

#salutation#

Welcome to the first edition of "Bio-Strategies, Insights Into The Growing Bio-based Economy" brought to you by the combined efforts of EnVertis Consulting Inc. and NLK Consulting Ltd. Our goal is to provide our readers with more than just the news of the day; we will provide an independent critical analyses of emerging technologies, and the associated opportunities for biotechnology strategies.

We plan on providing concise, to-the-point summaries that target busy executives and managers who need to stay abreast of current information in this arena of increasing importance. We hope that you will find these emails to be useful, informative – and sometimes even entertaining...

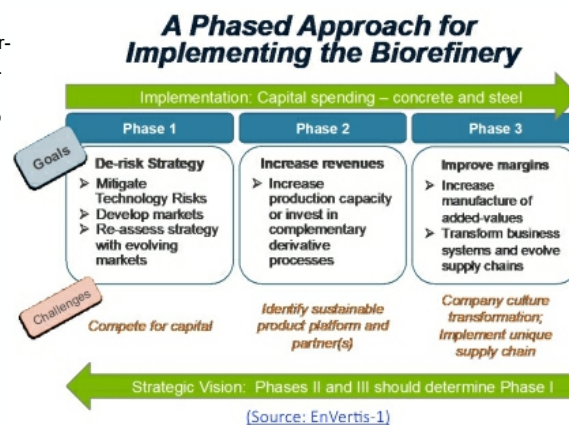
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We look forward to meeting with you at PaperWeek – you'll see us and other bioeconomy leaders outside the Biofor session room where we will be interested to discuss your biorefinery questions.

BioEconomy Success Factors: Define what you want to be when you grow up...

Companies on their way to setting successful bioeconomy strategies are beginning "with the end in mind", and planning near-term activities consistent with transformation over the longer-term. Recognizing the risk in implementing a bioeconomy strategy, companies identify the most effective and lowest risk way to get to "the end". This Phased Approach is practical, and mitigates technology and market risks with robust bioeconomy strategies. Near-term phases typically focus on competitive advantage through synergies with the core businesses and minimizing risk, while longer-term phases seek to "climb the value ladder" through secondary conversion processes to added-value bioproducts, including downstream market partnerships.

In this first edition of Bio-Strategies, we concretize this phased approach using 3 recent examples of emerging bioeconomy strategies.



Sappi



Official opening of the demo plant for sugar extraction on April 2017 (Source: papnews)

Following investments in biocomposites, [nanocellulose](#) as well as the expansion of lignosulphonate capacity, [Sappi recently announced](#) the opening of a second-generation renewable sugar extraction demonstration plant at its Ngodwana Mill in South Africa. [In September 2017](#), Sappi acquired Plaxica, a UK-based sugar separation and clean-up technology. What seems to be unfolding?

Well, it looks like Sappi may be using a phased-approach to mitigate technology and markets risk associated with the production of bio-chemicals from hemicellulose sugars.

In Phase 1, Sappi has invested in the Plaxica sugar extraction technology, while Phase 2 will focus on sugar valorization (separation and clean-up). Might we expect bio-chemical production announcements in a future Phase 3? Sappi is now one of several companies looking to establish a value proposal for C5 sugars from wood. Other companies

active in this domain include Cascades in Cabano and Fortress in Thurso in Canada, as well as Stora Enso with their investment in Virdia. Hemicelluloses, which may be less sexy than their cousins' cellulose and lignin, appear to be the basis for ambitious product diversification strategies for some leading forestry companies.

BioAmber

In BioAmber's [2017 Corporate Overview](#), one can find several hints about their phased approach.

After addressing technology development challenges with its demonstration facility through a Joint Venture with France-based Agro-Industrie Recherches et Développements (ARD) from 2011 to 2014, BioAmber opened its first semi-commercial plant in Canada in 2015, benefiting from various incubation and integration synergies with the Sarnia cluster. Today BioAmber operates the world's largest sugars-to-succinic acid manufacturing facility (30,000 t/y). This was a critical step in de-risking the technology. In this phase, developing a long-term off-take agreement with Vinmar was a key success factor.

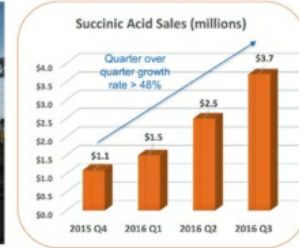
For the next phase, BioAmber now looks at larger plants (200,000 t/y), diversifying its product portfolio into Succinic Acid derivatives (BDO, THF) through quality partnerships. If this becomes a reality, then this plant will be the game changer for BioAmber; where economies-of-scale and higher added-value products will help to ensure a positive cash-flow for the company.

