



***CASTILLA-LA MANCHA BIO-ECONOMY REGION R&D BIOREFINERY
EXAMPLE OF PUBLIC INVESTMENT IN BIOECONOMY***

IRIAF

Instituto Regional de Investigación y Desarrollo
Agroalimentario y Forestal de Castilla - La Mancha



EUROPEAN UNION
Investing in Your Future

European Regional
Development Fund 2007-13



Castilla-La Mancha

IRIAF: General Information

The CLaMber R&D Biorefinery belongs to the Regional Institute for Agri-Food and Forestry Research and Development of Castilla-La Mancha (IRIAF).

The IRIAF is an autonomous body under the Regional Ministry of Agriculture, Water, and Rural Development of the Regional Government of Castilla-La Mancha. Its objective is to promote research, development, innovation, training, modernization, and the transfer of knowledge and research results aimed at the agricultural, livestock, forestry, environmental, hunting, aquaculture, and freshwater fishing sectors, as well as their processing and marketing industries. This is achieved through the promotion of technological development and the fostering of initiatives that lead to new productive orientations or adaptation to market demands and their requirements for quality and competitiveness.

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IT IS A SECOND-GENERATION DEMONSTRATIVE SCALE BIOREFINERY AT THE SERVICE OF COMPANIES TO CARRY OUT SCALING-UP EXPERIMENTS RELATED TO MATERIAL VALORIZATION OF BIOMASS TO OBTAIN BIOPRODUCTS

INTEGRAL

MODULAR

FLEXIBLE

INNOVATIVE

**1 t dry material
per day**



**FOCUS ON PROCESS OPTIMIZATION,
DEVELOPMENT OF NEW BIOPRODUCTS,
SCALE-UP EXPERIMENTS, COST
REDUCTION, ETC.**

SERVICES:

- RENTAL OF FACILITIES
- PROCUREMENT OF R&D PROJECTS
- PARTNER FOR COMPETITIVE FUNDINGS (RTO)
- TRAINING IN BIOTECHNOLOGY

Where is CLaMber R&D Biorefinery?

Location CLaMber R&D Biorefinery:

Aragonesas Industrial Estate
Calzada de Calatrava Road (CR-503)
13500 (Puertollano, Ciudad Real)

Coordinates:

38°40'43.8"N 4°03'58.7"W



19.000 m² area:

- 5130 m² urbanized
- 1700 m² constructed facilities:
 - ✓ 1400 m² equipment
 - ✓ 300 m² x 2 floors: reception, offices and lab

