DECISION SUPPORT TOOLS AND EX-ANTE RESEARCH FOR EVALUATING BIOECONOMY TRANSFORMATION STRATEGIES

Reference

Based on the proposal for a new task in Annex XI – Industry-based Biorefineries by CanmetEnergy National Resources Canada and Polytechnique Montreal Chemical Engineering Department.

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Information about current projects can be found at the IETS website.

Background

The robustness of new biorefinery concepts depends on their ability to survive under uncertain future conditions, for example, biomass/feedstock prices, energy prices, bioproduct prices, policy instruments, changes in grid power production, and performance characteristics of novel processes (yields, efficiencies, etc.). Assessments and evaluations, economically and in terms of GHG mitigation typically consider today's conditions, resulting in non-optimal decision-making. Decision support models and tools using Ex-Ante Evaluation that address future scenarios in order to identify robust biorefinery strategies analysis are needed.

Introduction

Decision-making is not a straightforward process, as complex problems involve numerous options or alternatives as well as an array of predefined criteria, which differ in nature and can include technical, economic, environmental, market, social, policy and supply chain related aspects. In addition, decision makers today require quick, efficient, and integrated methods for comparing various alternatives for a wide range of investment scenarios. For this purpose, decision support tools usually provide computational support for implementing multi-criteria analysis as well as interpreting the results through numerical or visual graphic aids.

The main questions for any company that seeks to implement a forest bioeconomy vision is how to identify a strategy for entering a new business field. As biorefineries will mostly be integrated into existing facilities, further questions will arise:

- What are the benefits of integrating a biorefinery technology into existing industrial facilities?

- What are the potential direct technical impacts of integration on existing industrial facilities?

- Under what scenarios does the biorefinery project become economically and environmentally viable?

Assessments and evaluations for bioeconomy transformation are typically made considering a range of complex criteria that are unique to the values of the company, e.g. economic, GHG mitigation, technology risk, market risk, policy risk, unique competitive advantage, etc.

Risks are due to uncertainties. Methodologies for systematically quantifying uncertainty and mitigating risks are critical when assessing biorefinery strategies, considering for example:

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- Input parameters for calculating assessment criteria (yields, CAPEX, OPEX, bioproduct prices, financial, policy indicators, etc.);

- Mathematical (models) uncertainty; and/or

- Different future scenarios.

To answer such questions and in order to take all the complexities of biorefinery decision-making into consideration, a decision support system, driven by a systematic and multidimensional approach, is required.

What is a decision support system?

A decision support system (DSS) is a computer-based information system that supports business or organizational decision-making activities. Sprague and Watson[1] describes the key features of a DSS as follows:

- DSS tends to be aimed at less well-structured, underspecified problem that upper level managers must often face;

- DSS typically attempts to combine the use of models or analytic techniques with traditional data access and retrieval functions;

- DSS focuses on features which make them easy to use by non-computer-proficient people in an interactive mode; and

- DSS emphasizes flexibility and adaptability to accommodate changes in the environment and the decision-making approach of the user.

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[1] Sprague, Ralph H. and Watson, Hugh J, Decision support systems: putting theory into practice, 3rd Edition, Prentice Hall International, 1993.

DSS can include knowledge-based systems. A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from a combination of raw data, business and technology models, scenarios to identify and solve problems, and to make decisions. This allows the end user to make decisions that are well informed at a quicker pace.

What is Ex-ante evaluation?

The ex-ante (and ex-post) reasoning in economic topics was introduced by Swedish economist Gunnar Myrdal over 1927–39. The development of ex-ante research has grown since that time. In the contemporary context, ex-ante research is broadly used, for example:

- In the financial world, the "ex-ante return" is the expected return of an investment portfolio,

- "Ex-ante analysis" is used to give an idea of future movements in price or the future impact of a newly implemented policy, especially in the European context, World Bank context,

- "Ex-ante review" has been used to estimate the potential energy savings for energy efficiency measures in California before being installed, based on predictions of typical operating conditions and baseline power usage.

Decision support tools and development of biorefineries

The robustness of new biorefinery pathways will depend on their ability to survive under uncertain future conditions. This may include any or all of access to biomass, biomass/feedstock prices, performance characteristics of novel processes (e.g. yields, efficiencies; integration constraints into existing or new facilities, etc.), energy prices, bioproduct prices and their market volatility over the plant lifetime, as well as new policy measures (e.g. new standards, cross-jurisdictional platforms,

reviewed regulatory processes, certification of new entrants in the forest sector, etc.).

