

## Multi-Criteria Decision Making Tool for Assessment of Biorefinery Strategies

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**Abstract :** Canadian forest industry is seeking to identify and implement transformational strategies for enhanced financial performance through the emerging bioeconomy or more specifically through the concept of the biorefinery. For example, processing forest residues or surplus of biomass available on the mill sites for the production of biofuels, biochemicals and/or biomaterials is one of the attractive strategies along with traditional wood and paper products and cogenerated energy. There are many possible process-product biorefinery pathways, each associated with specific product portfolios with different levels of risk. Thus, it is not obvious which unique strategy forest industry should select and implement. Therefore, there is a need for analytical and design tools that enable evaluating biorefinery strategies based on a set of criteria considering a perspective of sustainability over the short and long terms, while selecting the existing core products as well as selecting the new product portfolio. In addition, it is critical to assess the manufacturing flexibility to internalize the risk from market price volatility of each targeted bio-based product in the product portfolio, prior to invest heavily in any biorefinery strategy. The proposed paper will focus on introducing a systematic methodology for designing integrated biorefineries using process systems engineering tools as well as a multi-criteria decision making framework to put forward the most effective biorefinery strategies that fulfill the needs of the forest industry. Topics to be covered will include market analysis, techno-economic assessment, cost accounting, energy integration analysis, life cycle assessment and supply chain analysis. This will be followed by describing the vision as well as the key features and functionalities of the I-BIOREF software platform, developed by CanmetENERGY of Natural Resources Canada. Two industrial case studies will be presented to support the robustness and flexibility of I-BIOREF software platform: i) An integrated Canadian Kraft pulp mill with lignin recovery process (namely, LignoBoost™); ii) A standalone biorefinery based on ethanol-organosolv process.

**Keywords :** biorefinery strategies, bioproducts, co-production, multi-criteria decision making, tool

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