BIOMASS

LIGNOCELLULOSIC

Lignocellulosic crops



Herbaceous agricultural wastes



Woody agricultural wastes



SUGARED/STARCHY

Sugared crops



Starchy crops



RESIDUAL MIX

Manures



Whey



OFMSW



Grape marcs and lees



WWTP Sludges



Alperujo



Slaughterhouse wastes



High loading WW (vinasse, alpechin),

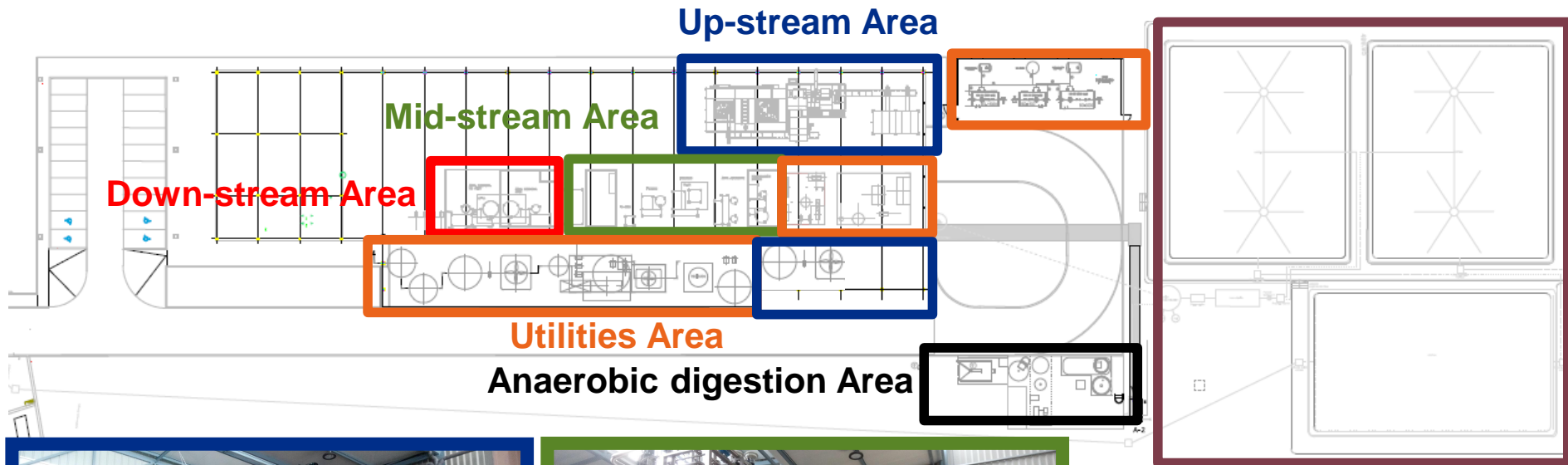


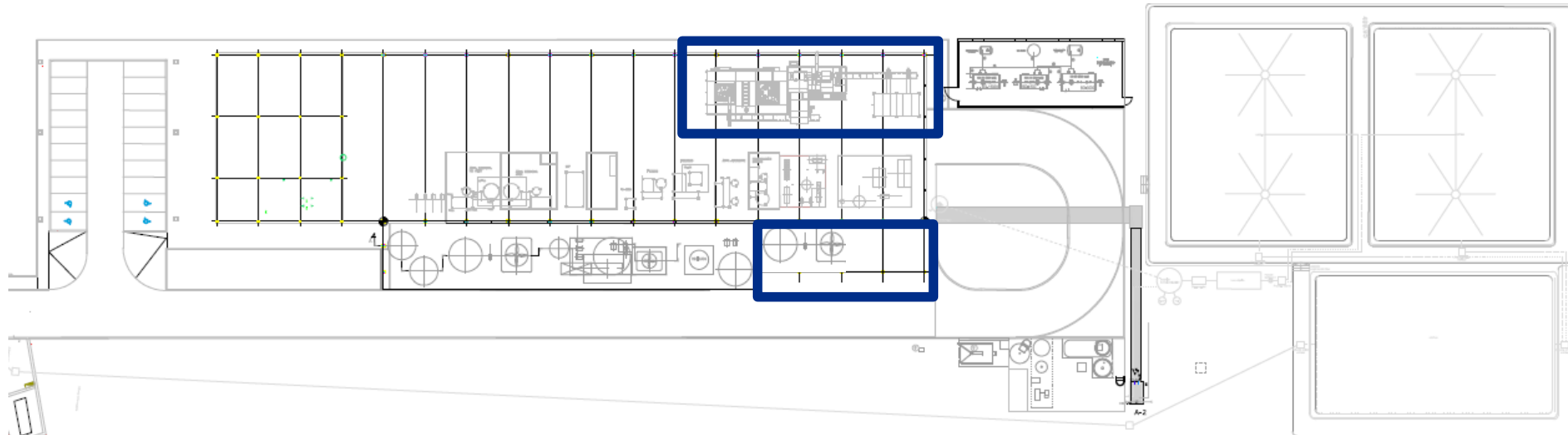
Valorization of Agrifood and Forestry byproducts:

1. Extraction of high-added-value products from Agrifood byproducts
2. 2nd Generation Biorefinery: Valorization of lignocellulosic byproducts
3. Bioplastic production from Agrifood byproducts
4. Biogas production from Agrifood byproducts
5. Agricultural bio-stimulant production from Agrifood byproducts



General distribution – Biorefinery Areas





Aim: Conditioning and pretreatment of herbaceous and woody biomass to obtain a fermentable carbon source

Equipment:

- ✓ Solid storage silos: 4 x 25 m³
- ✓ Sterile liquid storage system: Pasteurization (1 m³/h) and tanks of 10 and 30 m³.
- ✓ Herbaceous mill and woody crusher (200 kg/h)
- ✓ Extraction with water (1m³), with organic solvents (3x500 l) and with supercritical fluids (2x50 l)
- ✓ Steam cooking (3 m³)
- ✓ Steam Explosion reactor (400 l, up to 21 barg)
- ✓ Hydrolysis reactor (3m³)





Sterile conditions liquid storage
Pasteurization



Solid biomass storage silos

UP - STREAM Area





Aqueous Extraction Unit



Organic Solvents Unit



Supercritical Fluids Extraction Unit



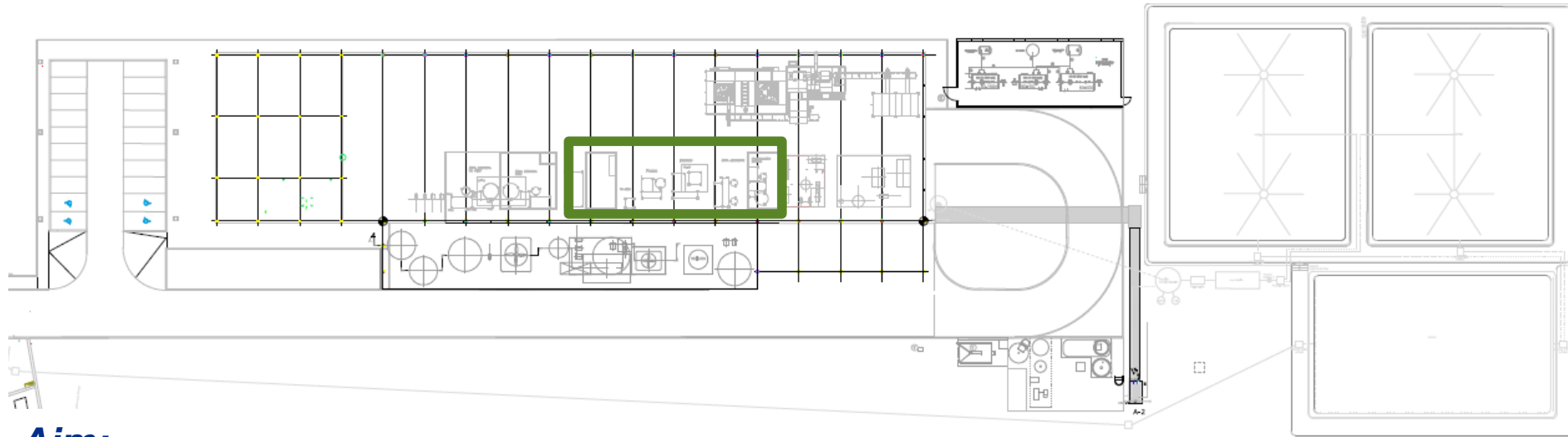
Steam Cooking and Steam Explosion reactors

Detail of Steam-Explosion reactor and Expansion vessel





Hydrolysis Unit



Aim:

Biotransformation of carbon sources into various bioproducts (bioplastics, biofuels, or building blocks)

Equipment:

- ✓ Inoculum laboratory for microorganism management (starters, inoculants, etc.)
- ✓ Fermenters: 2 x 3 l, 2 x 30 l, 1 x 300 l, 1 x 3,000 l, and 1 x 20,000 l
- ✓ Systems for sterilization, media preparation, addition of sterile substances, reagents, clean-in-place, and other auxiliary services.



