By **GRAEME RODDEN**, Editor

Actions catching up to words

Although there is still a long road to travel, progress is being made in the development of biofuels and a new generation of leaders should help

It's time to look at the development of biofuels/biorefineries not as projects but as a transformation of the pulp and paper industry. A transformation that may, in many cases, allow forest products companies not only survive and remain competitive, but have interesting bottom lines. This means looking at other products in addition to pulp and paper being their core business.

Around the world, it seems, companies are jumping on the biofuel bandwagon. Numerous ventures have been announced and some of these are detailed later in this article.

What is a biorefinery? The concept implies the full use of incoming wood biomass for the production of wood products, fibers, chemicals and/or energy. In other words, to maximize the economic value a company can get from its trees. It represents an opportunity to precipitate the transformation of the industry. And, there are obvious and numerous environmental benefits to be had such as a significant reduction in GHG emissions and fossil fuel consumption to name but two.

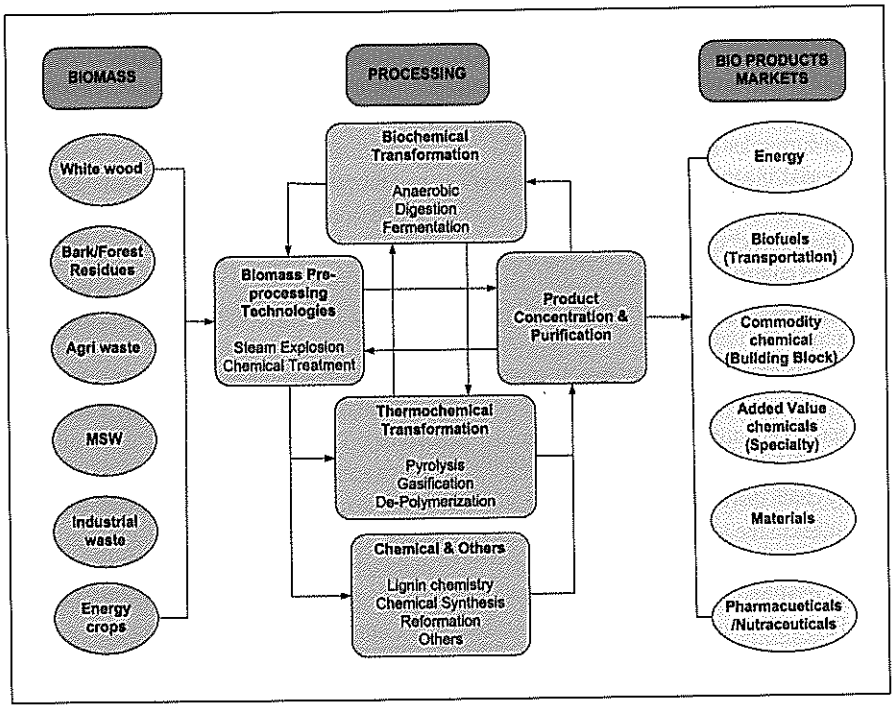
Speaking at the first Solander Symposium in Sweden in 2007, the University of Maine's Adriaan van Heiningen said that the industry needs more revenue from higher value-added products besides pulp, paper and board. These products could be ethanol, chemicals and polymers from hemicellulose; transport fuel from black liquor; bark and biomass as fuel.

But, obviously, it is not risk-free and these risks must be identified and mitigated.

Paul Stuart is the NSERC (National Sciences and Engineering Research Council [Canada]) Environmental Design Engineering Chair in Process Integration, Ecole Polytechnique de Montreal. He organized the first biorefinery session at PAPTAC's annual meeting in Montreal several years ago.

He presents the case of chemical giant DuPont as an example of successful transformation for the forest products industry to follow. It was established in 1802, producing explosives. It has since gone through various evolutions that have seen their own development, growth and maturity, from an explosives producer to chemistry and energy to the present where the company is now focusing on chemistry, biology and materials science. Can, Stuart asks, pulp and paper companies take up this type of challenge and adopt this transformation culture?

FIGURE 1.
Identifying the right biorefinery configuration is complex (Ecole Polytechnique 2007).



Nurture the culture of innovation

If a company has a culture of innovation, then even if only a few of a mutual fund of possible ideas/projects come to fruition, it can change transform its core business. Can the pulp and paper industry do it? Yes, says Stuart. It has a history of making saleable goods from the byproducts of the pulping processes, e.g., vanillin, turpentine and can build on these traditions accounting for today's context of current oil prices, emerging technologies and the carbon economy.

Many of these by-product producing plants have fallen by the wayside, stopped more by price volatility than by the market.

Stuart noted that the industry can move toward specialty chemicals but that the numbers are not always attractive when one looks closely at such factors as throughput rates for certain products and the nature of the market. It will be critical for companies considering the biorefinery to put processes and systems in place for shifts in production to meet supply and demand, thereby greatly mitigating the effect of price volatility. But, this means process flexibility is a must for the biorefinery; this is a big change from today's pulp and paper manufacturing culture. Stuart says there would be similarities with petroleum refineries, which adjust production between products to maximize margins.

