Convergence Of The Fuel, Food And Fiber Markets: A Forest Sector Perspective

• By Don G. Roberts, Managing Director, CIBC World Markets Inc.

• Paper For The MegaFlorestais Working Group Meeting In St. Petersburg, Russia
• November 2007

• Rights And Resources Initiative
• 1238 Wisconsin Ave NW, Suite 204, Washington, D.C., 20007
• +1 202.470.3900

Introduction

Our central thesis is that the biofuels sector will continue to experience significant growth over the coming decades, and that its development will lead to a convergence of the markets for fuel, food and fiber (e.g., wood) over time. These three markets will converge in the sense that their primary feedstocks will tend to trade on the basis of their "energy equivalency".

This paper has four objectives:

1. To identify the forces driving this convergence.

2. To provide a brief global survey of developments in the biofuels sector.

3. To analyze the economics of the biofuels sector.

4. To provide our initial assessment of the implications of the convergence for the forest sector.

CIBC World Markets

1. What Is Driving The Convergence Of The Fuel, Food And Fiber Markets?

There are a number of underlying forces driving the convergence of the fuel, food and fiber markets, and they all can be viewed in terms of “security”. Although the relative importance of the forms of security varies by country, the concerns relate to:

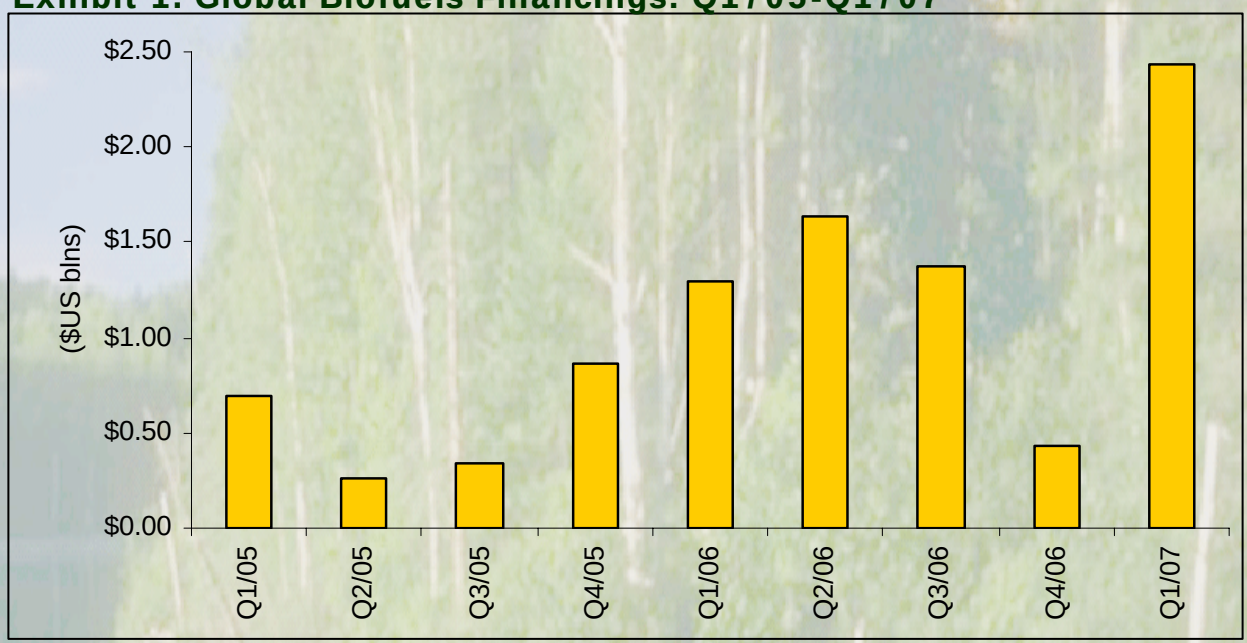
- Environmental Security (i.e., amelioration of climate change).
- Economic Security (i.e., protection against the rising real price of oil).
- National Security (i.e., decreasing North American and European dependence on the Middle East/Russia for fossil fuels).
- Political Security (i.e., greater rural development, and increased support from the rural population).

Capital Flows

In response to the perceived need for more biofuel, significant amounts of capital have been flowing into the emerging industry.

This point is illustrated in Exhibit 1, which summarizes the financings in the global biofuels industry since the beginning of 2005. They rose from roughly $2.5 billion in 2005 to $4.7 billion in 2006.

Exhibit 1. Global Biofuels Financings: Q1/05-Q1/07



Source: New Energy Finance.

Overall activity in the capital markets has slowed in the second half of 2007 due to concerns related to the debt market in the U.S. However, global biofuels financing approached $2.5 billion in just the first quarter of 2007 alone. We expect capital to continue to flow into the sector once the re-pricing of risk in the financial markets is completed later this year.

CIBC World Markets

Strategic Alliances

The American agricultural processing company Archer-Daniels-Midland is the biggest producer of biofuel in the world, and its primary feedstocks are corn and soybean.

One sign that convergence is occurring is the number and nature of strategic alliances that are being formed between companies in different industries, but with a focus on biofuels.

An example at one level is the alliance between the Chilean forestry company Arauco and Tokyo Electric Power Company. Arauco is supplying wood waste from sustainable pine plantations as fuel for electricity generation. Compared with Chile's existing generation mix of hydro, coal and diesel, this is expected to save about 300,000 tonnes per year of carbon dioxide for 21 years. Under the terms of the UN's Clean Development Mechanism, the Tokyo utility is buying credits to offset its own emissions of greenhouse gases.

At another level are the alliances on Research & Development. In most cases, these R&D initiatives involve oil or chemical companies with "feedstock companies". Examples of this include the following:

- Stora Enso/Neste Oil and UPM-Kymmene/Andritz with a focus on Fisher-Tropsche fuels.
- Weyerhaeuser/Chevron with a focus on cellulosic ethanol.
- Royal Dutch Shell/Petro Canada/Iogen with a focus on cellulosic ethanol.
- Royal Dutch Shell/Choren with a focus on Fisher-Tropsche fuels.
- British Petroleum/Dupont Chemicals/Associated British Foods (ABF) with a focus on bio-butonol.
- British Petroleum/D1 Oils with a focus on bio-diesel.
- ConocoPhillips/Tyson Foods with a focus on bio-diesel.

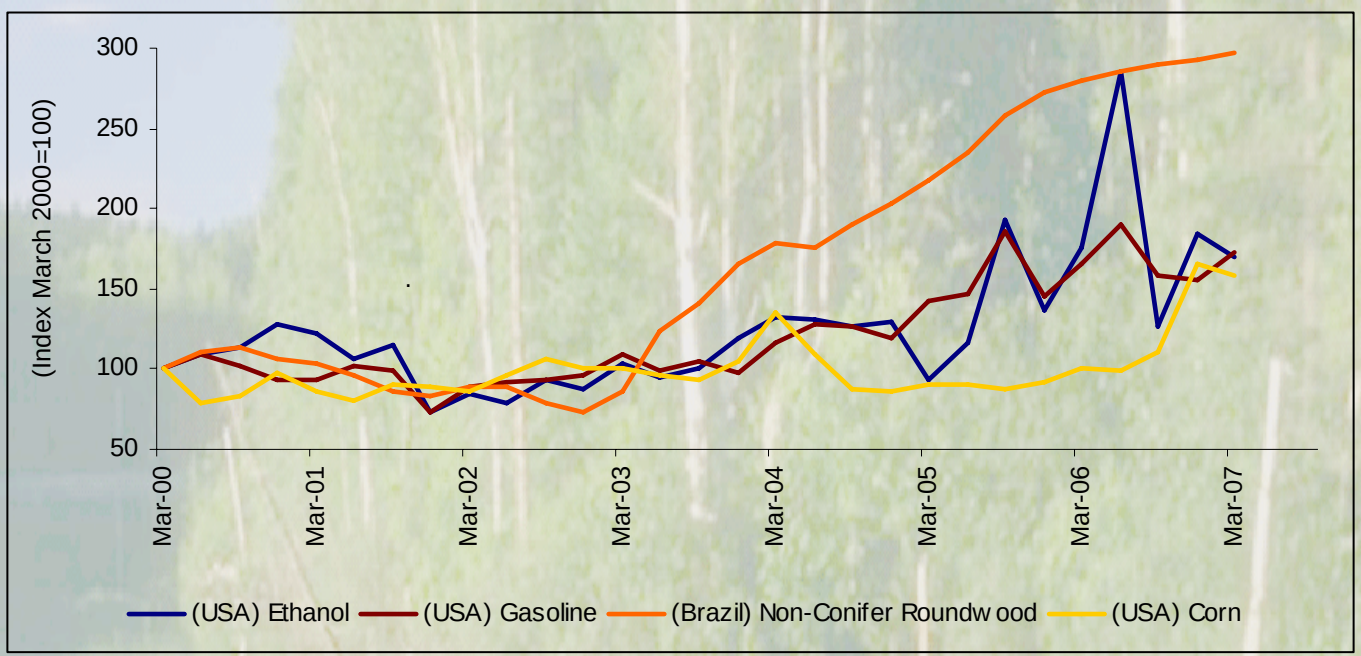
Note that the intended feedstocks and types of biofuel vary depending on the alliance in question. While those involving Stora Enso, UPM-Kymmene and Weyerhaeuser tend to emphasize wood (and grasses in the case of Weyerhaeuser) as the feedstock; D1 Oils emphasizes soya beans, palm oil and jatropha; and Tyson Foods and ABF emphasize animal fat and sugar beets, respectively.