MID - STREAM: Media preparation and sterile addition



Substrate preparation system



Nutrient, acid, base and anti-foam addition system

MID - STREAM: Microbiology lab: 3 and 30 L fermenters

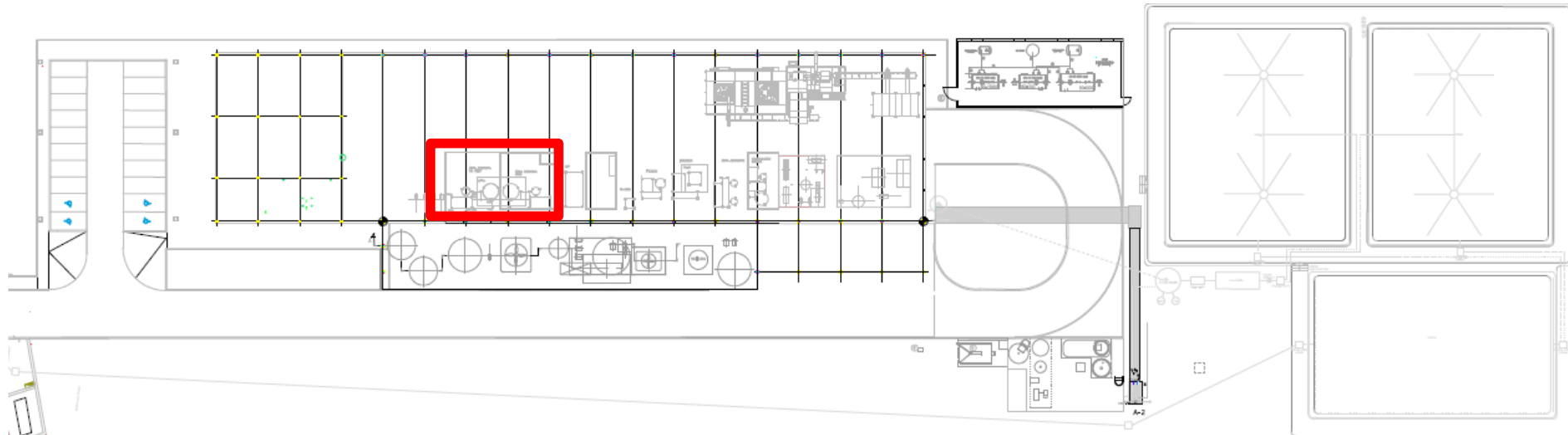


Microbiology laboratory (starters, inoculants, etc.): 3 L and 30 L fermenters

MID - STREAM: 300, 3,000 and 20,000 L fermenters



Fermentation train: 300 L, 3,000 L and 20,000 L fermenters



Aim: Purification and concentration of the fermentation product of interest

Equipment:

- ✓ Harvesting tanks: 2 x 10,000 l (1 x ATEX and 1 x no ATEX), 2 x 1,500 l (1 x ATEX and 1 x no ATEX)
- ✓ Microfiltration Unit (1 m³/h)
- ✓ Disc Stack Centrifugation Unit (1.5 m³/h) (ATEX)
- ✓ Bead Milling Unit (200 kg/h) (ATEX)
- ✓ UF/NF/RO/ High pressure RO (5 m³/h)
- ✓ Filter Press Unit (1.2 m³/h)
- ✓ Filter Basket 0.2 microns
- ✓ Rotatory Evaporator (100 l)



