CLaMber

CASTILLA-LA MANCHA BIO-ECONOMY REGION PLANT INVESTMENT MODEL IN BIOECONOMY

IRIAF

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

MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD

EUROPEAN UNION
Investing in Your Future

European Regional Development Fund 2007-13

Castilla-La Mancha

IRIAF: General Information

The CLAMBER Project was managed and developed by the Forest, Food and Agriculture Research Institute of Castilla-La Mancha (IRIAF).

- **The aim of IRIAF:**

Foster research, development and transfer of knowledge of the Agriculture, Livestock, Forest and Environmental Industry.

- **Associated centres:**
  - ✓ IVICAM: Grapevine and Wine Research Centre
  - ✓ CIAPA: Apicultural and Agro-Environmental Research Centre
  - ✓ CIAG: Agriculture and Environmental Research Centre “El Chaparrillo”
  - ✓ CIAF: Forest and Agriculture Research Centre
  - ✓ CERSYRA: Animal Selection and Reproduction Research Centre
  - ✓ CIGAF: Livestock and Forest Research Centre “Dehesón del Encinar”
  - ✓ EVE: Station for Viticulture and Oenology
  - ✓ CLaMber R&D Biorefinery: Castilla-La Mancha Bio-Economy Region

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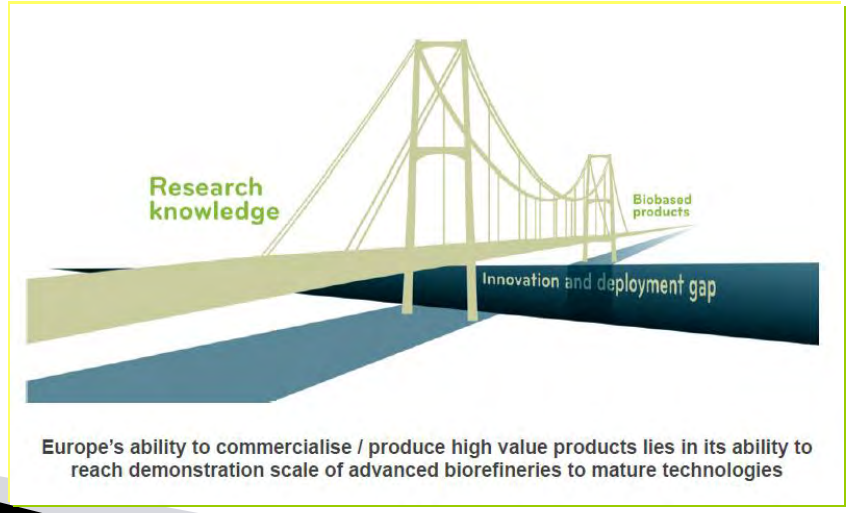
European Challenge: Demonstrative Scale