Price Movements

Key fuel, food and fiber prices have been on an upward trend.

Exhibit 2 illustrates the movement in (domestic) prices since 2000 for gasoline, ethanol and corn in the U.S., and non-conifer pulp wood in Brazil. Even though we use prices in the domestic currency, it still shows that pulpwood prices in Brazil have experienced the greatest increase among the commodities in question. From this data, we can only conclude that the prices are correlated, not necessarily that there is a causal relationship.

Exhibit 2. Food, Fuel And Fiber Prices (Domestic Currency): Q1/00-Q1/07



Source: Bloomberg, Wood Resources, CIBC World Markets.

CIBC World Markets

Price Movements

Both the OECD and FAO also say that structural changes in the biofuel industry could mean high prices for the next decade, with cereals, sugar and oilseed and vegetable oils all affected. Furthermore, the International Food Policy Research Institute estimates that prices for corn and oil seeds could rise by 23% and 43%, respectively, by 2020, on the back of expected increases in demand for their use as biofuel.

Our expectation is that with biofuel production spreading, the world price for oil will become a support price for farm and lower quality forest products.

2. A Quick Global Tour Of The Biofuels Sector

Brazil

- Brazil is the country with arguably the greatest comparative advantage in producing ethanol. For example, it is estimated that the European Union would need three times as much land as Brazil to produce the same quantity of ethanol because of the latter's environmental advantages.
- Sugarcane-based ethanol has been an important source of fuel in Brazil since the 1980s, and now accounts for over 40% of the country's consumption of non-diesel fuel.
- At the national level, Brazil is the low-cost producer. Industry observers suggest the Brazilian ethanol industry breaks even with oil prices at $35/Bbl. With oil prices above $50/Bbl, significant profits are generated.
- With roughly 7 million ha currently devoted to sugarcane, the crop only occupies about 2% of Brazil's arable land. Although unlikely, it is estimated that the potential area devoted to the crop could be expanded by 20-fold.
- Some analysts forecast that Brazil's annual ethanol output will grow from roughly 18 billion litres in 2006 to over 40 billion litres by 2015. Production, which is currently concentrated in southern Brazil, is expected to also grow in the middle and western region of the country.

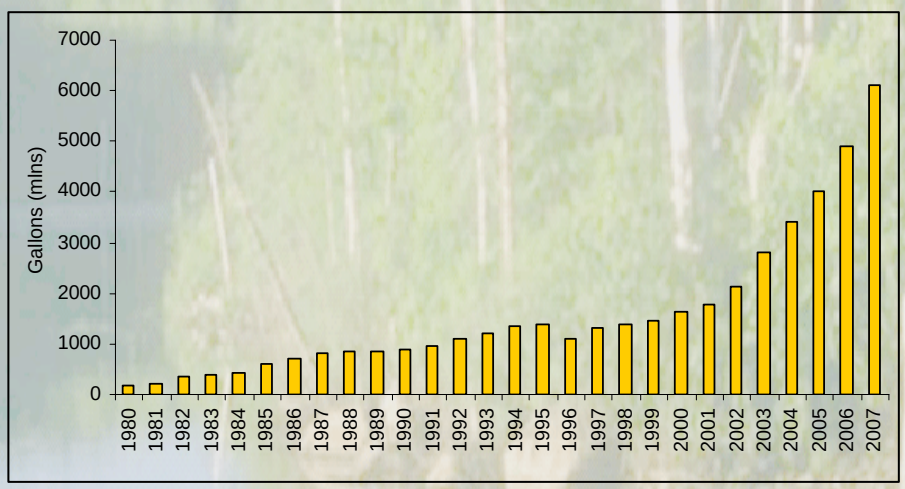
A Quick Global Tour Of The Biofuels Sector

United States

- Due to rapid growth since 2000, the U.S. is now the world's largest producer of biofuel.

- As illustrated in Exhibit 3, fuel ethanol production in the U.S. will exceed 6 billion gallons in 2007 – up from roughly 2 billion gallons in 2000. Capacity is expected to roughly double over the next 18-24 months, bringing the total to an estimated 11.6 billion gallons by Q1/09. There are currently 109 fuel ethanol plants in the U.S., with an additional 78 being constructed in 19 states. Essentially all of this capacity uses grain as the feedstock – primarily corn.

Exhibit 3. Fuel Ethanol Production In The U.S.



Source: U.S. Energy Information Administration/Renewable Fuels Association.

CIBC World Markets

A Quick Global Tour Of The Biofuels Sector

United States

- The surge in ethanol capacity in the U.S. is being stimulated by a combination of subsidies and minimum renewable fuel content targets.
    - In addition to a plethora of capital subsidies that vary by state, there is a $0.51/gallon blender's credit at the national level for using ethanol, and an equivalent tariff on imports. This summer the Ways & Means Committee of the U.S. House of Representatives approved an additional measure (HR2776) that provides an extra $0.50/gallon ($0.13/litre) credit for the production of cellulosic ethanol.
    - In June, the U.S. Senate majority leader introduced the Renewable Fuels, Consumer Protection and Energy Efficiency Act of 2007 (S.1419). The legislation would raise the national Renewable Fuels Standard target to 8.5 billion gallons in 2008 and in steps to 36 billion gallons in 2022. There is also a requirement for "advanced" biofuels, from feedstocks other than corn: 3 billion gallons in 2016 rising to 21 billion gallons in 2022.
    - More stringent renewable energy standards for transportation fuels are being mandated at the state level. For example, California is requiring a 10% ethanol blend by 2010, and Minnesota is requiring a 20% blend by 2013.

A Quick Global Tour Of The Biofuels Sector

United States

- Even at the 2006/7 level of around 6 billion gallons, roughly 20% of the U.S.'s corn crop is already being converted to biofuel – enough to have an impact on the price of corn. Furthermore, the U.S. Department of Agriculture's latest forecast suggests this will rise to 27% in 2007/8. However, it is important to place this level of corn-based ethanol production into a broader context. It is estimated that even if every single one of the roughly 90 million acres in the U.S. currently devoted to growing corn goes into ethanol, corn-based ethanol would still meet only 12%-15% of the country's transportation fuel needs.

- At some point, interactions with food and animal feed markets will make corn economically impractical as a feedstock. Given current gas prices, it is estimated that corn prices above $4.50/bushel make corn-based ethanol uneconomic. Each $1.00/bushel increase in the price of corn raises the cost of producing ethanol by roughly $0.35/gallon.

