Investment Opportunities in the Forest-Based Bio-economy

John Innes (University of British Columbia) and Don Roberts (Nawitka Capital Advisors Ltd.)
Key themes

• Investment in the traditional forest sector
• Investment opportunities for new forest products
• Investment opportunities offered by the diversification of forest goods and services
Where?

Generally looking out for:

- **Country risk** – institutional frameworks, legal and investment environments, governance, counterparty and Joint Venture risks, maturity of forest industry, safety of the operating environment, openness to foreign investment

- **Technical risk** – availability of biomass resource, productivity of major species, rotation lengths, yields

- **Currency risk** – can be an important factor (e.g., Russia)

- **Exposure to Asia** – a key factor for future investments in the bio-economy
When?

• Investing when prices are low – Paper Excellence strategy for pulp mills in Canada, Germany (Scheufelen), France (Saint Gaudens, Tarascon). Now has 2 million tonnes of pulp production capacity, 550,000 tonnes of paper production capacity

• Some markets growing rapidly, but increases in production capacity may outstrip demand (e.g., pellets in North America)

• Some factors are very unpredictable: global recession, US housing starts, etc.
Global Sawlog Price Index, 2002-2014

Note: Index based on delivered sawlog prices in 20 key regions worldwide.
Source: WRI, 2014b.
Huge choice available

The bioeconomy represents one of the fastest growing investment opportunities available. Being encouraged by both government policy and commercial opportunities

There is a huge choice of investment type available, with degree of risk varying enormously

Because of the potential rewards, and the very rapid development, there are multiple players globally, and some are moving very quickly (e.g., large chemical companies)

Many technologies are untested, or pre-commercialization, and for some, markets have yet to be established
BC

Return On Capital Employed (ROCE) Traditional + Emerging Technologies Earning Their Cost of Capital

- Cost of Capital
- Emerging Bio-technology
- Traditional Forest Product
- Integrated Traditional Forest Products and Emerging Bio-technology

CHP: Combined Heat and Power
NBSK: Northern Bleached Softwood Kraft market pulp
BCTMP: Bleached Chemical Thermal Mechanical Pulp
LWC: Light Weight Coated paper
Green: integrated technology production platform

Source: Forest Products Association of Canada (2010)
Timberland investment

14 yr-old Shining Gum (*Eucalyptus nitens*), Victoria, Australia
Traditional forest land investment

- Total value of global investable core timberland estimated at $125 - $300 billion (depending on which countries are excluded)

- Global timberland asset class consists of approximately $82 billion in assets under management, with over 80% of the assets located in the US

- ca. 58% of global timberlands assets under management are held privately by financial owners (TIMOs), with the remainder held by publicly listed entities (predominantly US REITs)

Source: I&P Real Estate
Timberland returns

Timberland returns have increased each year for the past five years (National Council of Real Estate Investment Fiduciaries (NCREIF)).

This reflects better economic conditions: NCREIF’s Timberland Index posted a total return for 2014 of 10.5%, consisting of 2.9% from income and 7.5% from price appreciation.

Have outperformed the S&P500 index for the last 5 years

Source: I&P Real Estate
Pension funds and other institutional investors

Institutional investors now own more than 12.5 million ha of U.S. forests, worth more than US$ 40 billion. Whilst most investments are in North American forests, interest in overseas forests is also growing, in countries such as New Zealand, Australia, South America, Eastern Europe, China, Mozambique and Cambodia.

Source: I&P Real Estate
Forest products

Including bio-products, engineered wood products and building systems.