Commercial plant started production in October 2015



World's Largest SA plant is a Joint Venture
60% BioAmber, 40% Mitsui & Co.

Over 180 companies globally have qualified our succinic acid



(Source: BioAmber)

Comet BioRefining



(Source: Comet BioRefining)

Why might forestry companies target partnering with BioAmber in the longer-term? There are a number of emerging technologies that forestry companies could consider as their Phase 1 primary conversion technology, such as Comet, breaking-down biomass into 2nd generation sugars – our third example. Over the last months, Comet [announced](#) having completed the financing of their large demonstration plant that will be located at the same Sarnia cluster as BioAmber, benefiting from synergies with the cluster to mitigate risk and technology implementation.

Once completed and running, this facility will have the opportunity to [provide BioAmber with a sustainable sugar supply](#) from agricultural and forest residues. Putting on a forestry hat, one might wonder... What is the forest company phased business strategy to enter the succinic acid business? What quality of lignin quality can we expect from the Comet biorefining process in order

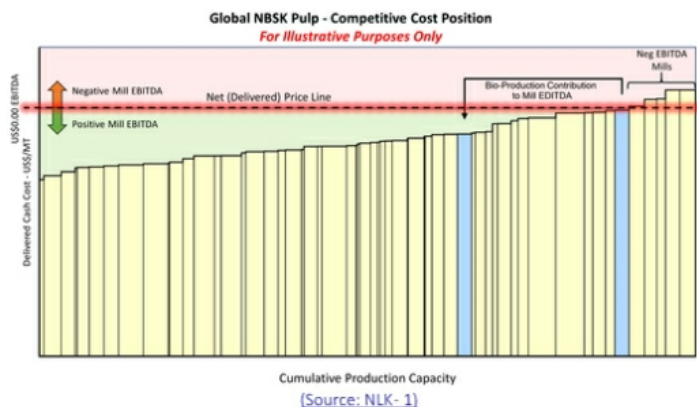
to support the overall economics, to strengthen the value proposal from the production of clean sugars? How little would the sugars need to be cleaned-up before they can be processed in the succinic acid process?

So, what does it all mean?

The importance of Competitive Cost Curve positioning for manufacturers of commodity products and the impact of by-product revenues on improving pulp mill competitiveness and sustainability.

Commodity producers are essentially 'price-takers' in that they have limited capability to differentiate their products from sector competitors. The key determinant of a producers' earnings (earnings before interest, taxes, depreciation and amortization - EBITDA), relative to its competitors is its position on the sector cost of supply curve.

As shown on the example figure NLK-1; the competitive cost curve for NBSK pulp has been developed from cost estimates based on calculated units of consumption, regional input costs, estimates of average delivery costs and public information (fiber, chemicals, energy, personnel, etc.); shown on the Y-Axis. These delivered cash costs are plotted against relative mill capacities on the X-Axis assembled in order of ascending costs to populate the cost of supply curve.



Recalling our Economics 101; where the demand curve intersects the supply curve is where the price level should be. It also indicates the position of the marginal producer whose behavior has a significant impact on short-term price levels. Its curtailment will support price levels, whereas continued operation with negative EBITDA's will depress prices. Higher cost mills are subject to negative EBITDAs, possible curtailments, and erosion of their capital bases.

For the example mill, highlighted in blue, by-product earnings (EBITDA) from bioproducts are subtracted from mill cash costs to effectively reposition the mill lower down on its cost curve. With its new position, the mill becomes less vulnerable to curtailments with market downturns, enhancing its long-term viability. An enviable position. From a traditional business perspective, mills implement biorefinery strategies strengthen their overall long-term competitiveness.

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EnVertis is a specialized consulting company, whose areas of expertise are in addressing strategic projects for its clients through the definition of business and technology plans. More specifically, EnVertis develops biorefinery strategies for the production of primary biochemicals/biofuels, through to added-value biochemicals/biomaterials - bringing together upstream and downstream partners across the value chain. We accompany our clients in the development of their biorefinery implementation plan, we remain abreast of state-of-the-art technologies, and we understand the need for our clients to develop their unique diversification strategy that creates competitive advantage over the longer-term while reinforcing their core business in the near-term.

NLK's areas of expertise include: Pulp, Paper, Packaging & Tissue and Bio-Solutions sectors. We focus on these sectors so our clients can benefit from our deep industry knowledge and specialist insights. NLK's knowledge extends across the value chain, through to processing, logistics and final end-product markets. The management consulting advisory services we provide to these sectors include: strategic analysis, market analysis and insights, prefeasibility studies, due diligence, cost improvement initiatives and product/margin optimization studies. NLK also offers our network of associates for temporary or part-time assignments providing cost effective technical and analytic support.

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