- As grain prices rise, it is generally agreed that biofuels growth will depend on new feedstocks of cellulose and hemicellulose, of which most of the plant world is constituted.

A Quick Global Tour Of The Biofuels Sector

Canada

- The federal government requires a 5% average renewable energy standard for gasoline by 2010, and 2% for diesel and heating oil by 2012.

- In early 2007, the federal government announced that it is targeting $2 billion over seven years to develop renewable fuels production, including heavy spending on cellulosic projects. The government's clean technology funding agency Sustainable Development Technology Canada asserts that Canada's unique strength is its wide range of cellulosic materials for ethanol production. This ranges from hardwood reserves in Eastern Canada, municipal solid waste and forestry residues in Ontario and Quebec, straw from the Prairie provinces and Mountain Pine Beetle-damaged wood from Western Canada.

- Various provincial governments are also providing an array of financial incentives, with Alberta being the most aggressive.

A Quick Global Tour Of The Biofuels Sector

Europe

- As in the U.S., biofuel capacity is growing rapidly in Europe with biodiesel capacity up roughly 70% in the past year. An estimated 185 biodiesel plants are already built, and 58 more are under construction. Given its existing fleet of cars and trucks, Europe is focusing more on biodiesel than is North America. (Note that the energy content of biodiesel is about 90% that of petroleum diesel, while the energy content of ethanol is about 67% that of gasoline.)

- Depending on the country, there are significant tax reductions if renewable feedstocks are used instead of fossil fuels for power generation. There is also a value associated with Carbon Credits.

- The European Commission has a 5.75% (non-binding) target for renewable fuel content in transport fuel by 2010, and a 10% (binding) target by 2020. The 2020 target corresponds to an estimated 27 billion litres of ethanol and 24 billion liters of biodiesel.

- The EU and the European Member States have also agreed on a binding target to reach a 20% share of renewable energy sources (i.e., biomass, biogas, wind, solar, hydro and geothermal energy) in the total energy output of the EU by 2020. (These targets are very aggressive, and we are skeptical that they will be met. As discussed below, if enforced, these regulations are expected to have a significant impact on wood markets.)

A Quick Global Tour Of The Biofuels Sector

China

- The central government has set an ambitious target for renewables to account for 10% of all energy consumption by 2010 and 16% by 2020. By the end of the 11th Five Year Plan (2006-2010), China is expected to have put into place a total of 5,500 MW of biomass-fired power generating capacity. The objective is 30,000 MW of generating capacity fuelled by biomass by 2020.

- In contrast to the U.S., the Chinese Government is not supporting the development of the grain-based ethanol sector. In fact, due to concerns with the tradeoff between fuel and food production, the central government announced in December 2006 that all proposed grain ethanol projects must be vetted at the national level. The National Development and Reform Commission (NDRC) has also recently cut its target for production of ethanol from 5 million to 2 million tonnes in 2010 – China produced 1.6 million tonnes in 2006.

- Cellulosic-ethanol production is being encouraged, with the central government having announced a 10-year, $5 billion commitment.

A Quick Global Tour Of The Biofuels Sector

China

- In early 2007, the State Forestry Administration announced that by 2020, it will develop 13.3 million ha of forests to produce fuel for biodiesel production and power generation. This initiative is in co-operation with the China National Petroleum Corp (CNPC), the grain trader COFCO and the State Grid Corporation.
    - Our understanding is that the intention is to focus this production on low productivity lands that are not currently devoted to commercial agriculture or forestry. (However, we are aware of some private companies like China Grand Forestry that are intending to convert relatively high value secondary forests to jatropha plantations.)
    - CNPC and the State Forestry Administration have already signed an agreement to develop at least 600,000 ha of forests in Yunnan and Sichuan with the capacity to produce more than 60,000 tonnes of biomass for fuel production. (China currently has 4 million ha of land with oil-bearing plants, which are able to produce 5 million tonnes of oil.)
    - The State Power Grid estimates that by 2010 it will have about 2,000 MW of biomass power generation, or about 36% of China's total biomass power generation capacity.

A Quick Global Tour Of The Biofuels Sector

China

- Dozens of biodiesel plants are under construction or in the advanced planning stages. Cumulatively, their output will exceed 3 million tonnes/year. The principal feedstocks will be domestically produced rapeseed oil and imported palm oil.

- The government has a policy of encouraging Chinese companies to invest in biofuels overseas, especially in countries such as Brazil, Malaysia and the Philippines.

A Quick Global Tour Of The Biofuels Sector

South Asia

- Southeast Asia produces almost 90% of the world's palm oil, with over 85% of this being in Malaysia and Indonesia. The region's production accounts for an estimated 12% of the world's output of biological oils and fats.

- Malaysia is reportedly planning to construct 15 biofuel plants by 2012, and targeting 40% of its palm oil output for biodiesel. It is estimated that the region as a whole will produce about 5.5 million tonnes of biofuel by 2010, with about 40% of this volume available for export.

- In Indonesia, the palm oil industry already has 6.5 million ha of plantations across Sumatra and Kalimantan. Some observers project this area will reach 16.5 million ha by 2020. Plans are currently underway to establish the world's largest palm oil plantation – 1.8 million ha – in Kalimantan.

- Clearing peatland for commercial palm oil plantations has become particularly controversial in the region because of the negative consequences for global warming. The reason is that drained peat shrinks because of oxidation, and this adds to greenhouse gas emissions. This is likely of particular concern in Indonesia where an estimated 25% of oil palms are on peat.

A Quick Global Tour Of The Biofuels Sector

South Asia

- Biofuel production is also being stimulated in the Philippines due to a new blending requirement in the country requiring petrol to contain 5% ethanol by 2009 and 10% by 2011. For example, a Philippines/Chinese biofuel joint venture has begun acquiring and developing 350,000-500,000 ha of land to grow primarily cassava.

- India already has roughly 30 agro-based ethanol plants, many of which have been built in the last three years. The country is also the leader in the development of jatropha as a feedstock for biodiesel. Jatropha is a plant well suited for re-claiming waste land due to its low water requirements and ability to fix nitrogen into the soil. Having said that, it produces an inedible oil, which is toxic, and has been banned in Western Australia because of its “weediness”.

- British Petroleum and D1 Oils are planning to plant 1 million ha of jatropha over the next four years in Southeast Asia. The joint venture has already planted 125,000 ha in Indonesia, India, China and Southern Africa.

A Quick Global Tour Of The Biofuels Sector

South America (Excluding Brazil)

- In Columbia, the government is encouraging a doubling of land in palm oil production.
- In Venezuela, despite the low local price of oil, the state-owned oil company PdVSA plans to build 26 ethanol plants, including 17 in the northern flatlands to refine sugar cane, yucca and rise grown on 320,000 ha.
- In Guyana, roughly 100,000 ha are available for sugar-based ethanol. The government has also been asked to lease savannah land for growing sweet potato and cassava as feedstocks for biofuel.

3 . The Economics Of Biofuels

The four key variables driving the economics of biofuel production are:

- the price of oil (the main substitute);
- the cost of the feedstock (50%-80 % of the variable costs);
- the conversion technology; and
- regulations, which stimulate demand.

At present, all four of these variables are in a state of flux.

Casual observation suggests that when crude oil prices fall below $60/barrel, interest in building biofuel plants falters in most countries (except for Brazil), and that it is sparked when oil hits $70/barrel and above.

- The Apec Energy Working Group assessed the cost competitiveness of alternative biofuels under different oil price scenarios. Given feedstock prices as of early 2007, its summary conclusions are:

- Ethanol from sugarcane in Brazil is cost competitive at crude prices of $28-$50/barrel.

- Biodiesel from palm oil in Malaysia and Indonesia is cost competitive with crude oil above $41/barrel and $44/barrel, respectively. In the same countries, biodiesel from jatropha can compete with crude at prices of $50-$68/barrel.