Picture source: Forest Products Association of Canada – Biopathways project
Global market potentials for different bio-products from forest biomass (billion US$)

<table>
<thead>
<tr>
<th>Product Type</th>
<th>2015</th>
<th>2020</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bio-energy, bio-chemicals, fibre composites</td>
<td>505</td>
<td>776</td>
<td>1309</td>
</tr>
<tr>
<td>Conventional forest industrial products</td>
<td>495</td>
<td>512</td>
<td>545</td>
</tr>
</tbody>
</table>

Source: FPInnovations
### Gross Market Opportunities

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Green chemicals</td>
<td>62.3</td>
<td>5.3</td>
</tr>
<tr>
<td>Alcohols</td>
<td>62.0</td>
<td>5.3</td>
</tr>
<tr>
<td>Bioplastic and plastic resins</td>
<td>3.6</td>
<td>23.7</td>
</tr>
<tr>
<td>Platform chemicals</td>
<td>4.0</td>
<td>12.6</td>
</tr>
<tr>
<td>Wood fibre composites</td>
<td>35.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Glass fibre market</td>
<td>8.4</td>
<td>6.3</td>
</tr>
<tr>
<td>Carbon fibre</td>
<td>18.6</td>
<td>9.5</td>
</tr>
</tbody>
</table>

Source: FPInnovations
Wood products

Focus has been on standard lumber grades, a commodity subject to considerable price variations.

More recent emphasis is on engineered wood products (glulam, cross-laminated timber, veneer strand lumber, etc.)

Also an emphasis on increased use of wood, particularly in non-residential buildings.
Inefficient lumber production, Idaho, USA
Highly mechanized sawmill in Quesnel, British Columbia
Pre-fabricated buildings
14-storey residential building in Bergen, Norway

http://www.sweco.no/no/Norway/Nyheter/2014/Webcam_Treet/
North American market

<table>
<thead>
<tr>
<th>Storey class</th>
<th>Floor area (Millions ft²)</th>
<th>CLT (Million m³)</th>
<th>Lumber (BBF)</th>
<th>Shell Value ($ Billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5%</td>
<td>15%</td>
<td>5%</td>
<td>15%</td>
</tr>
<tr>
<td>Low-rise (1 to 4)</td>
<td>52</td>
<td>156</td>
<td>0.9</td>
<td>2.7</td>
</tr>
<tr>
<td>Mid-rise (5 to 10)</td>
<td>16</td>
<td>48</td>
<td>0.3</td>
<td>0.9</td>
</tr>
<tr>
<td>Total</td>
<td>68</td>
<td>204</td>
<td>1.2</td>
<td>3.6</td>
</tr>
</tbody>
</table>

*Note: The Canadian market can be estimated at 5 to 10% of the US market on a floor area basis.*

*Figure 1. Market Opportunity for CLT by Scenario. From: Cross-laminated Timber: a Primer FPIInnovations. 2010.*

The potential market for CLT (based on an average usage factor of 0.62 ft² of CLT per ft² of construction area and 17.5 board feet of lumber per ft³ of CLT

Source: FPIInnovations
Pulp and Paper

By 2020, pulp and paper is expected to represent 40% of all global timber trade.

Demand is changing significantly, with growing demand for packaging, tissues, fluff pulp and new biochemical industries.

China’s consumption of wood pulp increased by 13% annually 2002-2012. Wood pulp imports expected to increase from 15 million tonnes in 2012 to 20.7 million tonnes in 2017 and 24.3 million tonnes by 2022.
Paper consumption in China, with projection for 2035 (million tonnes)

- **Current World Paper Production**
- **Chinese Consumption**

Source: NewForests, from various sources
Bioenergy (solid)

Solid biofuels (mostly from wood), accounted for 10.5% of primary energy production in the EU27 in 2012.

Very rapid increase in bioenergy use in Europe: 14-fold increase in Sweden, 18-fold increase in Austria (2000-2010)

35-45% of energy production in Sweden, Austria and Finland is from biofuels and waste. 3-6% in USA and Canada
What drives the economics of bio-energy?

Four key variables shape the economics of investing in bio-refineries:

1. The delivered cost of biomass (50%-70% of the variable cost)
2. The conversion technology
3. The price of fossil fuels
4. Public policy (including the price on carbon)

Given the trends in these key variables, the long-term outlook for bio-energy/chemicals is positive. In the mean time, there is considerable uncertainty in each of these variables
Emerging Drivers


- ~$250 billion in new investment in bio-energy has taken place globally since 2004.
- After exceeding $40 billion/year in 2006 & 2007, global annual investments in bio-energy fell to ~ $13 billion in 2013.....down by roughly two-thirds.
- Especially since 2009, the share devoted to biomass (power) has been increasing.
- Both trends are arguably negative in terms of value-added.