DOWN – STREAM Area: Harvesting tanks





No ATEX area with microfiltration and bead milling Units



ATEX area with centrifugation Unit



Equipos de concentración y purificación



NF/UF/RO/High pressure RO Unit



Rotatory Evaporator Unit



Discontinuous Evaporator for solvent recovery

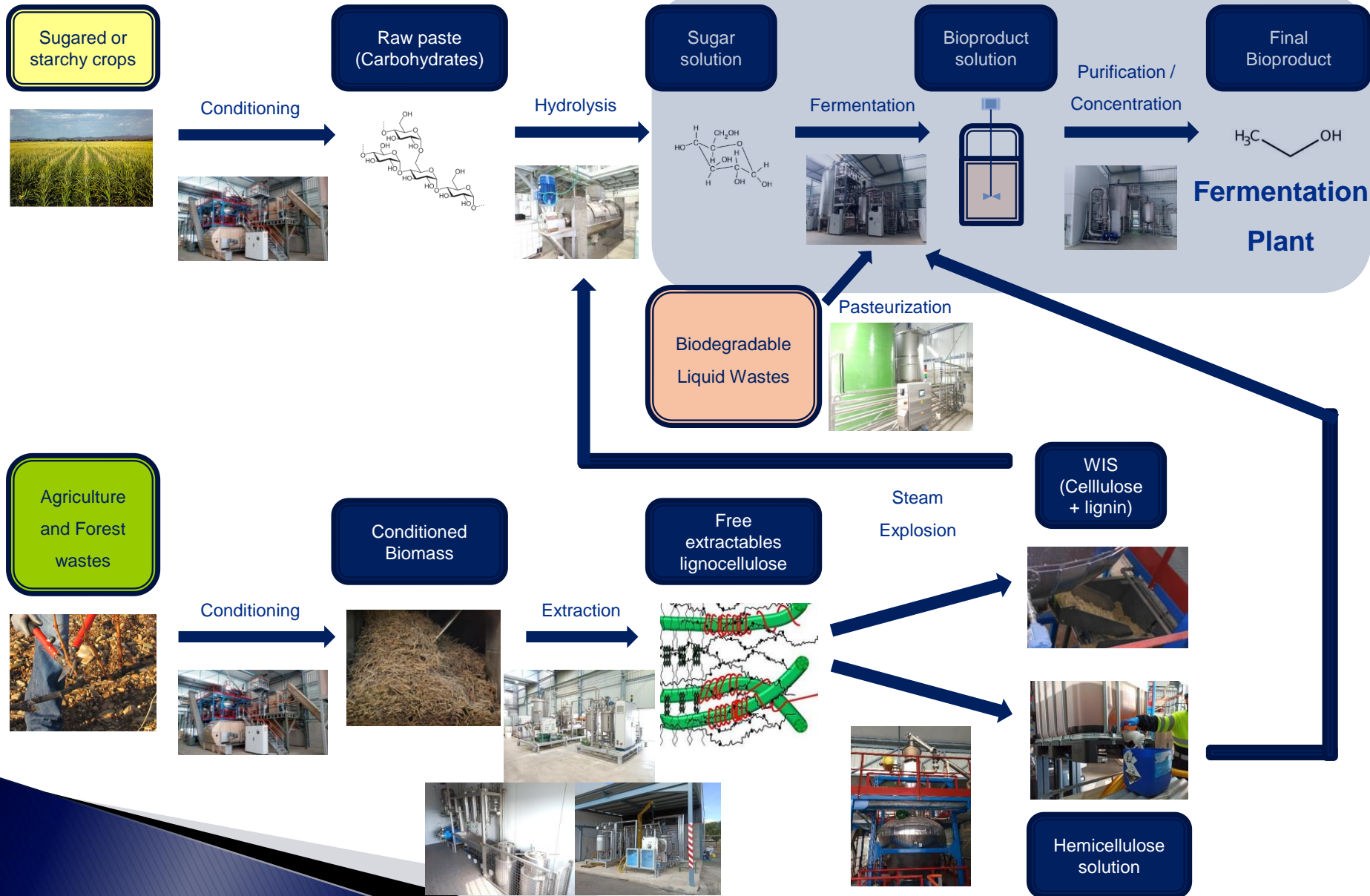


Filter Press Unit

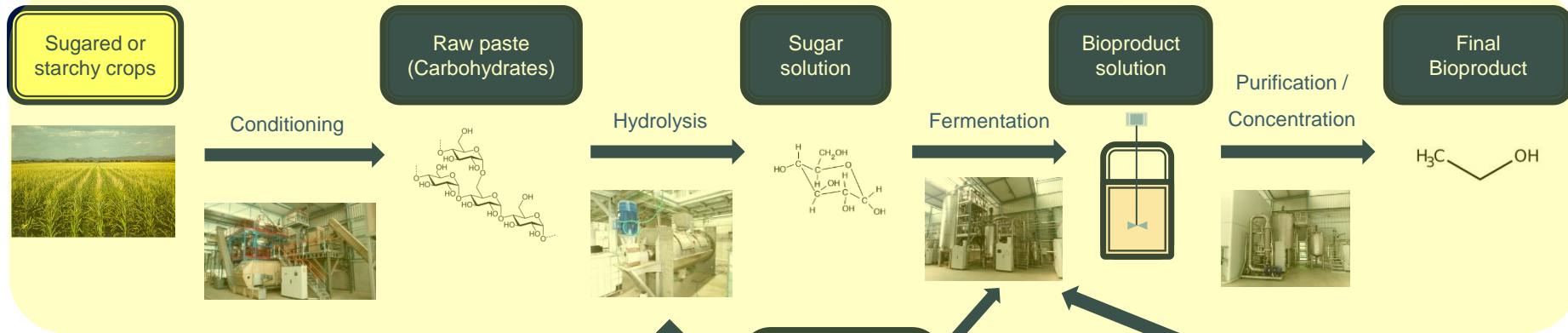


Basket Filter Unit

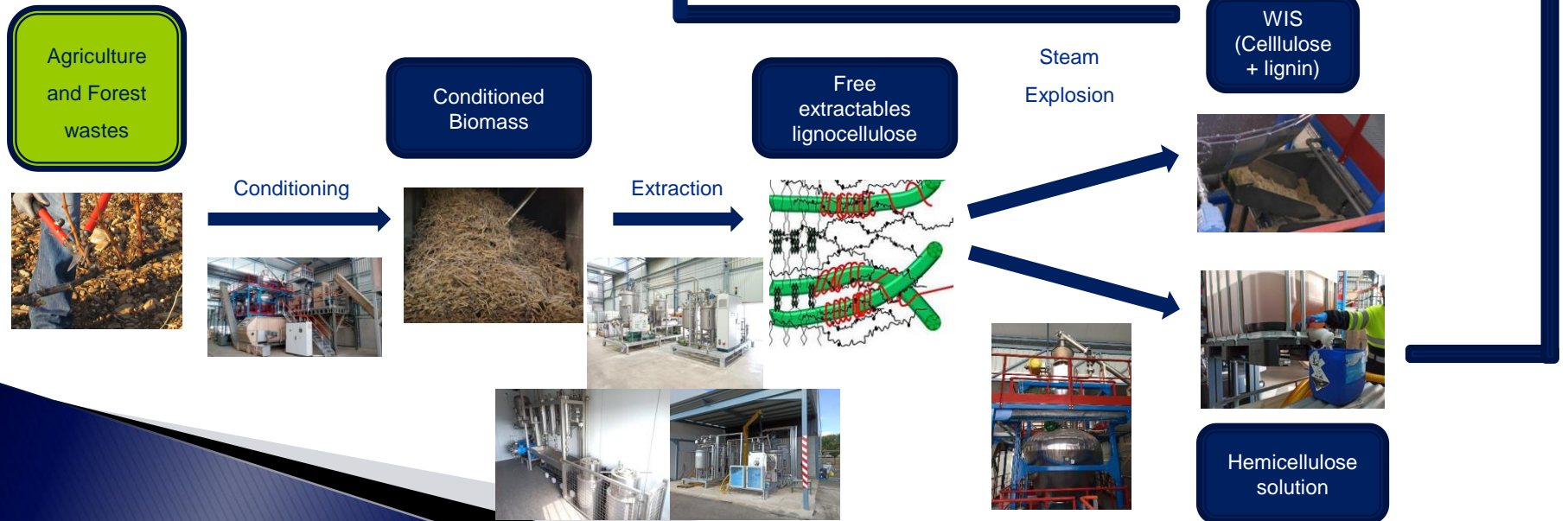
1st vs 2nd Generation Biorefinery



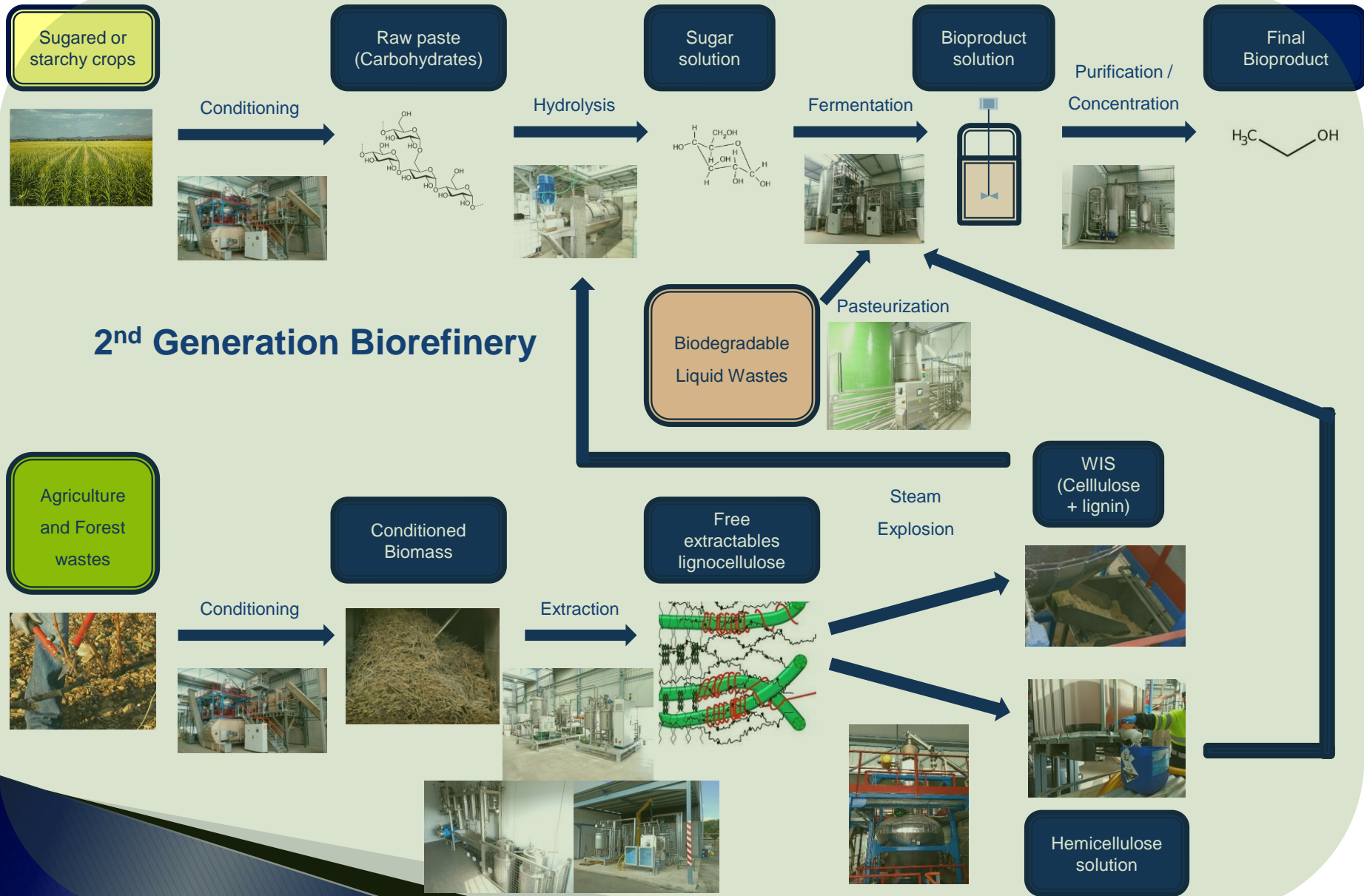