- Ethanol from corn in the U.S. is cost competitive at crude prices of $50-$68/barrel.

- Biofuels from a wide variety of cellulosic feedstocks would be cost competitive with crude oil prices of $80-$100 barrel.

High Tech Biofuels

Cellulosic ethanol technologies are evolving on two tracks:

1. Biological processes such as enzymatic digestion which break the tough molecular bonds of plant matter into fermentable sugars.

2. The application of heat to convert cellulose into gas from which it can be transformed into a number of fuel products including ethanol, synthetic gasoline and renewable diesel

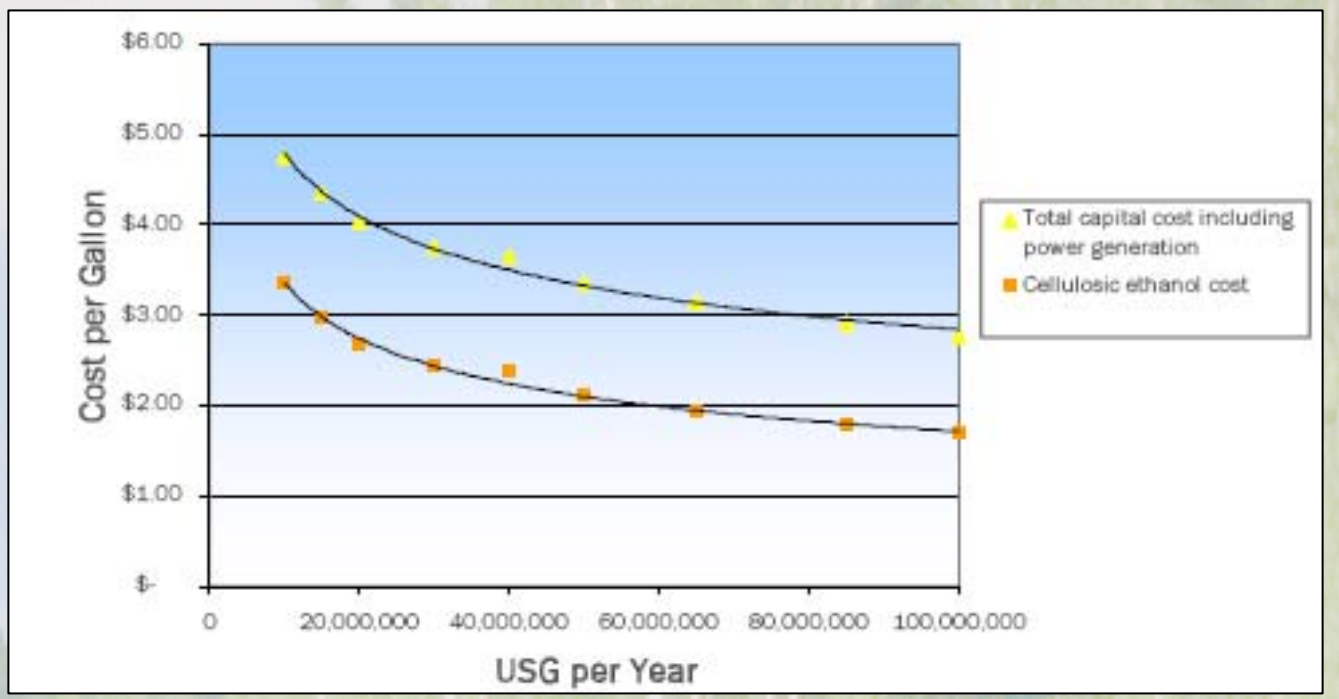
- Given time constraints, this paper focuses primarily on the first track.

- While cellulosic feedstocks are much more abundant and cheaper than grains, the processing technologies are still more expensive. However, processing costs are declining. According to the U.S. Department of Energy, the cost of cellulosic ethanol dropped from roughly $5.50/gallon in 2001 to $2.25/gallon in 2005. Costs have continued to decline since then as investment in R&D grows and some of the best minds in science are focusing on the issue.

- As illustrated in Exhibit 4, economies of scale also appear to be critical in improving the cost competitiveness of cellulosic ethanol.

High Tech Biofuels

Exhibit 4. Estimated Scale Economies For Hardwood-based Cellulosic Ethanol



Source: SunOpta Bio Process Inc.

We are aware of two commercial demonstration plants in Spain and China which are already producing cellulosic ethanol. These plants have an annual capacity in the range of 10 million gallons, and total unit costs estimated to be above $3.00/gallon. However:

- Given existing technologies, it is estimated that a world scale 100 million gallon (380 million litres) plant could achieve total unit costs as low as $1.70/gallon, and variable costs in the range of $1.25-$1.35/gallon (assuming no carbon credits).

High Tech Biofuels

- By comparison, starch-based ethanol plants generally have total unit costs of around $1.45/gallon, and variable costs in the range of $1.55-$1.75/gallon.

- The key message is that, although not yet constructed, large scale cellulosic ethanol plants may be competitive with existing starch-based plants. Although the capital costs are still higher, the variable costs may actually be lower. Furthermore, subsidies on capital exist in many jurisdictions. [It may also be possible to lower capital costs by utilizing abandoned infrastructure (e.g., that associated with closed pulp mills).]

- Our sense is that such plants may be able to afford to pay as much as $40/m3 for wood.

  Two key challenges associated with building “world scale” cellulosic ethanol plants are:

  - Demonstrating that the existing technologies within the plant can truly be scaled up to the size required to achieve competitive costs.

  - Meeting the materials handling challenge required to satisfy the plant’s consumption of large volumes of fiber.

High Tech Biofuels

The second point should not be underestimated. A world-scale 380 million litre plant would consume roughly 2.4 million m3 of wood per year (i.e., 1.2 million dry tons or 2.4 million green tons). This is as much wood as that consumed by a good size pulp mill.

Our understanding is that the first world scale plant will likely be constructed in the state of Georgia in the U.S.

If not used strictly for domestic use, economies of scale are also important for biofuel plants to be viable in developing countries. For example, one South African producer wanted to export 15,000 m3/year of ethanol to Germany. As the typical capacity of a tanker is about 60,000 m3, the producer would have to store the ethanol for up to four years before it could afford to export it.

Wood is only one of a number of types of cellulosic biomass that can be used to produce energy. However, wood does have the following relative advantages.

- Longer storage life and lower storage costs.
- Higher bulk density (lower transportation costs).
- Higher sugar content.
- Less intensive use of water and fertilizers.
- Established collection systems.

High Tech Biofuels

The first attribute has implications for the ability to achieve the desired economies of scale discussed above. In contrast to wood, both sugar cane and palm oil – the leading feedstocks for ethanol and bio-diesel, respectively, - both need to be processed within 24 hours of harvesting in order to avoid a deterioration in their energy content. As a result, the associated processing plants tend to be of a smaller scale due to the time required in getting the feedstock from the harvest site to the processing plant.

From an economic perspective, the key metric to compare alternative feedstocks and processes is the delivered cost/joule (i.e., the cost per unit of energy produced). To obtain this measure we require estimates of the:

- Joules per gallon (or MW per gallon).
- Cost per gallon.

Unfortunately, we have not yet obtained this data for all the alternative feedstocks. In the mean time, we are focusing on two other metrics in evaluating the energy performance of feedstocks for biofuel production.

