

ABC Project

ASSESSING BIOMASS to CHEMICALS

A Systems Platform for Substituting and Integrating Renewable Materials and Chemicals Manufacturing, with Applications in North East and elsewhere in the UK



BACKGROUND

The emerging market opportunity for products with a sustainable pedigree is leading to the chemical industry asking if they can produce all or a proportion of their products from renewable raw materials. In order to help decision making in this regard NEPIC, the NE Process Industry Cluster, assembled a group of chemical producers, research universities, renewable feedstock suppliers, resource efficiency experts and engineering contractors with interests in developing a tool to make possible the rapid optimized assessment of investment requirements. The objective was to allow quick identification of realistic processing options – and to understand the optimum routes for turning a specific raw material into a particular end product. The challenge for the team was to develop realistic processes which could be used now to make the required products, to understand how to support decision making by the industrial partners, to develop a tool to provide this information based on chemical engineering data and then to develop an optimisation system which would allow the comparison of all the possible routes. They were also hoping to include the capability to establish Carbon Dioxide emissions from the processes for later Footprinting calculations.

INDUSTRY ACADEMIA PARTNERSHIP

The project had a strong focus from the start with the industrial partners setting the list of target substances which were to be used as the test for the system. The focus was very much on platform chemicals not fine and speciality ones, as these operate in a different less cost sensitive market. The partners wanted to know if significant volumes might be made

economically to offer alternatives to existing production, or to be used to add a significant “green “ portion to an existing fossil based process.

The industrial partners involved were;

- Invista
- Growhow
- Akzo Nobel
- Jacobs Engineering
- Graphite Resources
- Link2Energy

To carry out the research needed to build the bio based chemical processes and to develop the tools the resources of Surrey University Dept of Chemical & Process Engineering, Newcastle University and Teesside University have been pulled together with NEPIC’s own specialist. Surrey focused on building the system to integrate the chemical flow sheets for the production processes developed by NEPIC, Teesside & Newcastle

Tackling the problem

The partners wanted to examine a range of platform chemicals which they had particular interests in. This meant that the project had the challenge of devising potential practicable large scale production processes which would work to produce the specific products.

Whilst the work was able to get this far, the challenge of optimizing for all routes to all products was never going to be possible, so this activity was deliberately restricted to a single test case.

Seven common, commercial, chemicals of particular interest to the partner grouping were chosen for use in benchmarking and testing of the emerging procedures;

- Acetone
- Propylene glycol
- Butanol
- Ethylene
- Ammonia
- Methanol
- Ethanol

These are all produced in large volumes from crude oil but smaller volumes from Biobased feedstocks are of interest in establishing the market for renewable raw material based products

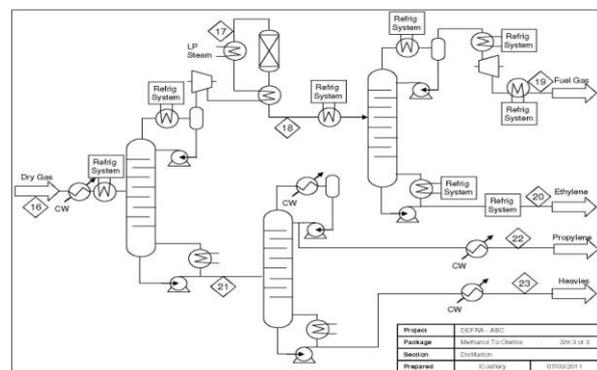
Feedstocks Options

The project team had also to focus in, on the most suitable feedstock options at an early stage. There are different types of Biomass which could be used and information was limited as the processes are often in the early stages of development. An overriding principle which emerged was to ensure no conflict with the food chain. Availability and cost base were taken into account, and the representative feedstock options for detailed study emerged as:

- Woody Biomass
- MSW and Wood waste
- On purpose crops

Process Routing Options

In all, nineteen processing stages were identified as being involved in the possible routing options from the three bio feedstocks selected to the seven target chemicals. It was necessary then to identify all of these intermediate stages in considerable depth as a basis for mounting knowledge on the evaluation platform for assessing the best overall possibilities. This work was a major research effort and the considerable project achievement here provides new and important information in the form of;