1st vs 2nd Generation Biorefinery



1st Generation Biorefinery



1st vs 2nd Generation Biorefinery



Anaerobic Digestion Unit

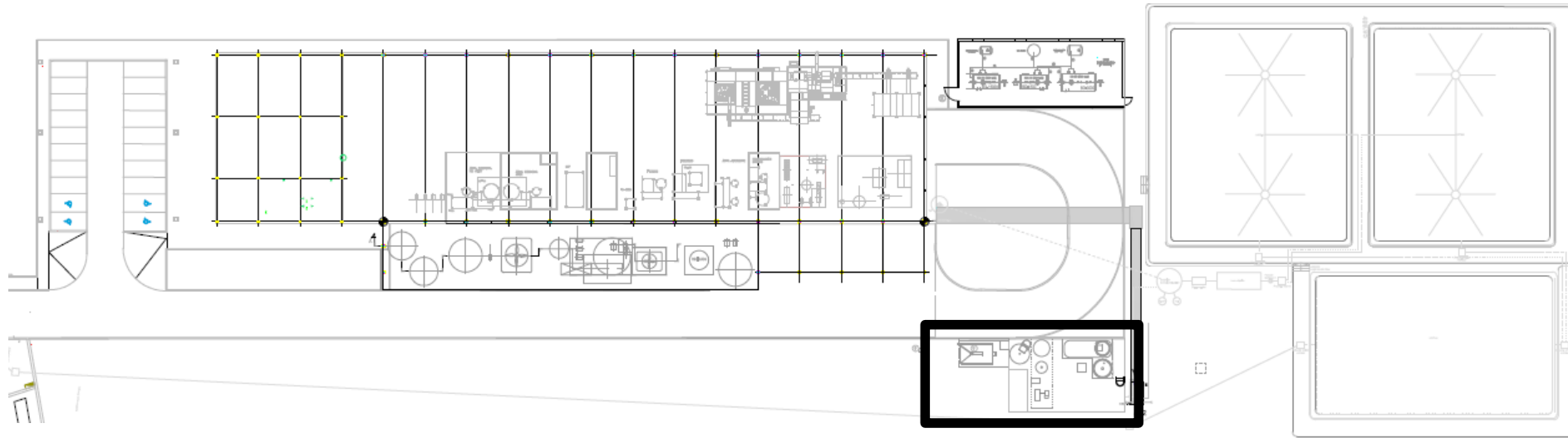


36 Discontinuous reactors (1 L) for BMP trials



9 Semicontinuous reactors (3 x 3 L + 6 x 5 L)
for lab scale anaerobic digestion trials

Anaerobic Digestion Unit



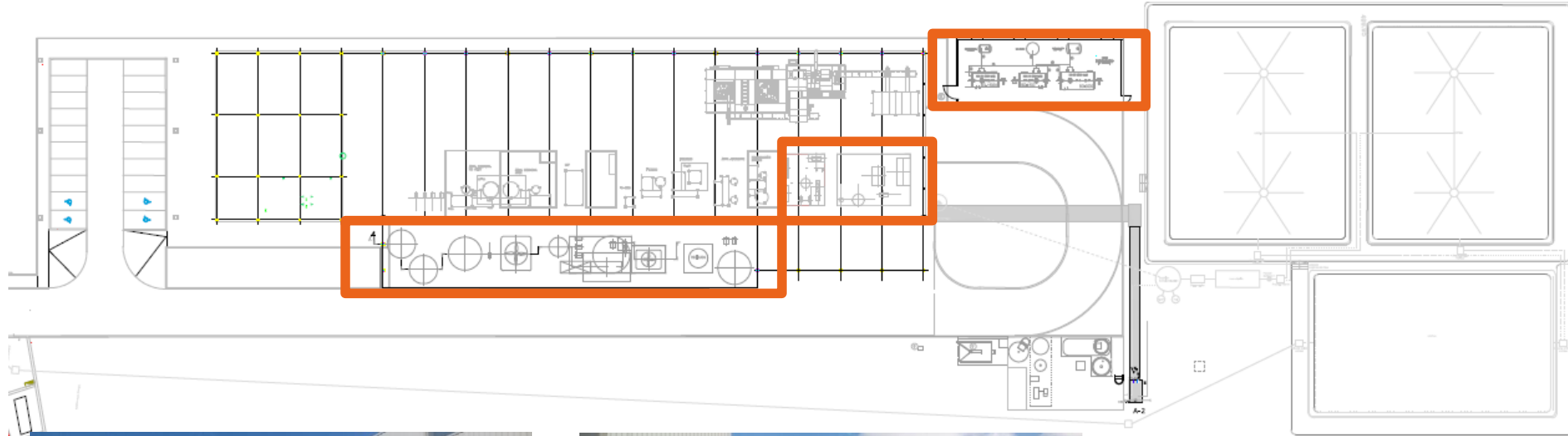
Aim: It is a modular and transportable pilot plant (400 l/d) for experiments of anaerobic digestion and codigestion of solid and liquid organic biomass to obtain biogas, VFA or biofertilizers.

Equipment:

- Liquid storage tank (20 m³)
- Solid storage hopper (10 m³)
- Pasteurization tank (1 m³)
- Homogenization Tank (3 m³)
- Digester (11 m³)
- Digestate tank (5 m³)
- Gasometer (10 m³)



Utilities Area



CONSTRUCTED WETLANDS



Through the harvesting of aquatic plants, new lignocellulosic biomass is obtained and fed into the pretreatment unit. This process recovers carbon and nutrients from a residual stream, closing the loop.