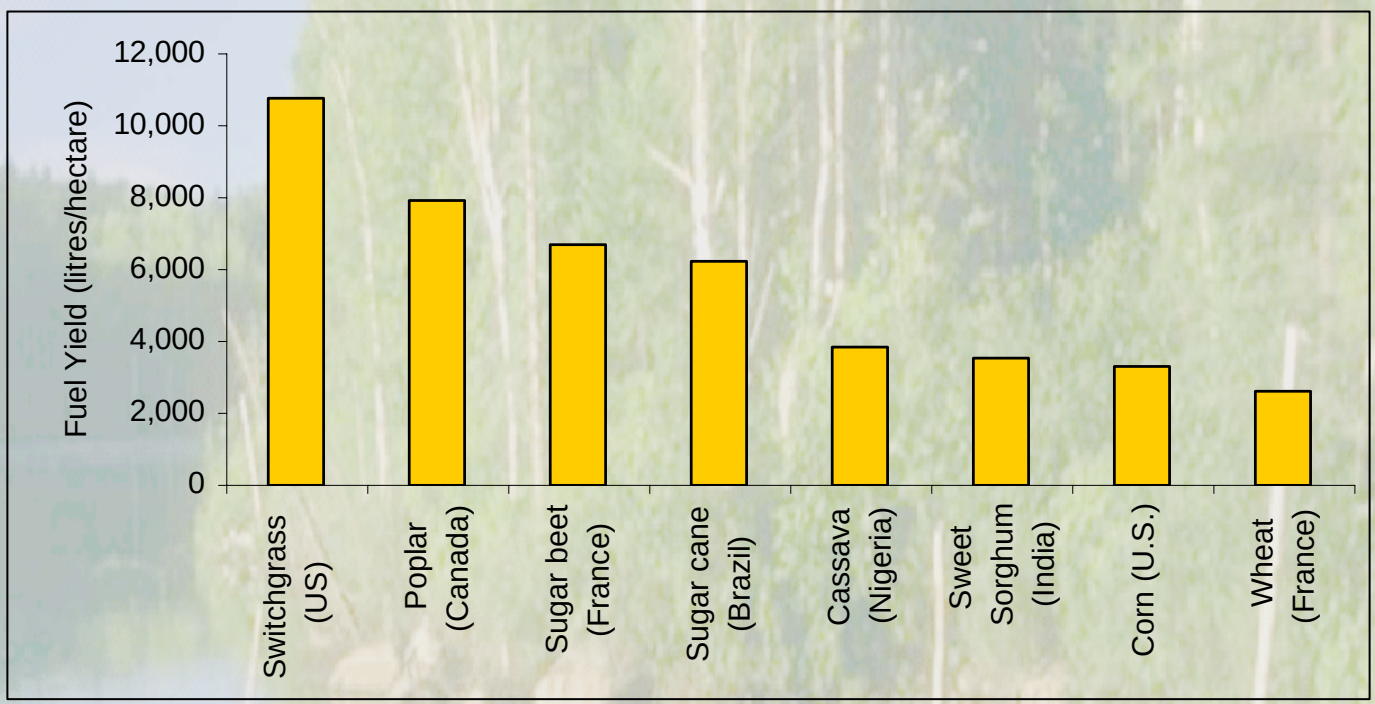
- Fuel yield per hectare. The best way to minimize harvest and transportation costs for a given scale of processing plant is to maximize the yield per ha. Land costs also vary widely by region.

High Tech Biofuels

- Fossil Energy Balance (i.e., the energy delivered to the customer, per unit of fossil energy used). Aside from the environmental benefits of a higher fossil energy balance, developments in markets and legislation related to greenhouse gases and carbon sequestration could provide additional revenue streams to growers.

Exhibits 5 and 6 illustrate the yields from selected crops in producing ethanol and biodiesel, respectively.

Exhibit 5. Ethanol Yield From Selected Crops

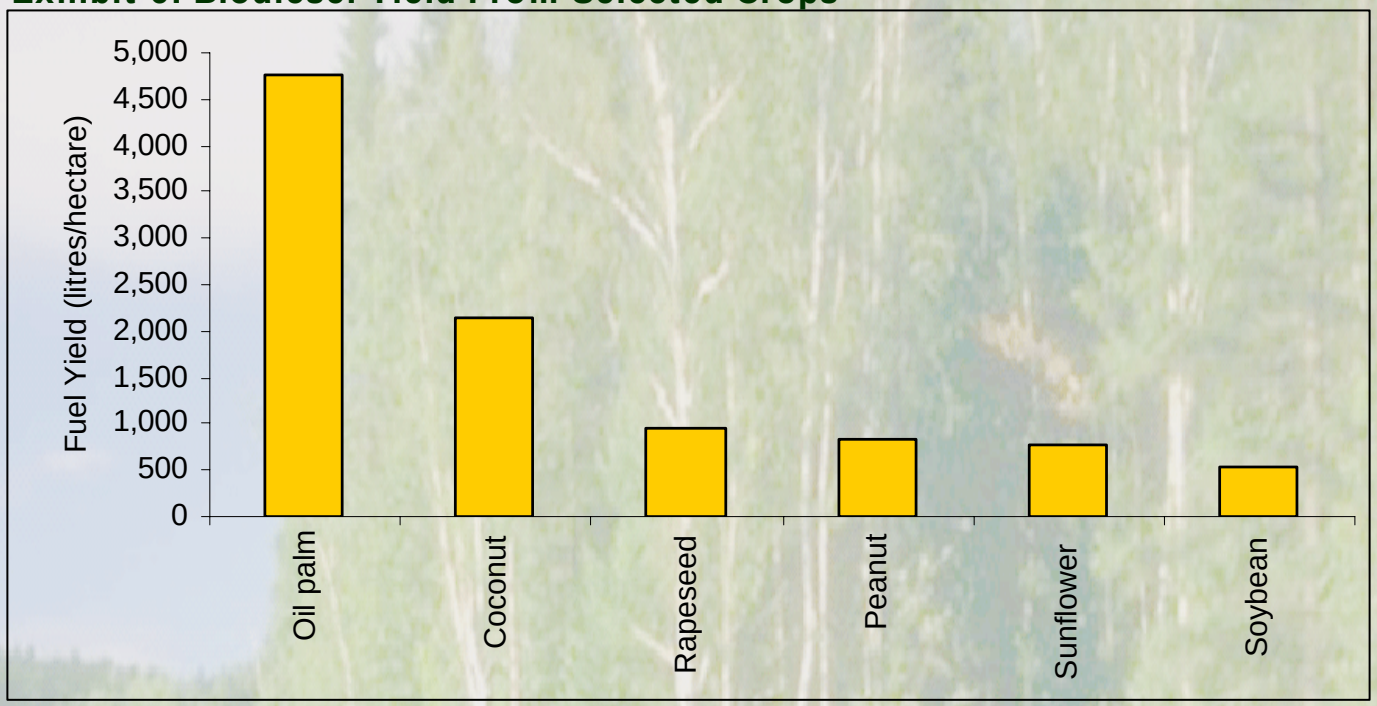


Source: Earth Policy Institute, CIBC World Markets Inc.

CIBC World Markets

High Tech Biofuels

Exhibit 6. Biodiesel Yield From Selected Crops



Source: Earth Policy Institute, CIBC World Markets Inc.

The most salient points to note from these exhibits are:

- For ethanol in general, the two highest yields are associated with cellulosic ethanol (i.e., switch grass and poplar).
- For conventional ethanol, the top yields are from sugar beets (in France) and sugar cane (in Brazil) – roughly double the yields from corn in the U.S.
- For biodiesel, oil palm (in Southeast Asia) is a strong first – roughly 5 times that of rapeseed and 10 times than of soybean. This reflects a much higher oil content per kg and per hectare.

High Tech Biofuels

Exhibit 7 illustrates the Fossil Energy Balance for a range of fuels using various feedstocks. As indicated above, this is a measure of a biofuel's ability to slow the pace of climate change. We emphasize that the calculations are sensitive to assumptions about co-production allocation and how the product is collected.

Exhibit 7. Fossil Energy Balance

Fuel (Feedstock)	~Fossil Energy Balance
Cellulosic ethanol (switchgrass)	~10
Biodiesel (palm oil)	~9
Ethanol (sugar cane)	~8
Biodeisel (waste veg. oil)	~5-6
Biodiesel (soybeans)	~3
Ethanol (wheat)	~2
Ethanol (sugar beets)	~2
Ethanol (corn)	~1.5
Diesel (crude oil)	0.8-0.9
Gasoline (crude oil)	0.80
Gasoline (tar sands)	~0.75

Source: Earth Policy Institute, CIBC World Markets Inc., Farrellet al (Science).

