Biorefinery Challenge

The company, Biomassa Ltd, has received backing of £500 million from venture capitalists (individuals who invests in new and innovative companies to make a large return on investment) to build a biorefinery in Scotland. You've been tasked to tender for the contract to build the biorefinery. To do this you need to produce a design for the biorefinery specifying the biomass that you will use and products you will generate. Biomassa has asked the Technology Strategy Board, the National Non Food Crops Centre and Scottish Enterprise, to select the best biorefinery design for the company at the EFIB event on the week of the 18th of October 2010. Tenders must be completed by **31st September 2010** for assessment by a STEM Ambassador.

Background

A biorefinery is a place where biomass is turned into fuel, power, heat and chemicals on one site. This doesn't have to happen in one building, many specialised facilities can be joined together.. In some ways, biorefineries are analogous to oil refineries. Oil refineries take crude oil and fractionate it into many different useful parts. This is done using a simple chemical distillation. Biomass, like oil, consists of many different fractions that are separated and made into useful products in biorefineries. However, the processes involved in fractionating biomass are more complex than those used in oil refineries.

There are a number of biorefineries in the UK - several are run by British Sugar using sugar beet as their source of biomass (feedstock). The sugar beet is processed into sugar, bioethanol, heat and power, animal food, even the waste CO_2 is used to grow tomatoes. However, newer biorefineries are being built which use wheat as their feedstock. The ideal biorefinery should use a **sustainable** source of biomass and one that will not compete with the food supply chain. A generalised description of a biorefinery is shown below:

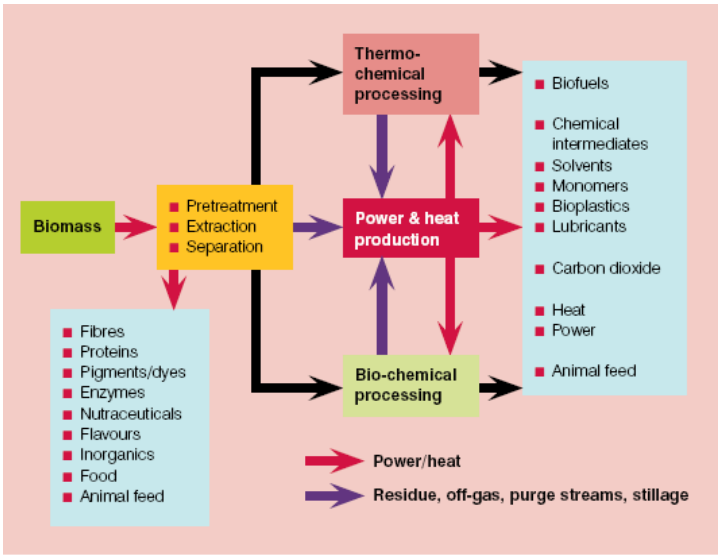

Figure 1 Schematic of a generic biorefinery complex

What is required?

The completed tender should include a description and model (2d or 3d) of the biorefinery including the selection of, with reasons

- Location
- Biomass
- Thermochemical and/or biochemical processing
- Products

And what are the benefits to the UK economy e.g. staff employed, profits.

Further supporting information can be found on: http://www.global-science.net/biorefinery-challenge.html

Glossary

Algae: are a large and diverse group of simple organisms, ranging from unicellular (microalgae) to multicellular (macroalgae) forms. They are photosynthetic, like plants, and "simple" because they lack the many distinct organs found in land plants. The smallest forms such as phytoplankton provide the food base for most marine food chains; the largest and most complex marine forms are called seaweeds.

Biochemical processing: the use of biocatalysts which might be whole cell e.g. bacteria, crude extracts or pure enzymes.

Biofuels: biofuels are a wide range of fuels which are in some way derived from biomass. The term covers solid biomass, liquid fuels and various biogases.

Biomass: is biological material derived from living, or recently living organisms, such as plants, wood, algae or food waste, that is renewable.

Bioplastics: plastics derived from renewable biomass such as vegetable oil or corn starch rather than petroleum. Some, but not all, bioplastics are designed to biodegrade.

Chemical intermediates: a building block that can be converted into a new product through a succession of subsequent steps.

Off-gas: a by-product of manufacturing, it can be rich in natural gas, which can be processed and sold as energy.

Purge stream: an inert gas is often passed through the system to remove other gases which might be harmful to the process.

Pretreatment, Extraction and Separation: these are methods used to breakdown biomass through chemical (e.g. acid or alkali treatment) or physical processes (e.g. crushing or cutting), removing the liquids such as sugars and then separating it from the solid material.

Stillage: remaining biomass material e.g. grain husks and liquid effluent.

Thermochemical processing: the use of heat to cause a chemical reaction. For instance, gasification - heating biomass with about one-third of the oxygen necessary for complete combustion - produces a mixture of carbon monoxide and hydrogen, known as syngas. Pyrolysis - heating biomass in the absence of oxygen - produces a liquid bio-oil. Both syngas and bio-oil can be used directly or can be converted to biofuels and other valuable chemicals.

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