

Biorefinery concepts



Definition¹

A biorefinery is a facility for the synergetic processing of biomass into several marketable biobased products (food and feed ingredients, chemicals, materials, minerals, CO₂) and bioenergy (fuels, power, heat).

Many industries (pulp & paper, crop-based ethanol, vegetable oil extraction, etc.) with a long history fall within this definition of biorefineries, as do biodiesel plants. The emerging use of biomass for a variety of applications is increasingly considering the biorefinery approach.

Below are some examples of biorefineries, already established in some industrial branches as well as emerging technologies for future bio-based or bio-fuel industries.

Biorefinery examples

AGRANA runs Austria's only bioethanol fuel plant and demonstrates complete and sustainable utilisation of the used agrarian raw materials. In addition to bioethanol, protein-rich animal feed, wheat starch and highly refined CO₂ are produced.

Pannonia Ethanol produces fuel ethanol and animal feed. The facility currently utilizes corn to produce renewable ethanol, Dried Distillers Grains with Solubles (DDGS), a high protein animal feed, and corn oil, a valuable animal feed ingredient. Pannonia Ethanol produces as much animal feed as renewable ethanol.

The Borregaard plant in Sarpsborg, Norway, provides special cellulose pulp and lignin products, including vanilla flavor, from wood. As a byproduct, ethanol is produced by fermentation of the hemicellulose C6 sugars.

End products

Bioenergy

Heat
Power
Biofuels

Biobased products

Food
Feed
Chemicals
Materials

Examples of biorefinery facilities

AGRANA	Austria
feedstock	Starch crops
products	Ethanol, wheat starch, bran and gluten, feed, CO ₂
Pannonia Ethanol	Hungary
feedstock	Corn
products	Ethanol, feed (DDGS, corn oil)
Borregaard	Norway
feedstock	Wood (spruce)
products	Specialty cellulose, lignin, ethanol, vanillin, bioenergy

In the area of biodiesel production, where vegetable oil is converted to FAME (fatty acid methyl ester) and glycerin, one example is the Biodiesel Bilbao plant in Spain.

An example from the pulp & paper industry is the UPM Lappeenranta Biorefinery. It produces diesel and naphta from tall oil, which is a by-product from the adjacent pulp mill. Further products are turpentine and pitch.

Another pulp biorefinery is Pöls in Austria. The major product from the Kraft pulping process in Pöls is market pulp. Tall oil and turpentine is recovered from the black liquor, which is then combusted to generate heat and power.

The Bomaderry Plant in Australia (food industry) uses wheat flour and extracts gluten and starch. Some of the starch is converted into liquid glucose, the remaining waste starch is converted into high-grade ethanol via fermentation. Stillage residues are processed for animal feed. Products are gluten, starch, glucose, ethanol and animal feed.

Avantium is an example for the chemical industry. Furan derivatives are obtained by catalytic dehydration/etherification of carbohydrates, and used to produce biomass-based building blocks for fuels, plastics and fine chemicals. A CHP plant is integrated in the process to ensure the efficient use of solid residues (lignin, humin).

BIOWERT in Germany combines a food residues-based biogas plant with a facility processing grass silage into high quality cellulosic fibres. By-product from the fibre production is green juice, which is utilized in the biogas plant. In turn, heat, electricity and process water of the biogas plant are utilized in the fibre production process.

Further information

IEA Bioenergy Task 42 deals with biorefining in a future bioeconomy and has published several essential studies and reports on biorefineries.

<http://task42.ieabioenergy.com/>

¹Definition of biorefinery according to IEA Bioenergy Task 42.

Examples of biorefinery facilities

Biodiesel Bilbao	Spain
feedstock	Vegetable oil
products	FAME, glycerin
UPM Biofuels	Lappeenranta, Finland
feedstock	Tall oil from the adjacent pulp mill
products	Diesel, naphta, turpentine, pitch
Pöls	Austria
feedstock	Wood
products	Kraft pulp, paper, tall oil, turpentine, bark, electricity and heat
Bomaderry	Australia
feedstock	Wheat and wheat flour
products	Gluten, starch, glucose, ethanol, stock feed
Avantium	The Netherlands
feedstock	Cellulose, hemi-cellulose, starch, sucrose
products	Furan-based biofuels, monomers for polymers, chemicals, solid fuels (humin, lignin residues)
BIOWERT	Germany
feedstock	Grass
products	Cellulosic fiber, composite granulate/profiles, nutrients, biogas