The most important points to note from Exhibit 7 are:

- When the balance is greater than 1, the amount of energy produced is greater than the amount of fossil fuel required in its production and refinement.
- Cellulosic ethanol provides the most attractive balance. (Note that we only have estimates for switch grass as a feedstock, but our understanding is that wood is of a similar range.)

High Tech Biofuels

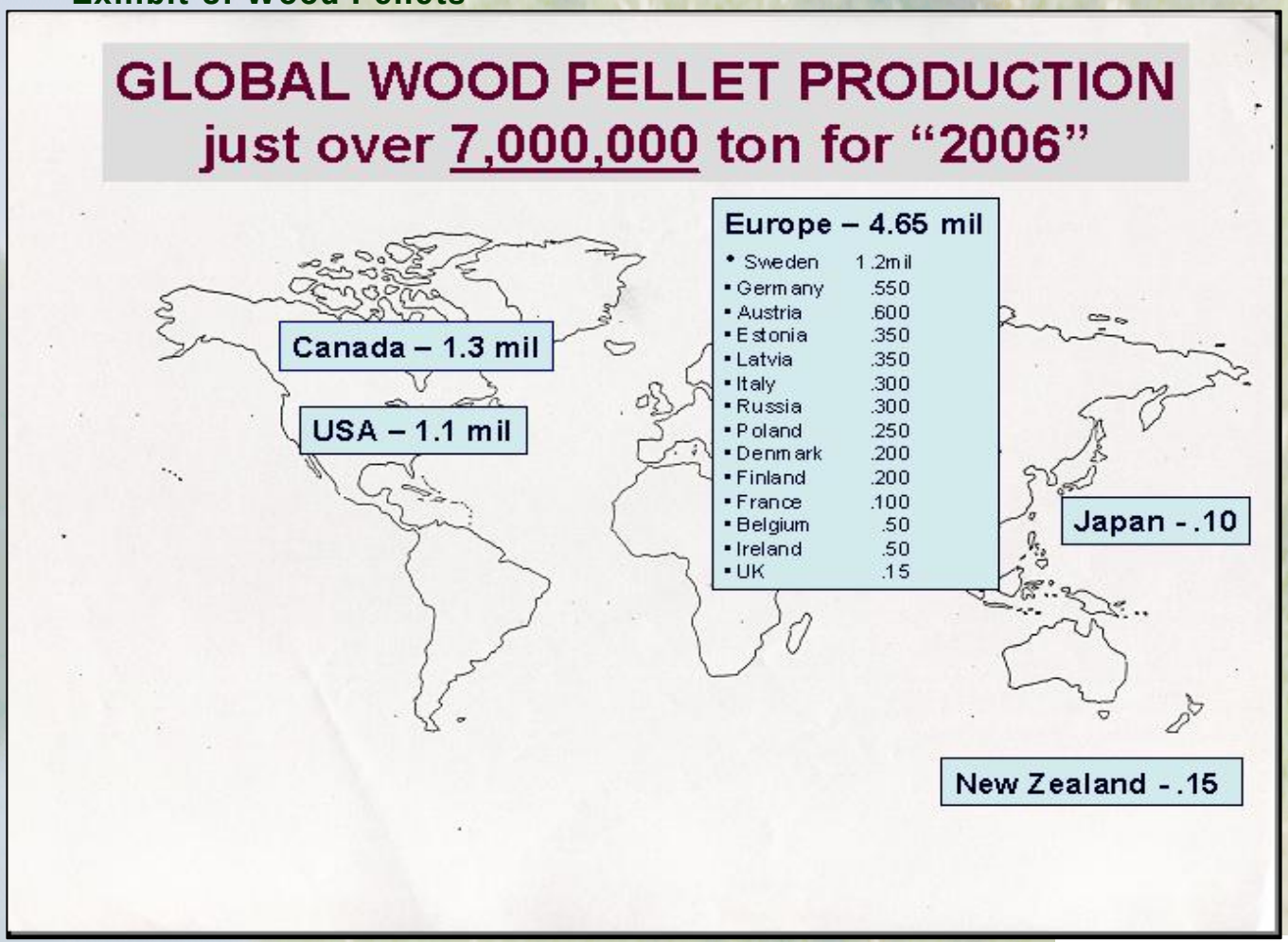
- Ethanol from sugar cane and biodiesel from palm oil also offer high balances, assuming they are grown on suitable soils.
- While still having a positive balance, corn from ethanol has a relatively low number.
- Gasoline made from tar sands actually has a balance less than 1 since a great deal of natural gas is required in its production.

Low Tech Biofuels

While fire wood is the ultimate “low tech” biofuel, our focus is on the emerging wood pellet market.

As illustrated in Exhibit 8, last year roughly 7 million tonnes of wood pellets were produced around the world. Over 65% of this was produced in Europe, and the bulk of the remainder in North America.

Exhibit 8. Wood Pellets



Source: Wood Pellet Association of Canada.

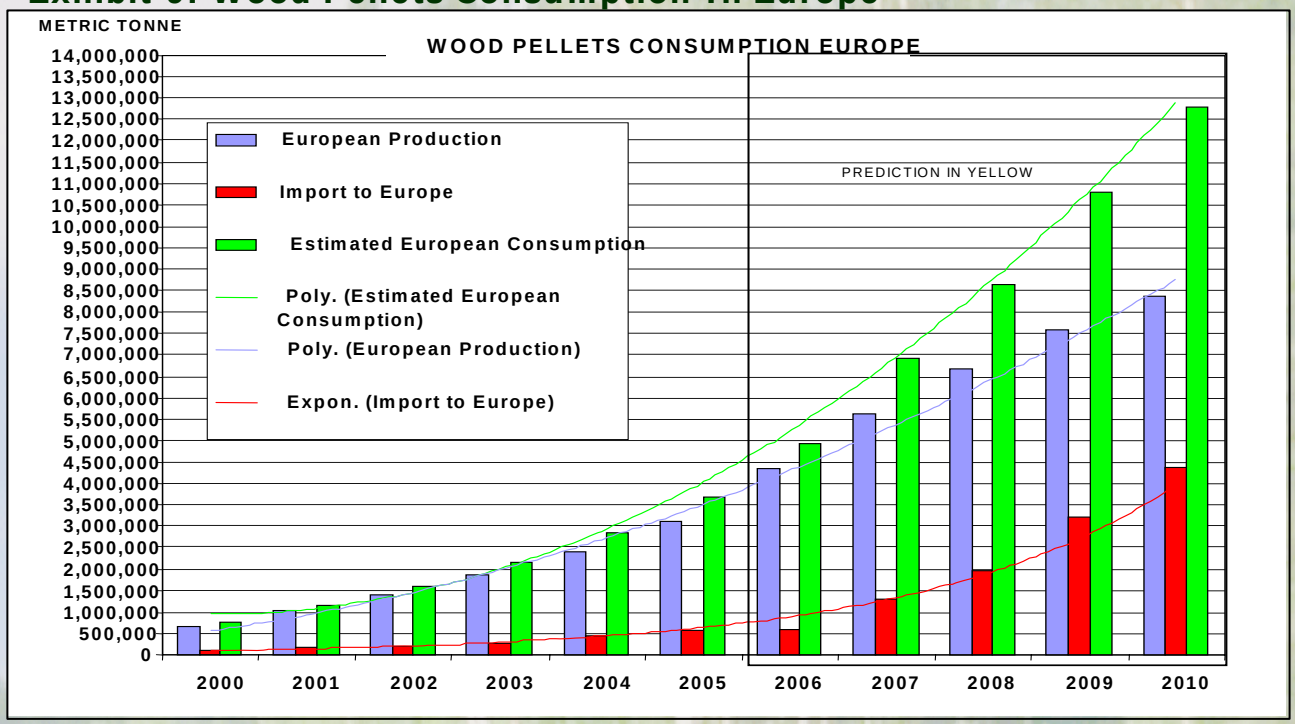
Low Tech Biofuels

Europe is driving the global market for wood pellets, and this demand is driven by governments with a series of “carrots” and “sticks”. Consumption has risen roughly 10x since 2000 to roughly 5 million tonnes, and is expected to rise to almost 13 million tonnes per year by 2010 (see Exhibit 9). In terms of end users, roughly 60% is by co-fired coal power plants, 25% by district heating units, and 15% by residential consumers.

