TECHNOLOGIES FOR BIOREFINERIES

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Biorefineries are complex platforms for the cascade production of biofuels, bio-based products/materials and bioenergy. The main raw materials include:

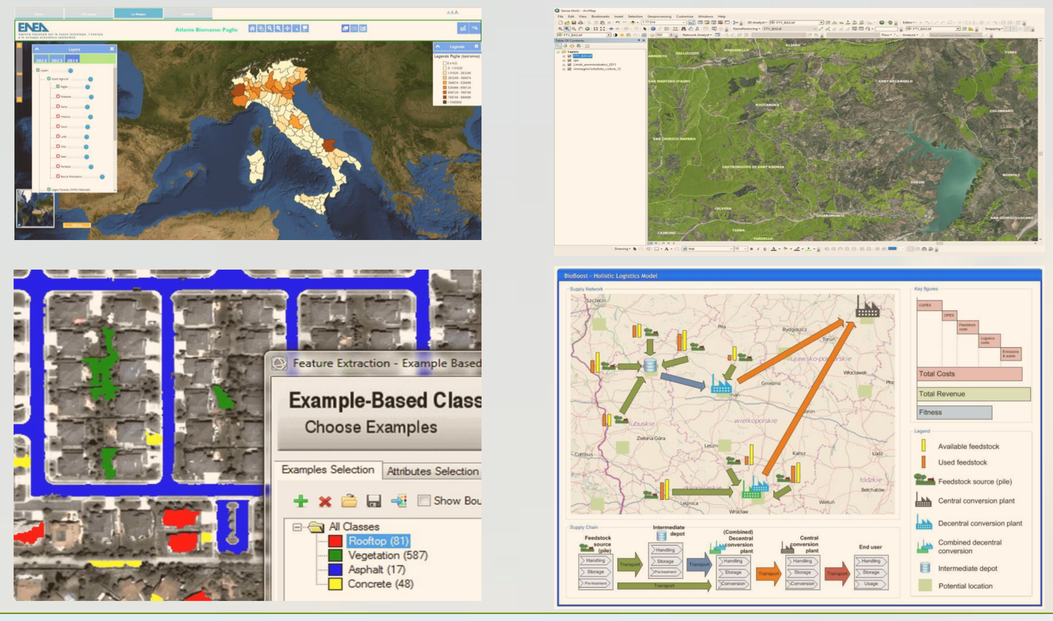
- lignocellulosics (residual type or dedicated crops);
- oil crops and residual oils;
- co-products of bioethanol and biodiesel production chains;
- by-products of food industry;

Biorefineries offer a promising pathway to a more sustainable and circular economy, where waste is minimized, and resources are used more efficiently. They can help to reduce dependence on fossil fuels, mitigate greenhouse gas emissions, create new jobs and economic opportunities, and support the development of new industries based on bio-based materials and products.

Main objective our research is to support the development of new models of integrated biorefineries through the implementation of processes and technologies for the production and conversion of major "platform" products: sugars, lignin, oils.

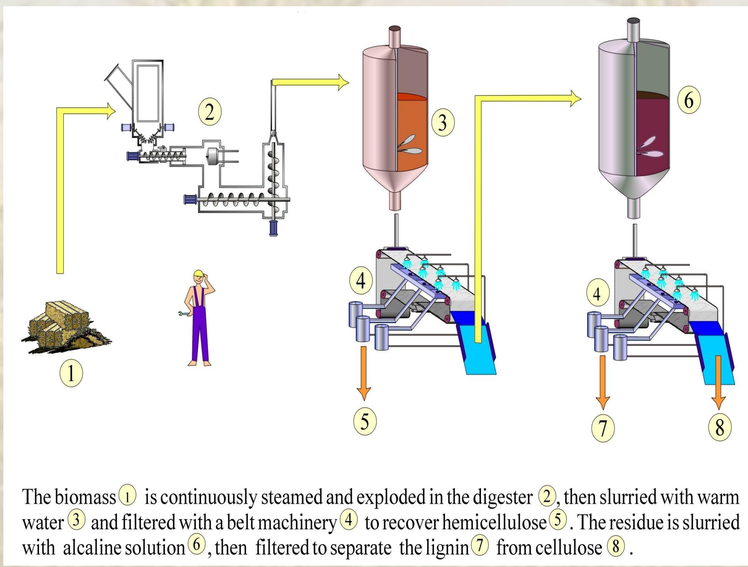
GEO Dataset and GIS Processing

- The ENEA Italian Biomass Atlas provides data and tools to assess the availability of local biomass
- Geographical Information System for forest BIOMASS MANAGEMENT
- Remote sensing for forest resources
- Software development for biomass management optimization



Biomass Pretreatment And Fractionation At Pilot Scale

Steam explosion pretreatment of biomass and **continuous fractionation** to its macro-constituents



The biomass ① is continuously steamed and exploded in the digester ②, then slurried with warm water ③ and filtered with a belt machinery ④ to recover hemicellulose ⑤. The residue is slurried with alcaline solution ⑥, then filtered to separate the lignin ⑦ from cellulose ⑧.

300 kg/h reactor

Chemical Laboratories

CHEMICAL-PHYSICAL CHARACTERIZATION OF BIOMASS – LIGNIN

- Proximate & Ultimate Analysis
- Thermogravimetric Analysis (TGA)
- Spectrophotometry (FTIR, UV-Vis, AAS, ICP-OES) and spectrometry (ICP-MS)
- Liquid and gaseous, process streams characterization (HPLC, HPIC, GC-TCD, GC-MS)
- Sample preparation
- Sampling on-site & on-line
- Analysis of metabolities

Biocomposites

Synthesis and characterization of **bio-based composites** – **Lignin →Bio-plasticizers and additives for cement; antimicrobial and antioxidant additives**.

2G sugar production

Pretreated products

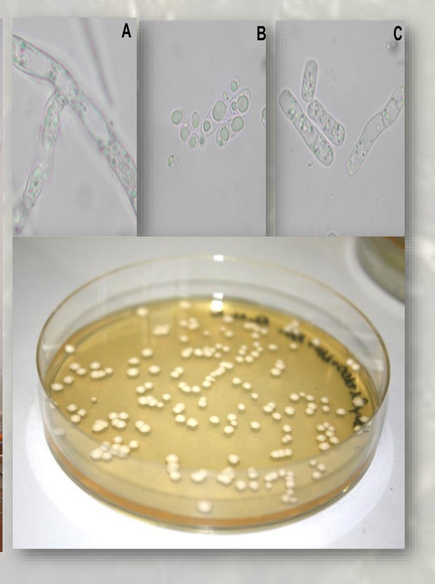
enzyme →

Concentrated sugar syrups

Lignin-rich hydrolysis cake

Biotechnological Processes

Development of biotechnological and chemical processes aimed to the transformation of biomass into **biofuels** and **bio-products**; Analysis of the scale up. Fermentation to **bioalcohols** and **bioH2**, production of **lipids by oleaginous yeasts .**



Downstream Processes

Membrane treatments: (UF and electro-dialysis)

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