Lab scale

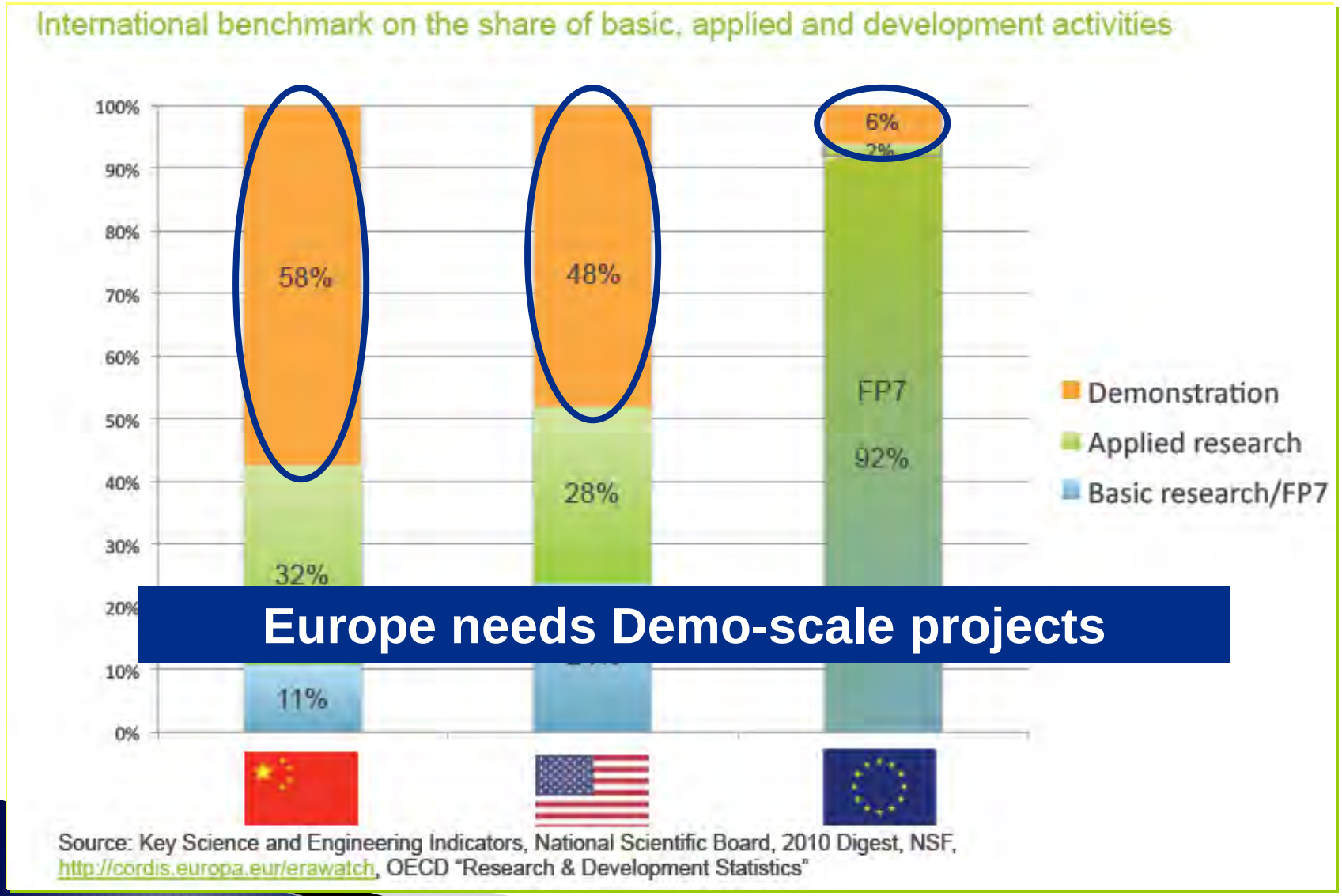
Biorefinery at demonstrative scale

Biorefinery at industrial scale



Europe's ability to commercialise / produce high value products lies in its ability to reach demonstration scale of advanced biorefineries to mature technologies

Statistics about R&D



CLaMber Project Funding

Castilla-La Mancha CLaMber

PLACING CASTILLA-LA MANCHA IN THE CENTER OF THE NEW EUROPEAN STRATEGY FOR BIOECONOMY

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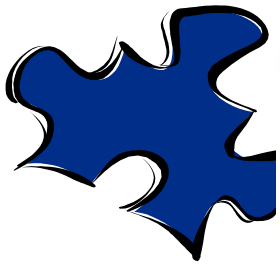
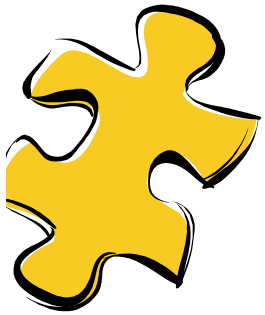
4 M€



CLaMber



16 M€

20 M€

CLaMber Project Target

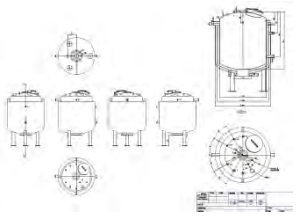
PLACING CASTILLA-LA MANCHA IN THE CENTER OF THE NEW EUROPEAN STRATEGY FOR BIOECONOMY