Dramatic growth in production is occurring in North America, with capacity expected to rise almost three times from 2006 to 2010. As illustrated in Exhibit 10, Canada’s exports are estimated to reach 5 million tpy by 2010. In British Columbia alone, production is expected to rise from almost 0.9 million tpy in 2006 to over 3.0 million by the end of this period.

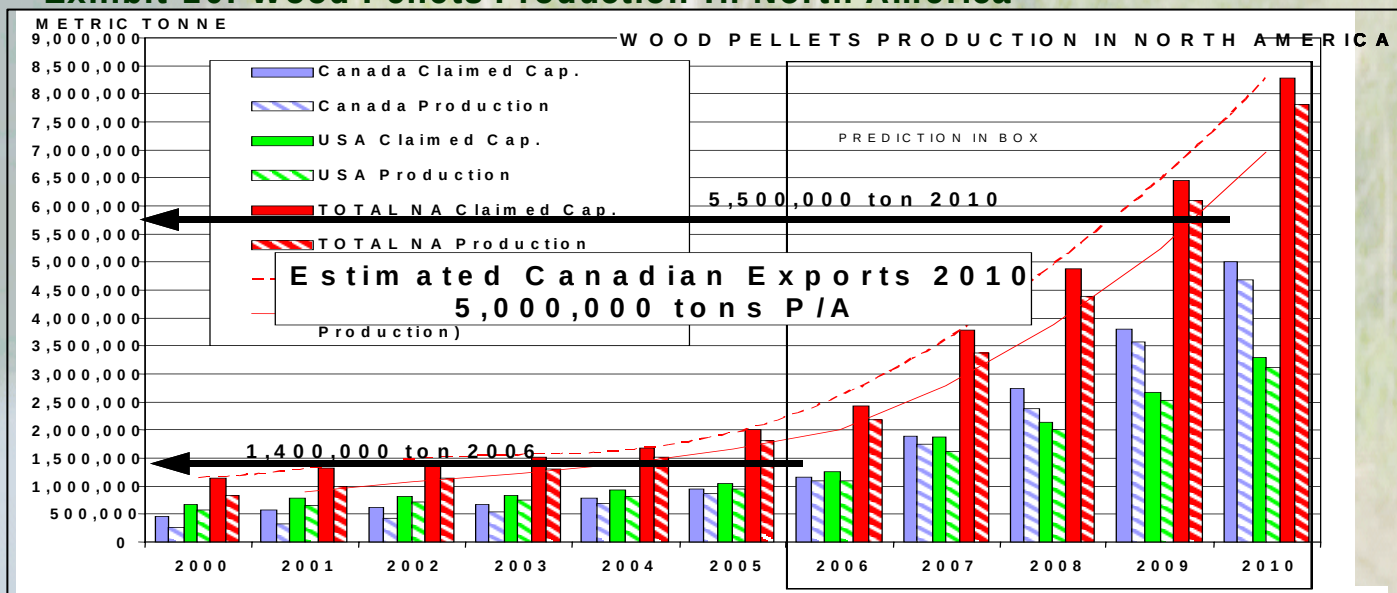
Low Tech Biofuels

Exhibit 9. Wood Pellets Consumption In Europe



Source: Wood Pellet Association of Canada.

Exhibit 10. Wood Pellets Production In North America



Source: Wood Pellet Association of Canada.

CIBC World Markets

Low Tech Biofuels

Sawdust and shavings from wood processing plants are the least expensive (and highly suitable) raw material for wood pellets, and essentially all species of wood can be utilized.

In most parts of North America, the price of sawdust/shavings has doubled to roughly $40-$50/ODMT (oven dried metric tonne, FOB mill) between 2005 and early 2007. However, due to the long hauling distance to major markets, the British Columbia industry has historically enjoyed significantly lower raw material costs of US$10-15/ODMT.

To expand production in most parts of North .America, the pellet industry needs to utilize fiber sources other than sawdust/shavings.

Raw material costs for traditional pellet plants typically account for 45%-60% of the total cash production cost. If fiber costs increase, other costs need to be reduced. As a result, producers in this market are also pursuing economies of scale.

There are roughly 100 pellet plants in the U.S., with an average capacity of less than 20,000 tpy. In Canada, there are about 25 plants with an average capacity of roughly 60,000 tpy. However, much larger plants with capacity in the 300,000 -500,000 tpy range are now being constructed. These plants are generally in the southeastern U.S., and have good access to ports for export to Europe; for example, Green Circle Bioenergy in Florida and Dixie Pellets in Alabama.

Low Tech Biofuels

Pellet prices can be quite volatile, and there is a large spread in prices paid by industrial and residential users (135-200 Euro/ODMT). It is currently possible to obtain three-year contracts with European power plants at an average price of roughly 135 Euro/ODMT.

Note that wood pellets typically have a calorific value of 20.5 GJ per ton (or 5.6 Mwh/ton). This implies that there is 3.36 barrels of oil to 1 tonne of wood pellets. As a result, an oil price of $70/barrel is consistent with wood pellets at $235/tonne mill-gate – a value in excess of the current price. Stated another way, wood pellets at $180/tonne is the equivalent to $8.78/GJ, and most consumers pay $11-$14/GJ for natural gas. There appears to be an economic incentive for consumers to substitute toward the use of wood pellets.

Due to CO2 emission reduction commitments, we expect continuing use of wood pellets in Europe even if it were not supported by the underlying economics.

4. Implications For The Forest Sector

The emergence of the bioenergy sector means that there is now another meaningful user of wood. This increase in demand will put upward pressure on the price of lower quality wood. In effect, it is expected to provide a price floor which reflects the wood's energy equivalency.

