Special Session on:

The Forest Biorefinery

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Session Co-Chairs:
Paul Stuart (École Polytechnique)
Philippe Navarri (Natural Resources Canada CETC-Varennes)

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Jim McNutt, Center for Paper Business and Industry Studies (CPBIS)

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Leon Magdzinski, Tembec Inc.

Business & Market Issues – Driving Forest Biorefinery Deployment

Jim McNutt
Executive Director
Center for Paper Business and Industries Studies (CPBIS),
Atlanta Georgia, USA

The North American Forest Products Industry is facing the potential of pursuing deployment of an industry transforming technology driven by recent developments centered on the Forest Biorefinery. However, as has been demonstrated by the Forest Products Industry's history, -- new technologies' deployment have often advanced absent serious needed early and ongoing attention to critical business and market place factors. Proper consideration given to such business and market place issues will drive a better focus on the development and deployment process toward economically viable configurations. Moreover, such considerations will also reduce the risk of failure associated with necessary commercial success – an absolutely essential outcome for the ultimate deployment of the industry's newly evolving technology options.

Illustratively, the current evolution of the Forest Biorefinery opportunity has seemingly expanded to encompass almost any mill configuration (or re-configuration) that can seemingly [at that place and time] make the most out of the forest carbon chain from the technology options perspective -- including the production of green fuels, petrochemicals, value-added pharmaceuticals, and even new-wave value added fiber products for new and novel applications. This technological-based landscape is broad, complex and increasingly confusing to both technologists and senior managers. What seems to be missing is the guiding context in which the Forest Biorefinery technology(Ies) can and should be brought forth beyond answering the question – "can we do this or that technologically speaking".

Accordingly, this necessary context can -- ***and should*** -- be provided by a much more encompassing incorporation of business and market factors to help guide the most opportunistic and commercially viable steps forward on the Forest Biorefinery pathway. For example, serious consideration must be given to market structure demands and pricing for alternative Biorefinery-based products – and in what time frame and in what optimal delivery option. What is the ***scope*** (size) of the market option? What is the ***competitive landscape***? What are the ***alternative*** products pricing scenarios looking out? What are the ***supply chain requirements*** – including logistics of delivering any final product to the market place – required to succeed? What is the real value-added potential ***for the system (not on the margin)*** for various alternative Forest Biorefinery scenarios? What are the best alternative total business models for delivering the right Forest Biorefinery-based products from what technological configuration to what end market(s) in what manner that optimizes the opportunity for both commercial and enterprise success?

Exploration of these critical business and market place questions early and consistently at increasing levels of resolution throughout the development and deployment process for the Forest Biorefinery opportunity is absolutely required for the most successful of outcomes for both the industry and the individual firms that pursue this industry-transforming pathway.

Converting a Kraft Pulp Mill Into an Integrated Forest Products Biorefinery

Adriaan van Heiningen
Department of Chemical and Biological Engineering
University of Maine

There are fundamental global developments which will make energy supply one of the central problems in the coming decades. There is also growing consensus that fossil-fuel CO_2 emissions will need to be controlled. Renewable forest material is carbon neutral. A recent study by the USDA and DOE has identified that about 1.3 billion dry ton of biomass, of which 368 billion dry ton coming from forest land, would be available in the US on an annual basis. This total amount of biomass would be enough to produce biofuels to replace more than one-third of the current US demand for transportation fuels. Therefore, managed forests have enormous potential to reduce green-house gas emissions by conversion of the forest material into liquid fuels, electricity and other products now derived from nonrenewable carbon.

The forest products industry in N.A. is facing global competitors who use the latest and largest installed technologies, and also have wood and labor cost advantages. As a result of the increasing competition the prices for forest products will continue to decrease. In addition, the low level of investment over the last 10 years has brought the NA Forest Products Industry to the edge of obsolescence

In order to remain viable, the N.A. forest products industry needs to increase its revenue by producing bioenergy and new biomaterials in addition to traditional wood, pulp and paper products. This can only be done economically if all product lines are highly integrated, are highly energy efficient, and have a minimal or no use of fossil fuel. The development of an Integrated Forest Biorefinery (IFBR) which accomplishes this goal represents a great opportunity for the industry. At the same time the IFBR concept addresses the societal need to use renewable resources rather than fossil fuels to produce commodity products, liquid fuels and electricity. The present talk will discuss the opportunities and challenges of one version of the IFBR, a biorefinery which uses the kraft pulping process as the central wood separation technology.

The Canadian Forest Biorefinery

Ulrika Wising and Paul Stuart
NSERC Environmental Design Engineering Chair
Process Integration in the Pulp & Paper Industry
Department of Chemical Engineering
École Polytechnique – Montreal

Reduced profit margins and a global competitive market are among the challenges facing the Canadian pulp and paper industry. Also the Canadian dollar is rising, energy costs are increasing and there has been a lack of capital investment in recent years. These challenges need to be aggressively addressed for the future prosperity of our industry. In this process, our classical business model must be questioned, as well as the spectrum of products we have traditionally produced.