WW PRETREATMENT

Process Control Areas

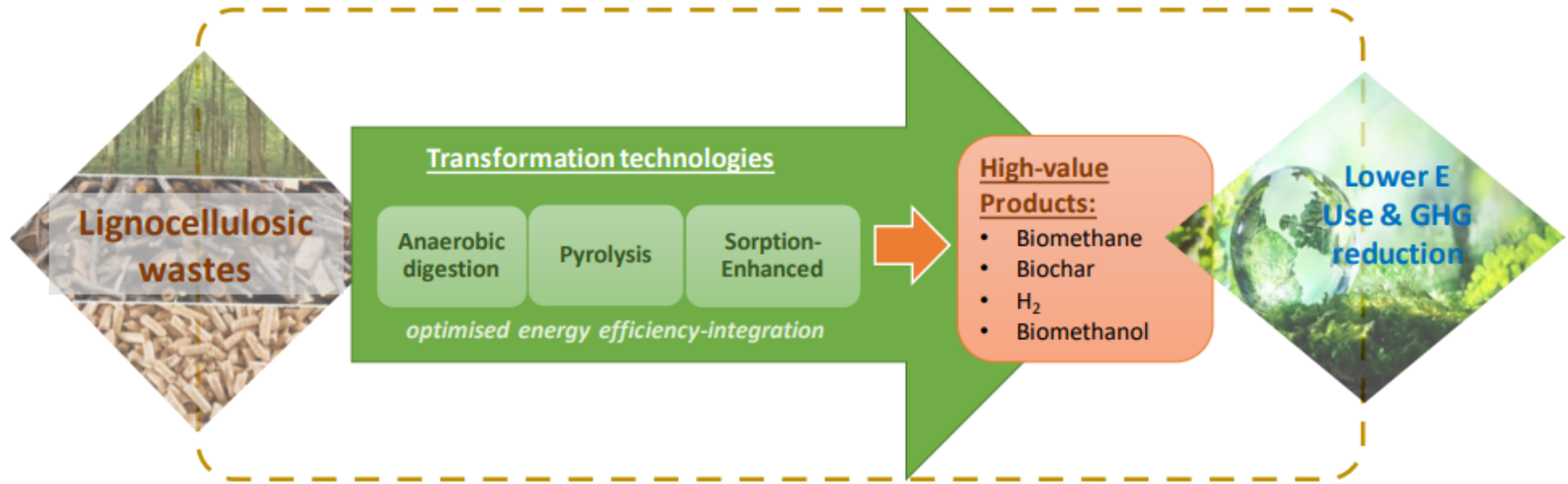


Partners



BIOPRODUCTS:

- ANTIOXIDANTS (POLYPHENOLS)
- FATTY ACIDS
- BIOFERTILIZERS
- BIOFIBRES
- RESINS
- NATURAL RUBBER
- LATEX
- CELLULOSE
- HEMICELLULOSE
- LIGNIN
- BIOPLASTICS
- PROTEINS
- PLANT BIOESTIMULANTS
(ESSENTIAL AMMINOACIDS)
- BIOETHANOL
- BIOSURFACTANTS
- BIOGAS
- BIOACTIVE COMPOUNDS
- ENZYMES
- SUGARS



1 L Reactors



3 L Reactors



Extraction



Fermentation



**Acidogenic Anaerobic
Digestion**



OFMSW



Bioplastics



50 kg of Bioplastics



20,000 L Fermenter

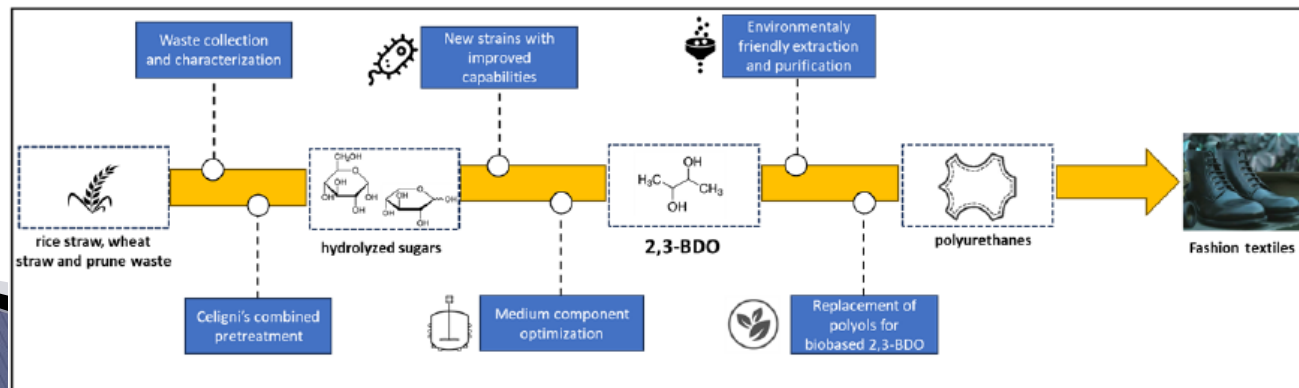
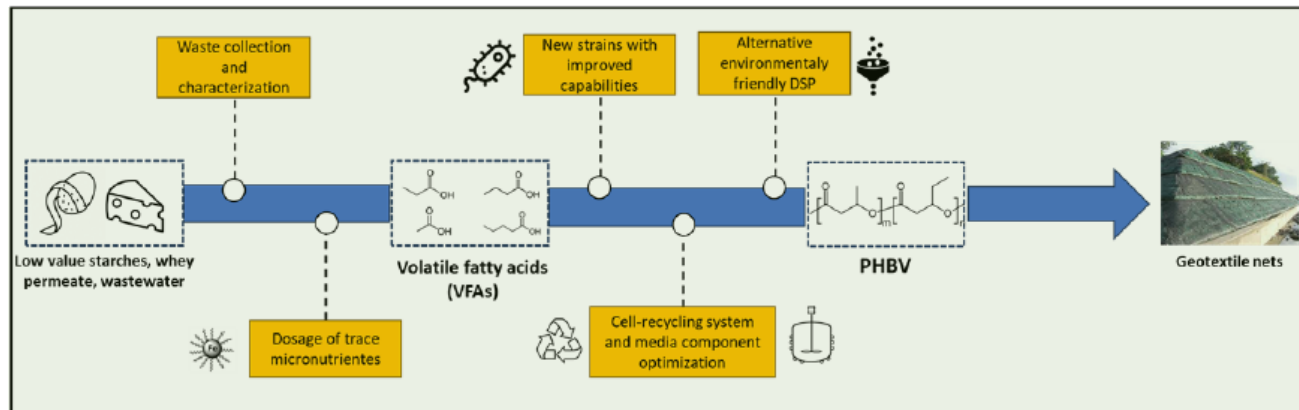
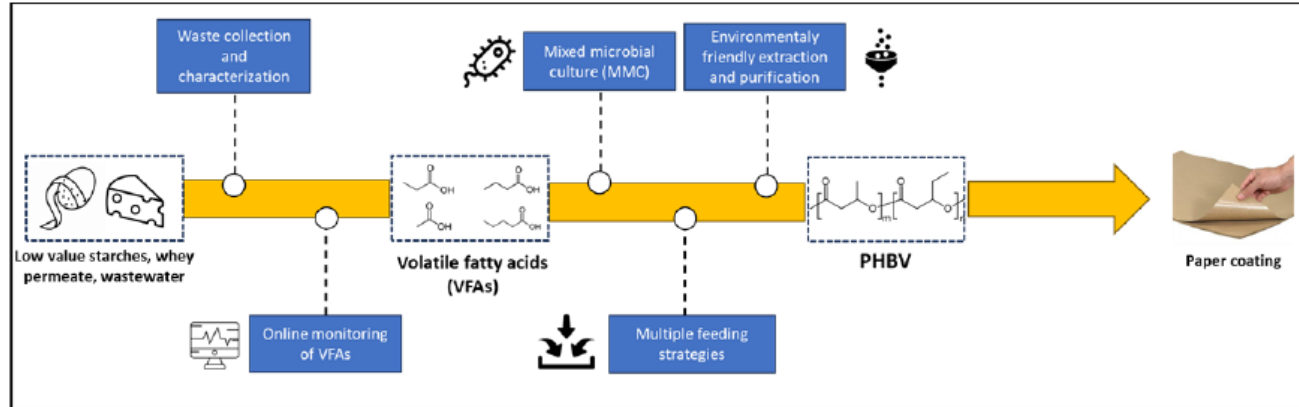