Source: Bloomberg New Energy Finance and Nawitka
Emerging Drivers

Global Asset Financing in Biomass-based Power

- The U.S. & China are the two largest national investors, followed by the UK.
- Europe is the biggest continental investor
- If we believe the national targets for 2020, there will be upward pressure on the global price of biomass
  - EU expects to double its biomass power capacity to ~26 GW.
  - China expects to triple its to 18 GW.

Global Asset Financing in Biomass Power
(Q1/2004 – Q2/2014)

~$125 billion invested since 2004

Source: Bloomberg New Energy Finance and Nawitka
Emerging Drivers

- UK is the most attractive market for biomass in Europe.
- Best estimate is that the UK will increase its consumption of biomass for power to over 13 million ODMT (+35%) by 2016.
- This is down from an estimate of 18 million ODMT made in 2013, and 26 million ODMT made in 2012. (Largely due to the exclusion of co-firing capacity from the Renewables Obligations.)
- We think most forecasts of biomass demand in Europe are finally realistic.

**Biomass Demand in the UK (million ODMT)**

- 2008: 1.9
- 2009: 2.1
- 2010: 2.1
- 2011: 2.2
- 2012: 2.3
- 2013: 2.5
- 2014: 2.7
- 2015: 3.1
- 2016: 3.4

**Note:** Scenarios are based on the likelihood of success according to how well projects are keeping to plan.

**Source:** Bloomberg New Energy Finance, Nawitka.
Wood Pellets

Wood pellet industry in BC that has grown from zero to 1.9 million tonnes annually. 94% is exported. Global capacity in 2011 was 14.4 million tonnes, but increasing rapidly.

The Drax plant in the UK alone needs 7 million tonnes annually (2 of 6 generating units converted to biomass, a third is planned). Has 10-year contracts with suppliers.

Estimates suggest Europe will need 25-40 million tonnes of biomass by 2050.

New markets emerging in Korea, Japan, and China. Korea has mandated power producers to include 2% renewable fuel in 2012, rising to 10% by 2020.
Wood Pellets

Source of material is critical

Sawdust may contain 50% moisture – it may require a third of its volume to dry the remaining 2/3 sufficiently

Dead pine from MPB can be as low as 20%, making bushgrind economically feasible

Logistics are critical – a single rail car can carry 100 tonnes of pellets, the optimal ships currently carry 50,000 tonnes
Bioenergy: major developments

New waste-to-energy technology will use a mixture of feedstocks: blended waste wood, scrap tires and sewer sludge.

Downdraft gasification plant is being developed in Lebanon, Tennessee, that will cleanly convert up to 64 tons per day of waste into a fuel gas that will generate up to 300Kw of electricity.

Such investments will mostly be driven by national policies, such as the Swiss 2000-Watt policy.
Source: IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation 2010
Emerging Drivers

As expected, VC/PE investors are focusing on Next-generation technologies/projects because they see them as the future of the biofuels industry. Over $5 billion invested since 2004.

Due mainly to policy uncertainty & low natural gas prices, VC/PE investments in Next-Generation Biofuels fell sharply in 2013/2014.

Many newer investments include a focus on both bio-fuels & chemicals.

• Although it is still in its infancy, early stage investors are starting to commercialize cellulosic biofuels. **More than ten smaller commercial-scale plants will start-up in 2015/16.** Within five years, it will likely be the product of choice for residual biomass by many sawmills.