One of the opportunities increasingly being discussed is the forest bio-refinery. The forest biorefinery overall concept is that of a processing plant where biomass feedstock is extracted from the forest, and converted into a spectrum of added-value products. For the pulp and paper industry, this could lead to significant financial and environmental benefits due to a wiser utilization of biomass feedstock. The industry would not only produce pulp and paper products, but also, a range of products such as bio-fuel, fine chemicals, electricity, etc. In this presentation, bio-refinery processes available today or under development will be summarized.

There are many possible ways that the bio-refinery can be implemented. Some will be much more attractive than others – however the answer to this question is far from obvious. How can we best develop the forest biorefinery in the Canadian context, i.e. given our tax structures, mill capacities, existing supply chains, access to fibre, etc.? Each bio-refinery installation will be in a retrofit context, and will be unique. In this paper, we present a survey of the Canadian kraft pulp and paper industry. This survey is used to identify the critical criteria and specific opportunities for the Canadian bio-refinery. Product and process design methodologies will be critical. We describe process integration techniques that can be used to identify the best possible pathways in the Canadian context.

The Potential of Bioconversion to Produce Fuels and Chemicals

Jack Saddler and Warren Mabee
Forest Products Biotechnology
Faculty of Forestry
University of British Columbia

Biomass can provide a sustainable, renewable source of transportation fuels and industrial chemicals that may significantly reduce our dependence upon petroleum.

In the United States, bio-based fuels and chemicals are currently being produced from agricultural feedstocks, such as corn grain. These feedstocks are predominantly starch, a polymer that is easily broken down into its carbohydrate components. However, recent technical improvements have made bioconversion technologies to process wood (lignocellulose) more technically and economically feasible. The bioconversion platform typically uses a combination of physical or chemical pretreatment and enzymatic hydrolysis to convert lignocellulose into its component monomers. Once liberated, the carbohydrate components of wood may be processed into a number of products. A number of US-led projects are paving the way for new chemical products from the lignocellulose-based biorefinery, including bioethanol, lactic acid and polylactide, acrylic acid, propanediol, and glycerol; these chemicals can be used to create consumer products such as bioplastics, or as platform chemicals in a number of industrial applications. The development of better ways to separate lignin from the lignocellulose matrix during bioconversion has created the possibility of developing value-added lignin-based products as well. The bioconversion platform therefore has the ability to serve as the basis for full-fledged wood-based biorefining operations, generating value-added bioproducts as well as fuel and energy for the forest sector.

Biorefinery:
Opportunities and Barriers for Petrochemical Industries

Mohini Sain and Muhammad Pervaiz
Centre for Biocomposites and Biomaterials Processing
Earth Science Center/Forestry
University of Toronto

Today, with the exception of wood and cotton, very few renewable materials are being used to manufacture consumer goods on mass scale. Most probably, bio-plastics and natural fibers represent industrial segments with the highest potential of growth among all renewable products. Currently on global basis, around 150 million tons plastic is produced which is predominantly derived from petroleum based raw materials. It is estimated that by 2020 only one fifth of total plastic production can be replaced by bio-plastics. However to achieve a true technical and commercial success in this area, there are number of barriers to deal with; lowering production costs for consistent quality raw materials, finding more economical separation processes, and improving material performance through better understanding of basic plant science.

In the area of composite materials, there is a strong desire to replace glass-fiber reinforcement with natural fibers and industry has already taken the imitative in this direction, especially in the auto sector. But to fully compete with glass-fiber products on both cost and performance, there is a need for standardization of natural fibers' properties to guarantee quality constancy and product reliability.

Bioenergy and Bioproducts at Tembec:
Synergies in Integrated Processing of Biomaterials

Leon Magdzinski
Corporate R&D Director
Tembec Inc.

Tembec has integrated sustainable forestry feedstocks and forest byproducts to produce bioenergy, biomaterials, and bioproducts in an economically disciplined manner. This paper presents a working example of value-driven bioprocessing on an industrial scale yielding both traditional and innovative products and processes at the Temiscaming site that was established nearly 100 years ago.

Guided by its internal programs of Forever Green™ and Impact Zero™, Tembec extends its supply chain of FSC™ certified forest operations into its production of USP-grade and food-grade specialty cellulose products. Using both traditional chemical and bio- transformations of associated waste streams into modified lignin, ethanol and biogas production, Tembec has established a culture of innovative bioprocessing and integrated sustainable manufacturing. With this Tembec culture of innovative use of biomaterial feedstocks, the continuing evolution of forest biomass integration with on-site bioenergy is key to new Temiscaming community growth opportunities.