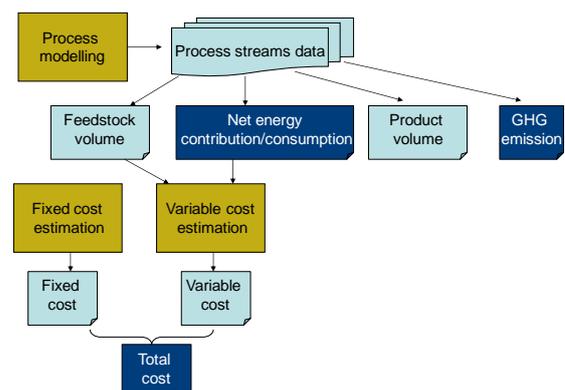
- Process Flowsheet definitions of manufacturing routes
- Equipment Specifications for all major plant items
- Heat and Mass Balances across the identified processes , indicating raw materials quantities, product rates, energy needs, by-products arising, etc
- Emissions data, including CO₂

The industrial partners were very pleased with this output alone.

Assessment Approach

Working together the partners were able to develop a list of evaluation criteria which would be used by the evaluation platform (e.g. pay-back periods; staff levels and cost; plant operating costs; emissions costs; etc). A key decision was to go for two modes of operation:

- Simulation mode for examination of individual routes
- Optimisation mode for identifying preferences within complex manufacturing systems

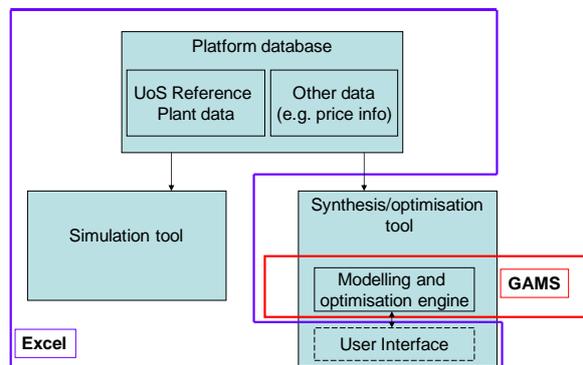


Platform Development and Testing

Led by Surrey University, the evaluation platform involved a number of novel approaches including;

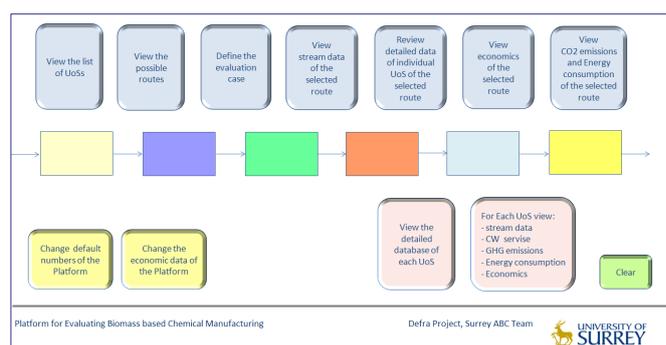
- Concept of Unit of Synthesis for process modelling
- Development of a Costing Methodology
- Methodologies for Process Synthesis and Optimisation

As well as the practical design & construction of a modelling platform to simulate and optimise process routes.



Summary & Outputs

The tool produced was tested by the industrial partners and provides a configurable way of comparing bio based processes as was the aim initially.



The production of flow sheets of a number of basic bio based processes was a major success, and the team was able to demonstrate the effective use of an optimisation tool to look at route selection. It did appear that bio based routes were significantly more expensive than fossil based equivalents – this confirms the opinions of many – but this situation will change as newer routes are identified including ones using Industrial Biotechnology.

Industrial interest was maintained throughout and the package of process data and the tool is now with the partners. The next step is to look for opportunities for presenting the package to potential users and integrating it with Carbon modelling tools such as C Calc. Surrey University and NEPIC are taking on developing opportunities for the tool.

Further Details

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