3 L Fermenters



30 L Fermenters





Marginal lands biomasses



Conditioning



Steam Explosion



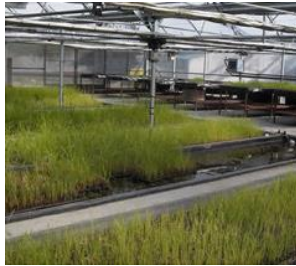
Enzymatic Hydrolysis



LIGNOCELLULOSICS
FERMENTABLES SUGARS



Aquatic plants from
Constructed Wetlands



Conditioning



Basic Hydrolysis +
Enzymatic Hydrolysis



S/L Separation



Ethanol Fermentation



BIOETHANOL



OLIVE PRUNNING



HYDROLYSIS



BIOMATERIAL



Pretreatment

Anaerobic Digestion



70 t of OFMSW



Motor



CIRCULAR BIOECONOMY



WWTP Sludge



Anaerobic Digestion



OFMSW



TH - OFMSW



Duplicate biogas production

DEMO (future)



1 L Reactors



3 L Reactors



POLYPHENOLS

- Antioxidants
- anti-inflammatory agents

RAW PISTACHIO



PISTACHIO PROCESSING



SOFT SKIN



EXTRACTION



BIOGAS

ANAEROBIC DIGESTION TRIALS



AGRONOMIC TRIALS WITH INFANTES PEPPER



BIOFERTILIZER 1



BIOFERTILIZER 2



STEAM SPLOSION



“Campo de Calatrava” Fresh Eggplant



EGGPLANTS, LEAVES AND STEMS



ORGANIC SOLVENT EXTRACTION



SUPERCRITICAL FLUIDS EXTRACTION

THE VARIETY OF FRESH EGGPLANT FROM THE CAMPO DE CALATRAVA REGION EXHIBITS HIGHER CONCENTRATIONS OF PHENOLIC COMPOUNDS AND ANTIOXIDANT ACTIVITY LEVELS COMPARED TO OTHER VARIETIES.

CHLOROGENIC ACID AND NASUNIN:

- Neuroprotective against degenerative diseases
- Protective against cardiovascular diseases
- Anti-inflammatory
- Hypoglycemic
- Reduces triglycerides and cholesterol
- Prevents septic arthritis
- Stimulating



DE LUQUE
extractos y aromas

GRAPE SEEDS



**ORGANIC SOLVENT
EXTRACTION**



POLYPHENOLS



SHELL, RIND, AND LEAVES OF THE NERPIO WALNUT



ORGANIC SOLVENT EXTRACTION



POLYPHENOLS

THE NATIVE VARIETIES OF NERPIO HAVE GREATER ANTIOXIDANT POWER THAN THE COMMERCIAL VARIETIES.

BIOREGIO

Interreg Europe

BIOREGIO boosts bio-based circular economy through transfer of expertise about best available technologies and cooperation models.

www.interregeurope.eu/bioregio

An interregional cooperation project for improving resource-efficient economy policies.

Project Partners

Lahti University of Applied Sciences (FI)
Regional Council of Päijät-Häme (FI)
Deputy Regional Ministry of Environment (ES)
Slovak University of Agriculture in Nitra (SK)
Aristotle University of Thessaloniki (EL)
Region of Central Macedonia (EL)

National Research and Development Institute for Chemistry and Petrochemistry ICECHIM, Calarasi Subsidiary (RO)
Association of the Chambers of Agriculture of the Atlantic Area (FR)

An interregional cooperation project to share expertise about circular economy models and best available technologies of biological streams between other European regions.

DEVELOPED BY THE DEPUTY REGIONAL MINISTRY OF ENVIRONMENT OF CASTILLA-LA MANCHA.

The policy instrument that Castilla-La Mancha expects to improve with this project is the ERDF Regional Operational Programme.

Environment & resource efficiency

€
1.30 M
ERDF

Jan 2017
Dec 2021



European Union
European Regional
Development Fund



THANKS FOR YOUR ATTENTION

IRIAF

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CLAMBER Project website (spanish): <http://clamber.castillalamancha.es/>

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Castilla-La Mancha