A link exists between decision support software and ex-ante research. By quantifying uncertainty and relating this to biorefinery robustness and multi-criteria decision-making (MCDM) or other decision-making methods, companies, government and other stakeholders can greatly increase their success at identifying and

implementing biorefinery strategies. It is in this context that anticipating and planning for the future is an essential element in the development of bioeconomy transformation strategies. Scenario analysis will be utilized for analysing the risks associated with different scenarios, evaluating the combined effects of different variables and criteria, and assisting the decision-makers regarding the different scenarios.
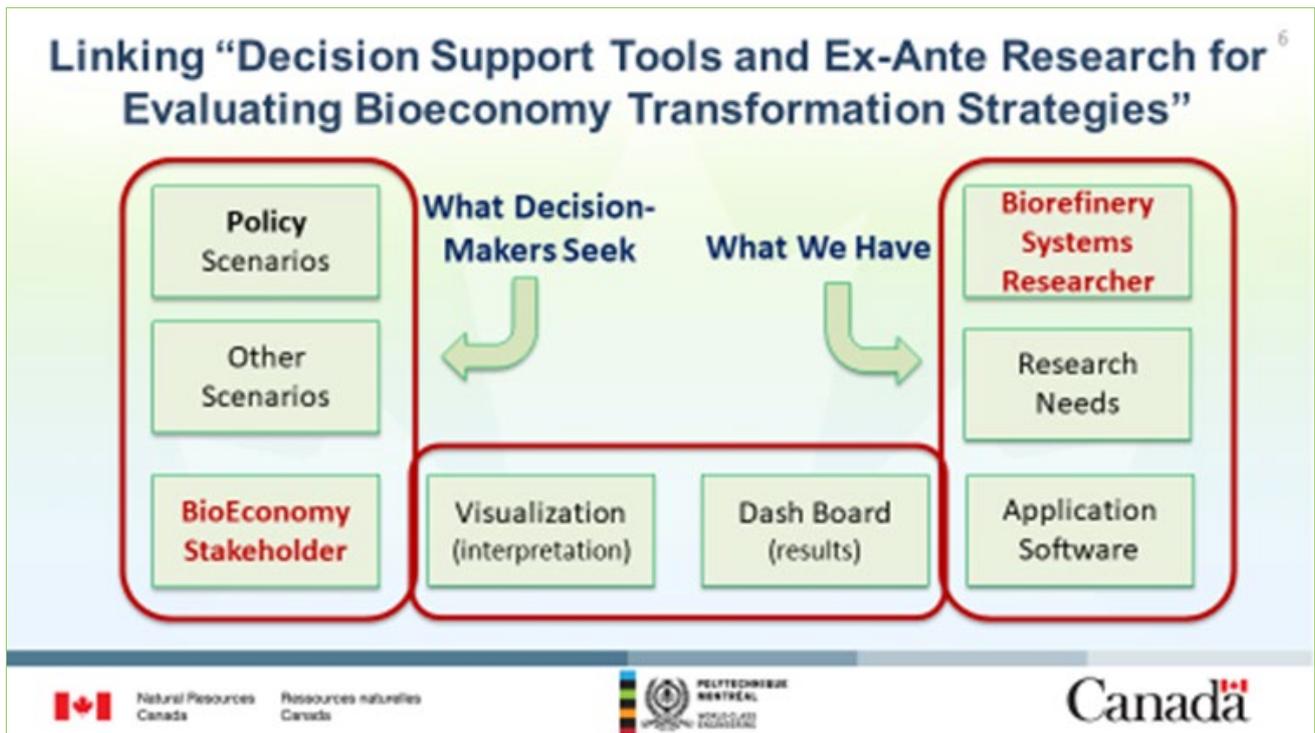

Figure 1. Illustration of the interaction between policy decision makers and biorefinery transformation strategies.

Systems analyses must be presented visually, in an interpretive manner, so that decision-makers can use the information to support their strategic,

tactical and operational decisions, hence the importance placed on DSS.

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IETS, Industrial Energy-Related Technologies and Systems

About IETS

The IEA TCP on Industrial Energy-Related Technologies and Systems (IETS), founded in 2005, is dealing with new industrial energy technologies and systems.

The mission of IETS is to foster international cooperation among OECD and non-OECD countries for accelerated research and technology development of industrial energy-related technologies and systems. In doing so, IETS seeks to enhance knowledge and facilitate deployment of cost-effective new industrial technologies and system layouts that enable increased productivity and better product quality while improving energy efficiency and sustainability.

Through its activities, IETS will increase awareness of technology and energy efficiency opportunities in industry, contribute to synergy between different systems and technologies, and enhance international cooperation related to sustainable development.

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