Source: Bloomberg New Energy Finance and Nawitka
Emerging Drivers

Global Next Generation Biofuel Investments

▲ Aggregate investments in Next Generation Biofuels have totaled roughly $12 billion since 2004 – this is real.
▲ The bulk of the investments have occurred in the U.S.
▲ Going forward, we expect them to be concentrated in the U.S. and Brazil


- United States: 60%
- Netherlands: 10%
- China: 9%
- Brazil: 6%
- Italy: 6%
- Other ASOC: 2%
- Other EMEA: 4%
- Other AMER: 3%

Source: Bloomberg New Energy Finance, Nawitka
UPM Biofuels. Construction of the Lappeenranta biorefinery at UPM’s Kaukas mill site began in 2012; commercial production began in January 2015. UPM’s total investment was EUR 175 million. 120 million litres renewable diesel production annually. Raw material is crude tall oil (a by-product of pulp making)
U.S. Government’s Renewable Fuel Standard

Non-Food-Based Bio-Fuels

Objective is to stimulate the production of “next-generation bio-fuels”

- One of the few federal initiatives to have bi-partisan support.
- Specific technological pathways must be approved by the EPA.
- The feedstock must come from a renewable and sustainably managed resource.
- Requires 21 billion gallons of advanced bio-fuels by 2022.
  - Up from 1 bgal in 2010
  - 2022 target must include at least 16 bgal of advanced cellulosic bio-fuel
  - Annual interim targets, with 5.5 bgal in 2015

RFS-2 creates a broad and sizable market in the U.S. for cellulosic fuels with numerous motivated potential customers

Source: U.S. EPA, Company Website.
Non-Food-Based Bio-Fuels

Objective is to stimulate the production of “next-generation bio-fuels”

• One of the few federal initiatives to have bi-partisan support.
• Specific technological pathways must be approved by the EPA.
• The feedstock must come from a renewable and sustainably managed resource.
• Requires 21 billion gallons of advanced bio-fuels by 2022.
  • Up from 1 bgal in 2010
  • 2022 target must include at least 16 bgal of advanced cellulosic bio-fuel
  • Annual interim targets, with 5.5 bgal in 2015

RFS- 2 creates a broad and sizable market in the U.S. for cellulosic fuels with numerous motivated potential customers

Source: U.S. EPA, Company Website.
Flexibility to Use a Wide Variety of Abundant and Low-Cost Feedstocks

- Woody biomass has historically shown much less volatility and price inflation compared to other commodities and feedstocks.
- RFO can also be produced from other forms of biomass (e.g. bagasse, oil palm residues) which are a fraction of the cost of woody biomass.

**Low Cost Abundant Feedstocks**

- **Hardwoods & Softwoods**
- **Whitewood & Bark**
- **Sawmill and Other Operational Residue**
- **Agriculture Residue: Oil Palm and Sugar Cane Residues**

**Woody Biomass: Low Cost and Stable Pricing**

Prices indexed to 100 @ Q1 2000

Source: Wood Resources Quarterly (wood chip prices); Bloomberg (other commodities). Data as of end of Q2 2011.
Cellulose Filaments

North American market for CF as a strength reinforcing agent for pulp and paper products is 120,000 tonnes annually

Similar market for thermoplastics, reinforced plastics, thermosets, adhesives, non-woven fabric and coatings

Combined, represents a market value of $500 million annually
Biotextiles

Wood-derived viscose accounts for 6% of the world fabric market (it occupies third place, behind synthetics and cotton but ahead of wool)

Traditional viscose problematic because of the chemicals used in production. New ‘closed loop’ systems and second-generation fabrics such as produced by the Lyocell process are greener.

Wood-derived fibres are a close substitute for cotton, which has its own environmental problems. Future restrictions on cotton production will open up opportunities for wood-derived fibres

Major marketing exercise still required to change perceptions about what is ‘natural’.
Materials

- 100% Tencel™ Lyocell.
- Tencel™ fibers are produced from the wood pulp of Eucalyptus trees, creating a high strength, natural fiber that is also biodegradable.
- Will continue to soften with repeated washing.