Stuart says the pulp and paper industry is in a "stalemate" situation and the biorefinery

concept represents an important opportunity. However, as noted, the industry will need to identify and mitigates the risks involved: technical, economic and commercial.

Moving forward, the industry does have some competitive advantages. Perhaps most important, it has access to biomass and the harvesting know-how. It has an existing infrastructure of sawmills and pulp and paper mills in close proximity to the biomass and it has an established supply chain for the products it already produces.

However, other key factors must be recognized and addressed as biorefinery strategies are developed. For example, at present, the industry suffers from a lack of capital; it has lost its product development culture and it has a lack of knowledge of product quality requirements as well as supply chain knowledge for the biorefinery products. This is why it is imperative to find partners as can be seen by the projects listed.

Although most of the talk is about biorefinery technology and this is critical for a competitive position in the short-term, from various cases studied thus far, Stuart says the most important factor in achieving a strong competitive position in the long-term is the unique supply chain the industry company develops for biomass procurement through to product delivery.

Thus, to be competitive in the long run, companies must think product before process. They must first ensure they can sell what they make. Manufacturing flexibility will alleviate varying market conditions helping to meet profitability targets.

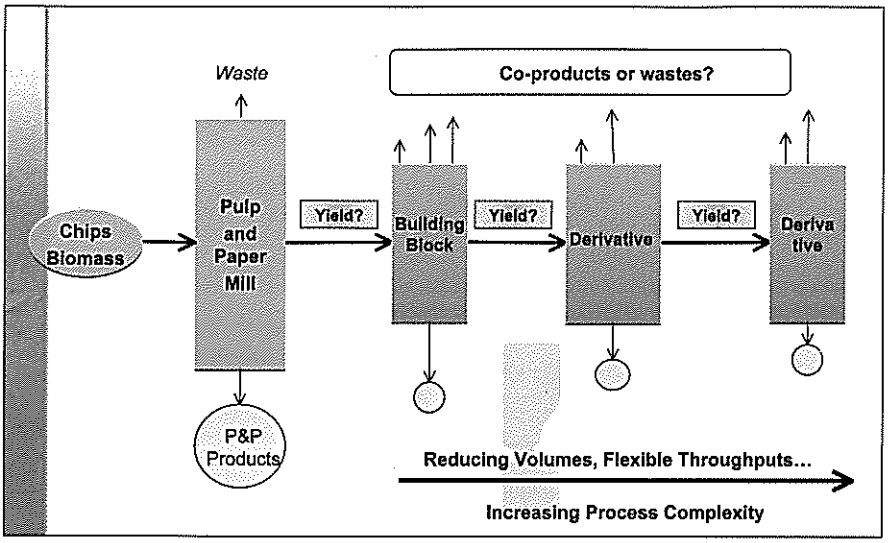
Strategic approach

Stuart describes three phases for companies considering implementing the biorefinery. The first is to lower operating costs by replacing fossil fuels and/or using minimal risk technologies. Many mills can claim they are there already.

Phase II will result in increased revenues through the production/marketing of green energy and/or the manufacture of chemical derivatives. Developing the market for these products is critical. Phase II carries with it a higher process complexity and, therefore, a technology risk. Stuart cited Tembec with its chemical plant in Temiscaming, QC, as an example of a company that has reached Phase II.

FIGURE 2.

Building blocks and derivatives



Finally, Phase III will see a company that has knowledge-based manufacturing in order to benefit from production flexibility. A culture of continuous product development will exist and there will be a business flow transformation. To enable this transformation, there are other factors that must be thought through. These include:

- Supply chain restructuring
- Outsourcing
- Process standardization
- Process re-engineering: Identify, design and deploy value-driven processes; eliminate activities that do not create value
- Market driven culture: this goes back to ensuring that what is made can be sold.

Again, partnerships are important here and one of the steps a forest products company must consider if it wants into the game. Stuart cited the case of Stora Enso and Neste. The joint venture business will produce syngas through a Fischer Tropsch synthesis that will be refined and sold as a biofuel.

"This is a once-in-a-lifetime opportunity," Stuart says of biorefineries. "To be successful, it's time for forest products companies to be first to market for many biorefinery chemicals, the industry to be the first at being third!"

Although he feels there is no alternative in the longer term to the biorefinery for many companies, Stuart is optimistic the industry will rise to the challenge, especially that there are some better bottom lines being realized. He hopes that the new generation of industry CEOs will untap the hidden potential and latent opportunity that exists and that "they will be the stars of the stock market."

What's going on?

There has been a lot of talk about biorefineries but actions are beginning to catch up with words. What follows is a small selection of the projects underway or proposed. ➤

It's been well documented that in 2007 the Department of Energy (DOE) chose to help fund six biorefinery projects to the tune of $385 million, but that none came from the pulp and paper industry.

