


The economics of biorefining – a collaborative approach

- Multiscale modelling within business and environmental environments
- Bioresource knowledge and data system targeted for downstream conversions (BioTARG)
- Value chain analysis platform for biorefining processes

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Close collaboration with the University of Surrey for three IAA-funded projects has enabled Bio-Sep Limited (BSL) to test the economic feasibility of its bioseparation process, which allows the production of high-value chemicals from biomass.

Driven by concern for the environment, there is an ever-increasing focus worldwide on the possibilities of cheaper chemical intermediates from 'green', carbon-friendly products, with the global biomaterials market currently worth an estimated $64.7 billion. An SME operating in this market, BSL has developed and patented an innovative process to extract a variety of valuable chemicals from woody and other lignocellulosic biomass for use across the food, pharmaceutical, cosmetic, textile and energy industries.

In order to check that this technology was economically viable, the company realised they needed a tool to enable a value chain evaluation, and approached the University of Surrey because of its renowned expertise in process modelling.

In an initial collaborative IAA project, the team from Surrey's Centre for Process and Information Systems Engineering (PRISE) successfully built a technology process model using data provided by BSL together with a value chain model (VCM), and performed a techno-economic assessment using feedstock (sitka spruce), geographical, transport and energy data from Scotland to validate the model. This led to two further projects, also co-funded by the IAA, which have drawn on academic expertise within Surrey's Department of Chemical and Process Engineering and its Centre for Environmental Strategy (CES).

The second project looked at the creation of a dynamic database which would give the user access to up-to-date information on feedstock availability, prices, product demand and other factors in order to help their decision-making process. Headed up by Professor Richard Murphy of Surrey's CES, this project – known as BioTARG – involved building into the original model data gathered from across the world on different types of lignocellulosic feedstocks and different types of outlets.

The third project arose from a realisation that the model developed in the first IAA project – although sound – needed to be capable of automatically integrating the data amassed during the BioTARG project. At the same time it was felt that the original VCM would benefit from some improvement to make it less complicated to operate. With these goals in mind, the project team has improved the operator interface to make it more user-friendly.

"This will enhance the usability of the model, both for BSL and in a wider sense for consultancies looking at opportunities to do biorefining for all


different types of feedstock," explains BSL director Geoffrey Drage. "The overall concept is much wider than the original one we were looking at, and has much greater impact."

The IAA route has been a successful one for BSL. Geoffrey comments: "As a small SME we were not in a position to be able to employ a consultancy, so the IAA route has been an excellent opportunity for us. The funding has enabled us to access the modelling skills of experts in this field, while for the University it has enabled researchers to use their skills to build something that could have wide application.

"The key for us has been to insist right from the beginning that we visit the Surrey campus every couple of weeks or so to see the team, understand what's going on and address any problems that arise. While this has meant devoting considerable time to the projects, it has resulted in an outcome that meets the needs of our business."

BSL director Kenneth Day adds: "The shape and size of IAA projects (lasting six to ten months on average) is relatively easy for a business like us to run with. Rather than having a complex bureaucratic process, all decisions have been taken within the four walls of the campus, which has enabled us to move reasonably quickly. In the future we have every reason to stay engaged with the University of Surrey."

It has also been a successful experience for the University. Lead researcher at Surrey, Professor Franjo Cecelja, says: "I've been impressed with the level of involvement Bio-Sep has taken on throughout the projects. The partnership has worked very well – and continues to do so – because of clear expectations, detailed planning and a flexible approach that has allowed us to modify our plans as we've gone along."

Having proven the underlying technology through the collaboration with BSL, the University team is now actively investigating commercialisation of the model with different industries.

Lignocellulosic biomass is a generic term for dry matter from plants. It can be broadly classified into virgin biomass (e.g. trees, bushes and grass), waste biomass (e.g. agricultural and forestry by-products and waste) and crops grown specifically to serve as a raw material for the production of biofuels or chemicals.