1: Whole Crop Biorefinery

Description

The first step of whole crop biorefining of cereals is to separate the seed form the straw. The seeds (e.g. corn) may be converted to either starch or meal, and then to a wide variety of products including ethanol and bioplastics. Straw can be processed to products via ligno-cellulosic or syngas conversion processes.

Example

The French Biohub Programme – led by Roquette – aims to develop a portfolio of cereals-based platform chemicals (e.g. isosorbide) as intermediates for biopolymers and biomonomers, for speciality or commodity markets.

2: Green Biorefinery

Description

Green biomass – including grass, alfalfa, clover, immature cereals, algae – undergoes wet fractionation to separate the crop into a fibre-rich press cake, and a nutrient-rich green juice.

The green juice contains such useful chemicals as amino acids, organic acids, dyes, enzymes, hormones, minerals. The press cake can be used for fodder, fuel, fibres or as a hydrocarbon feedstock for chemicals.

Examples

The Green Biorefinery Demonstration Plant in Brandenburg (Germany) produces high valuable proteins and lactic acid from 30kt/yr of alfalfa and wild mix grass. The press cake is used for fodder.

The Austrian Green Biorefinery is based on the processing of green biomass from silage to a range of bulk and fine chemicals (lactic acid, amino acids), fibre-derived products (animal feed, boards, insulation materials, paper) and biomass CHP.

3: Lignocellulosic Feedstock Biorefinery

Description

Ligno-cellulosic feedstocks can include straw, reed, wood, paper and municipal waste. The lignin, hemicellulose and cellulose components are first separated and then processed.

Hemicellulose hydrolysis can produce pentose and furfural (nylon precursor). Cellulose conversion yields glucose, ethanol or chemical building blocks. Lignin is commonly gasified or used for fuel or adhesives.

Examples

Abengoa Bioenergy are participating in the FP6 BioSynergy project to construct a pilot plant for 70t/day of corn stover, wheat straw, grasses and wood residues in Salamanca, Spain. The main product will be ethanol, with co-products synthesised from syngas.

The Icelandic Biomass Company has an ethanol-oriented demonstration plant processing 20kt/yr.

4: Two-Platform Biorefinery

Description

The feedstock is separated into a 'sugar platform' (biochemical) and a 'syngas platform' (thermo-chemical). The whole carbohydrate feedstock is thus utilised. Both platforms can offer chemicals and fuels, including methanol, ethanol and polymers.

Example

No biorefineries of this type currently exist in Europe but sugar conversion technologies and gasification approaches, e.g. Choren's Carbo-V® process, are independently used.

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BIOPOL

European Biorefineries: Concepts, Status & Policy Implications

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BACKGROUND

The European Commission's Biomass Action Plan (2005) highlights the importance of the biorefinery concept to maximise the value derived from biomass feedstocks by making fuller use of their components. The potential for biorefineries to improve the cost-efficiency and environmental performance of biofuels is an area of much research and discussion worldwide. However, there remains some uncertainty over how biorefinery concepts can be defined and promoted, how the technologies will develop and enter the market, and the implications for agricultural and forestry policy.

PROJECT AIMS

To assess the status (technical, socio-economic, environmental, policy, and deployment) of innovative BIOrefinery concepts and the implications for agricultural and forestry POLicy.

PROJECT OUTPUTS

A scenario-based assessment of solutions that impact several key European industries;

A 'map' of biorefinery activities in Europe;

Technical models of the biorefinery concepts and component technologies;

Cost comparisons for biorefinery plants under different policy conditions;

An insight into the awareness and acceptance of biorefinery concepts among key stakeholders;

A valuable contribution to EU biomass energy and sustainable chemistry research agendas.

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Project website

http://www.biorefinery.nl/biopol

Results will be disseminated via the website, related conferences, and annual workshops.

BIOREFINERY DEFINITION

"Biorefinery is the sustainable processing of biomass into a spectrum of marketable products"
– IEA Task 42

Biorefinery: concepts; facilities; plants; processes; cluster(s) of industries.
Sustainable: maximising economics, and minimizing environmental aspects; fossil fuel and feedstock replacement.
Processing: upstream processing; transformation; fractionation; thermo-chemical and/or biochemical conversion; extraction; separation; downstream processing.
Biomass: crops; organic/forest residues; aquatic biomass.
Spectrum: more than one marketable product.
Marketable products: both intermediates and final products (i.e. fuels; power; heat; food; feed; chemicals; materials).

BIOREFINERY CONCEPTS

The biorefinery is not a single or fixed technology. Several different routes from feedstocks to products are being developed and demonstrated, and it is likely that multiple biorefinery designs will emerge commercially in the future.

The biorefinery concepts that are presented here have been identified for evaluation in the BIOPOL project. It is important to understand the differences between these and to appreciate the diversity in biorefinery technologies.

Cover picture: Brandenburg Green Biorefinery Demonstration