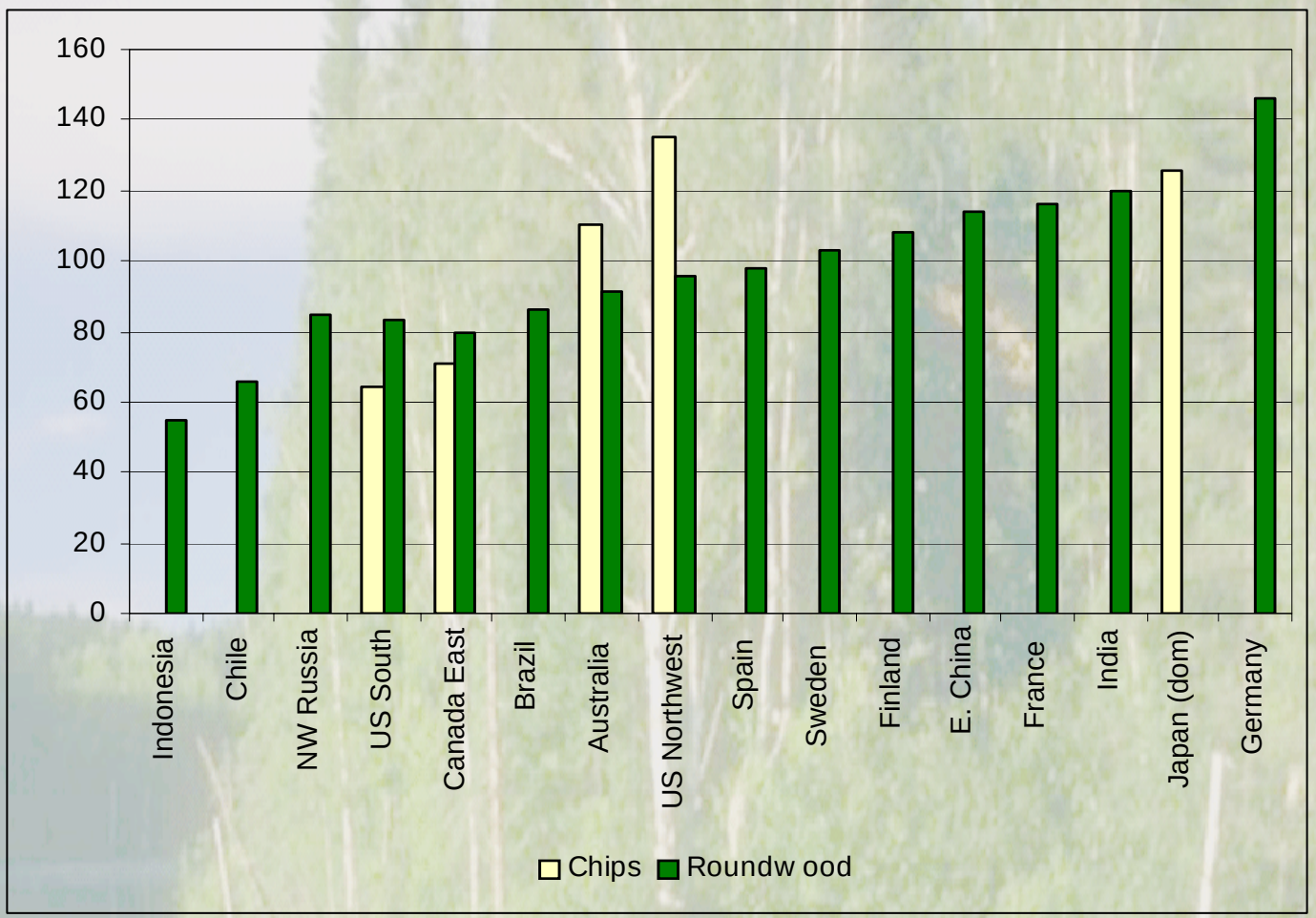
Of all the regulatory moves to stimulate the consumption of biofuels, the European Commission's binding renewable energy target in 2020 is likely to have the greatest impact on wood markets. Given the target and reasonable assumptions about the supply of renewable energy from other sources, one study estimates a gap in the supply/demand for wood in Europe in the range of 200-260 million m3 by 2020. In this scenario, the price of wood would have to increase meaningfully in order to bring the wood market into balance.

In some regions, we also expect shifts in land use as the bioenergy sector develops. Especially in the Southern Hemisphere we expect less land to be devoted to forestry as it is switched into the production of other crops which are even more attractive for the production of bioenergy (e.g., palm oil, jatropha) and food.

On a net basis, we expect the "bioenergy shock" will shift the regional price curve for wood fiber upwards as it stimulates demand (see Exhibit 11). However, due to possible decreases in the supply of land for forestry, we also think that the price increases will tend to be greater at the lower end of the curve where the producers in the Southern Hemisphere tend to reside. As a result, the global price curve may also become flatter.

Implications For The Forest Sector

Exhibit 11. Average Delivered Hardwood Fiber Prices For Q1/07 (US$/ODMT)



Source: 2007 Wood Resources International.

From another perspective, we could well see a decrease in the "intensive margin" of forestry as the relative financial returns to forestry decline on the better lands which are better suited for alternative crops. At the same time, there may be an increase in the "extensive margin" of forestry as harvesting is extended into more remote regions in response to higher absolute wood prices.

CIBC World Markets

Implications For The Forest Sector

While the Southern Hemisphere is expected to maintain its absolute advantage in growing wood fiber, (at the margin) the comparative advantage may start to shift back to producers in the Northern Hemisphere.

The operators of biofuel plants are expected to earn a reasonable economic return over a cycle. However, we do not expect any abnormally high returns due to the competitive nature of the market.

It is also useful to identify some of the “winners” and “losers” which are expected to result from the convergence of the fuel, food and fiber markets.

Winners

- Tropical countries. The potential for bioenergy is largest in tropical countries since they generally enjoy higher crop yields and have lower land and labor costs. This is a potential opportunity for nations that have a natural biological advantage, but have not been able to realize it in traditional agriculture due to trade restrictions in the developed world.

- Owners of the feedstock (and especially the land). Since the production of biofuels (and food) will generally be sold into a competitive market, over time we expect any "abnormal" profits to be reflected in higher prices for the feedstock. This in turn will ultimately be capitalized into the value of the land (the input in most inelastic supply). It will also be more valuable to control the land than the feedstock since there is an option value to switching land use. (While policy makers may be concerned with "elite capture", it may be prudent to first ensure the creation of wealth, and then focus on how it should be distributed.)

- Owners of the key technologies. This is true provided there is adequate patent protection. Developers of new enzymes for producing cellulosic ethanol may be of particular interest.

- Solid wood processors. These enterprises now have an alternative outlet for their residual fiber. This is especially important in regions that are facing a contraction in their existing pulp & paper industry (e.g., Canada), or do not have much of a pulp & paper industry to start with (e.g., Russia). Note that wood residues typically account for about 50% of a sawlog, and that income from residues can account for as much as 30% of a sawmill's revenue stream.

Losers

- Existing users of residual wood fiber. The pulp and paper industry makes extensive use of wood residues, and is already amongst the biggest producers of renewable energy. The non-structural panel industry also uses this product as its main source of fiber. As a result, these established industries generally view the emerging bioenergy sector as a threat because of the upward pressure on fiber prices. It is true that governments must be careful in how they encourage the bioenergy sector. One reason is that, in the case of Europe, a given volume of wood generates 13x more employment and 8x more value added when used in the production of pulp & paper as opposed to energy.

- Forest dwellers without property rights. Forests and marginal agricultural land are often the "homes of last resort" for the rural poor. Since the persons who occupy these lands often lack property rights, the shifts to biofuel production and more intensive agriculture could result in their displacement. However, if steps are taken to ensure these people participate in the growing and processing of biofuels, this threat may be turned into an opportunity. In general, a biofuel industry that is focused more on the local market is more likely to benefit the rural community. It is also less vulnerable to external exploitation and market fluctuations.

- Non-market goods & services at the "extensive margin". As discussed above, due to the anticipated rise in the price of wood we expect the forest industry will be able to extend its extensive margin of operations. To the extent appropriate forestry practices are not followed, non-market goods & services in these areas may be jeopardized.

Losers

- Biodiversity. To the extent natural forests are replaced with mono-culture bioenergy crops, there may be a decline in biodiversity. However, the introduction of biofuels may also offer the opportunity to expand the existing degree of bio-diversity. For example, Weyerhaeuser is considering planting saw-grass in its pine plantations.

Bioenergy Future

In response to concerns about the sustainability of the bioenergy sector, a number of entities have recently been established. These include:

- The Renewable Energy Global Policy Network, which provides an information clearinghouse on the issue.
- Roundtable on Sustainable Palm Oil (RSPO), which is seeking to make the palm oil trade sustainable. The RSPO is trying to set up a certification protocol based on sustainability criteria.
- The International Roundtable on Sustainable Biofuels (RSB), which was formed at the Swiss technology institute Ecole Polytechnique Fédérale de Lausanne to establish global standards and codes for the sector. Members include oil firms British Petroleum and Petrobras, car maker Toyota, wildlife charity WWF and the Dutch and Swiss governments. The RSB has issued draft principles for biofuels production and processing, with the aim of agreeing on a final version by the end of 2007.
- The FAO's International Bioenergy Platform, which is to develop guidelines for investors and governments on the food security and environmental impacts of bioenergy. The guidelines will be technical in nature and cover, among other things, land-use and what to plant and when.

Bioenergy Future

Despite the above efforts, a realistic assessment of the situation is likely reflected in the words of Xiong Bilin (Deputy Director General of the Industry Department in the Chinese Government's National Development and Reform Commission), "We are at the very beginning of this issue and I don't think we can reach a consensus soon".