However, in late February 2008, the DOE pledged $30 million to a possible biorefinery project at the NewPage's Wisconsin Rapids, WI, mill. The funding is part of $114 million approved by the DOE for four small-scale biorefinery projects. NewPage has not determined if it will follow through with the project and is still studying the total cost and potential return on investment before deciding on its feasibility. Stora Enso, the mill's former owners, proposed the project. The plant would produce 5.5 million gal/yr of Fischer-Tropsch diesel fuel and consume about 175,000 tons of wood residue.

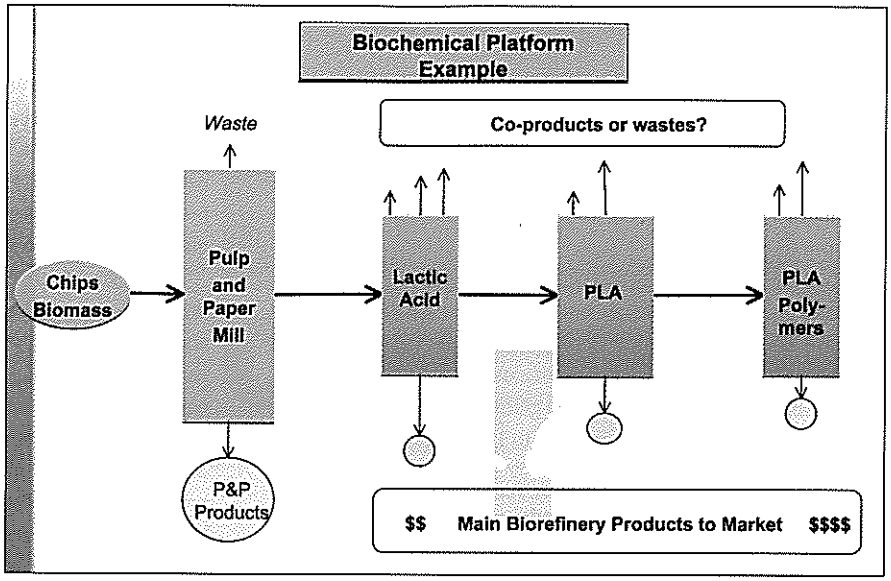
NewPage has already signed an agreement with Swedish-based Chemrec to look into the development of a black liquor gasification plant (BLG) at NewPage's Escanaba, MI, mill (*Pulp & Paper,* January 2008, p.48). The plant would use Chemrec's BLG technology to convert pulping process waste into syngas. The Escanaba plant could produce up to 13 million gallons/yr of liquid biofuel.

Following up on its announcement in 2007 to jointly asses the feasibility of commercializing the production of biofuel from cellulose-based sources, Weyerhaeuser and Chevron announced the formation of Catchlight Energy, a 50:50 joint venture to focus on the development of renewable transportation fuels from non-food sources.

Flambeau River entered into a Memorandum of Understanding with American Process for its cellulosic ethanol plant at its mill in Park Falls, WI. It will be the forest pulp mill biorefinery in the US, producing 20 million gal/yr of cellulosic ethanol from spent pulping liquor. Flambeau will use American Process's AVAP™ process technology. It is estimated that the facility will have a positive carbon impact of about 140,000 tons/yr.

FIGURE 3.

Biorefinery platforms



In 2006, Potlatch in collaboration with several partners announced it was studying the feasibility of a pilot biorefinery at its Cypress Bend, AK, pulp and paperboard mill.

Finnish-based UPM, Andritz and its associated company, Carbona, announced they would cooperate on the development of technology for biomass gasification and syngas purification. The companies said they would start joint testing of Carbona's gasification technology at the Gas Technology Institute, located near Chicago. Pilot testing is expected to be complete by the end of the year.

In Canada, Nexterra announced in 2007 it had signed a $2.7 million contribution agreement with Sustainable Development Technology Canada to support the demonstration of a unique application of Nexterra's gasification technology to displace natural gas used to fire lime kilns in kraft pulp mills with a syngas produced by gasifying wood residue. Domtar's Kamloops, BC, mill has plans to use the technology (*Pulp & Paper,* June 2007, p.28).

Overseas, Chemrec has operated demonstration and pilot plants, atmospheric and pressurized of its BLG technology since 1991. It plant in Pitea, northern Sweden, is a pressurized BLG facility around which Sweden's national BLG is centered.

In a project initiated by Volvo, there will be a dimethyl ester (DME) pilot plant opening in Pitea in mid-2009. DME is a synthetic fuel derived from natural gas. The pilot plant is expected to produce about 4 tonnes/day of DME.

Also speaking at the Solander Symposium, Chemrec's Ingvar Landalv said the objective is to start up a plant that can produce 25,000 tonnes/yr of DME by the end of 2010. Work is being done with Sodra at its Morrum, Sweden, mill on a BLGMF or multi-fuel system that combines gasification with a chemical synthesis plant for the production of green automotive fuels. P&P

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