue in the capital markets.)

- Results underscores integration of new into traditional production facilities is far better for the production of both the traditional and emerging product.

- There is a compelling financial case for both the established and potential new entrant to co-operate.
General Bio-energy Strategy?

- Simply selling bioenergy is generally not good enough in the long-run.
- However, selling bioenergy may still make sense in the long-term if:
  - If it is one of a series of products that are jointly produced in a bio-refinery.
  - You are operating in a special environment characterized by:
    - Low delivered cost of biomass
    - High price for electricity.
- The best value will be created if you can exploit bio-energy’s “battery-pack” and “optionality.”
- The threat is that the competitiveness of bio-energy relative to other sources of renewable energy is expected to deteriorate over time.
Is There a Trade-off Between Financial Returns and Employment?

---Top 5 Employment---

Avg ROCE = 3%
Avg Employment/100,000 odt = 594

---Top 5 ROCE---

Avg ROCE = 21%
Avg Employment/100,000 odt = 212

Canada’s Natural Resources – Now and for the Future
Carbon Analysis

- **Purpose**
  - Provide mill-level analysis for investment decisions
  - Provide product-level analysis for comparison with current products (e.g., fuels, power, structural products)

- **Methodology**
  - **Direct**
    - NG, Oil, other fossil fuels
    - Conversion carbon emissions (e.g., lime kilns, enzymes)
  - **Indirect**
    - Electricity – varies by province
    - Fibre supply model – harvest, transportation
    - Other – LCA, carbon multiplier, sensitivity analysis
Biopathways: Key Take Home Messages

• The future of the industry lies in integrating new technology into the existing sector rather than replacing it.

• New and emerging technologies offer some promising opportunities but no silver bullets.

• Bioenergy is only part of the story – with higher-value co-products being more promising & sustainable over the longer term.

• The long-term viability of some traditional products in Canada is surprisingly strong.

• A functioning, healthy solid wood sector is key…turning low-cost waste residues into diverse higher valued product streams.

• There are tradeoffs in financial vs. socio-economic benefits and environmental indicators of different products/technologies.
Implications for Public Policy

- Sector renewal will require a new business model as well as technological innovation on the part of the industry
  - Programs and policies should encourage new partnerships between the forest sector and energy, chemical and technology firms.

- Future of the industry likely lies with a mix of traditional and emerging products
  - Maintaining a viable lumber sector key

- Support for particular technologies or products can have unintended consequences on environmental and regional development objectives
  - Choosing winners and losers is a risky business (technologies, jobs)

- Investors will require sustainability of fibre supply…
  - Need to ensure environmental sustainability if we increase removals from forest
  - May require broadening of definition of forest sector
Canadian Federal Support for Forest-sector Transformation

- Transformative Technologies – Pilot-scale demonstration (TT-PSD: Can$40M)
  - Support development of technologies at the pilot stage

- Investments in Forest Industry Transformation (IFIT: Can$100M)
  - Support for demo to pre-commercial technologies and partnerships with non-traditional industries

- Pulp and Paper Green Transformation Program (PPGTP: Can$1B)
  - Supports “green” investments, including energy efficiency, renewable energy, etc.
Next Steps - Lines of Inquiry 4-6

4. Examine the market potential of emerging bio-products;
   - Levelised cost of energy vs. other renewables
   - Foreign markets and competition

5. Explore new approaches to managing the value chain and development of partnerships; and
   - Cost reduction and logistics optimization

6. Build capacity to manage innovation in the Canadian forest products sector.
Thank you

Questions/Comments?

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