Benefits

- 400 thread count.
- Soft and smooth.
- Moisture control to keep you cool and comfortable.
- Resistant to fading, shrinking and pilling.
- Luxurious Jacquard

Fit

- Fits mattresses up to 18 inches deep.
- Fully elasticized fitted sheet.

Set Includes

- Queen: 1 flat sheet, 1 fitted sheet and 2 Standard / Queen pillowcases.
- King and Cal King: 1 flat sheet, 1 fitted sheet and 2 King pillowcases.

EUCA-LYPTUS ORIGINS™

100% TENCEL™ LYOCELL

EUCALYPTUS ORIGINS™

400 THREAD COUNT

EUCA-LYPTUS SHEET SETS

400 THREAD COUNT

- Fits mattresses up to 18" deep

Full

- Queen: '129'
- King: '159'

Standard pillowcase

- '49'

King pillowcases

- '59'

Sheet set includes 1 flat, 1 fitted & 2 pillowcases.
Bio-chemicals
Speciality Biochemicals

Green chemicals – global annual growth estimated at 5.3%, to US$ 62.3 billion

Biomass-based platform chemicals – global annual growth of 12.6%, to US$ 4.0 billion
Speciality Biochemicals

Options include:

Lignin-based products for resins, adhesives, plastics additives etc.

Sugar-based platforms for butanol or for various plastics or chemical precursors such as succinic acid, lactic acid, xylose etc.

Fibre-based products for composites, fibre-reinforced plastics, novel paper or construction products etc.
Speciality Biochemicals

Investment options:

Adding small-scale projects to existing mills to generate revenue from new products

Investing in large, green-field biorefineries for the production of biofuels, and other bio-products
Bioplastics and plastic resins

Annual growth rate of 23.7%, growing to US$ 3.6 billion
Natural Fibre Plastic Composites

Wood Plastic Composites and other Natural Fibre Plastic Composites both growing rapidly. Used for decking, fencing facades, furniture, automotive applications, etc.

The global market for wood-plastic composites (WPCs), cellulosic plastics, plastic lumber and natural fiber composites was valued at 2.8 million metric tons in 2013. This market is expected to increase from nearly 3.1 million metric tons in 2014 to 5.6 million metric tons in 2019, at a CAGR of 12.7% for the five-year period, 2014 to 2019. (BCC Research)
Conservation

The forest sector has largely been focused on products, but markets have emerged to monetize environmental benefits: carbon credits, wetland mitigation banking credits, nutrient pollution credits, biodiversity conservation certificates, etc.
Mitigation Banking

Total US market is estimated to be between $2.0 billion and $3.4 billion annually

Currently 1605 active and pending mitigation banks

Market has grown on average 15% annually over past three years

Example prices:
• Wetland credits  $15,000 - $80,000 per acre (€5656-30’587/ha)
• Stream credits  $200 to $350 per linear foot (€57-100/m)
• Rare habitat > $300,000 per acre (€114’700/ha)

Source: NewForests
Source: Energy Information Administration, Office of Oil & Gas Division
Carbon

Global emissions trading schemes now valued at $30 billion

40 countries and 20 states, regions or cities have implemented carbon pricing mechanisms

Both mandatory (regulated) and voluntary markets exist

Regulated: European Union, California, New Zealand, US Northeast
Unregulated: purely voluntary offsets
Clear policies are essential

The Finnish Bioeconomy Strategy has 4 strategic goals:
• A competitive operating environment for the bioeconomy
• New business from the bioeconomy
• A strong bioeconomy competence base
• Accessibility and sustainability of biomasses

The FBS has the objective of increasing the Finnish bioeconomy output up to €100 billion by 2025 (currently €60 billion) and to create 100,000 new jobs (currently 300,000). Over half of today’s bioeconomy in Finland relies on forests
Conclusions

• Huge range of opportunities
• Level of risk varies significantly
• Not all products have clearly identified markets
• The most promising approaches integrate conventional and new technologies (for economics and jobs)
• Government policies will play a major part in a) reducing investment risks, b) reducing feedstock costs, and c) creating demand