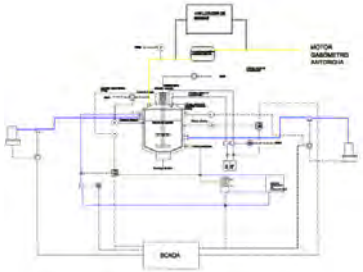
Specific objectives:

- **Create a technologically advanced biorefinery pilot plant that allows the research on production of innovative bioproducts.**
- **Create a technology hub in the region to enable synergies with both companies producing biomass and bioproducts users and encourage the creation and exploitation of new market niches.**
- **Revitalize the local economy and reverse the negative demographics that characterizes rural areas.**
- **Create a efficient public-private cooperation system in order to increase scientific and technological progress and to stimulate European and international research initiatives.**

First action involved in the CLaMber Project

CONSTRUCTION OF A DEMONSTRATION SCALE BIOREFINERY





INTEGRAL | **MODULAR** | **FLEXIBLE** | **INNOVATIVE**

1 t dry material per day

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

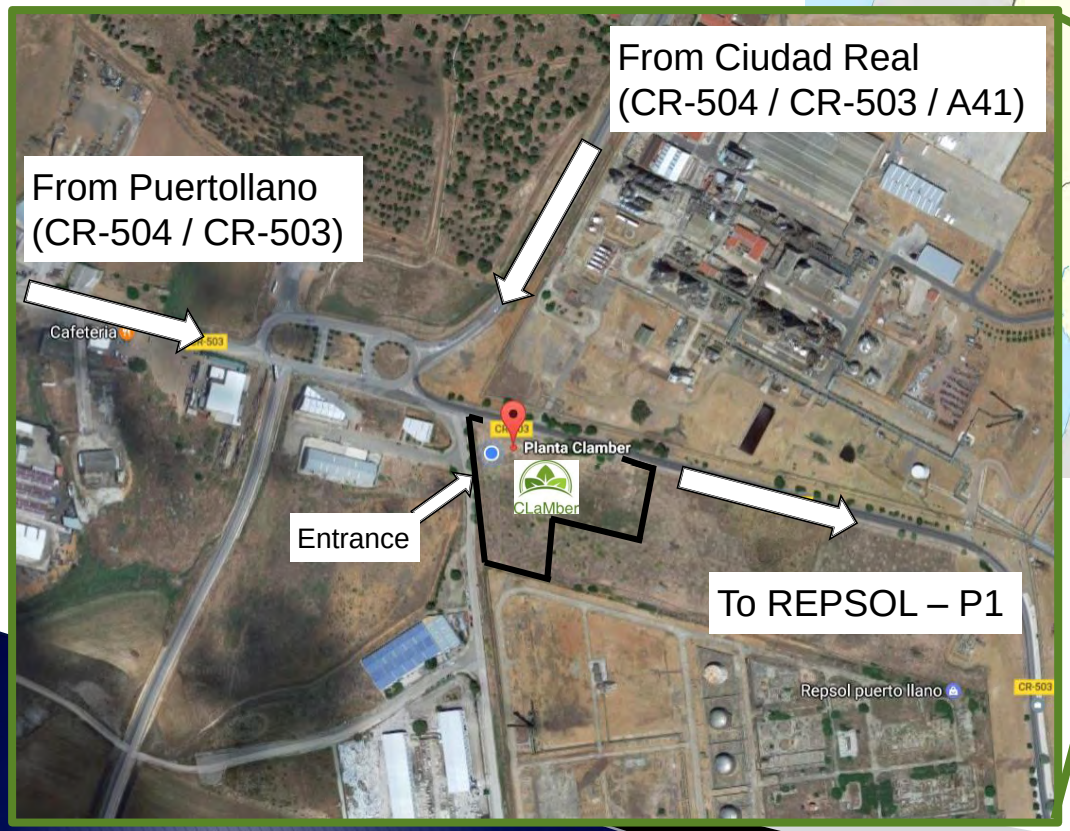
Where is CLaMber R&D Biorefinery?

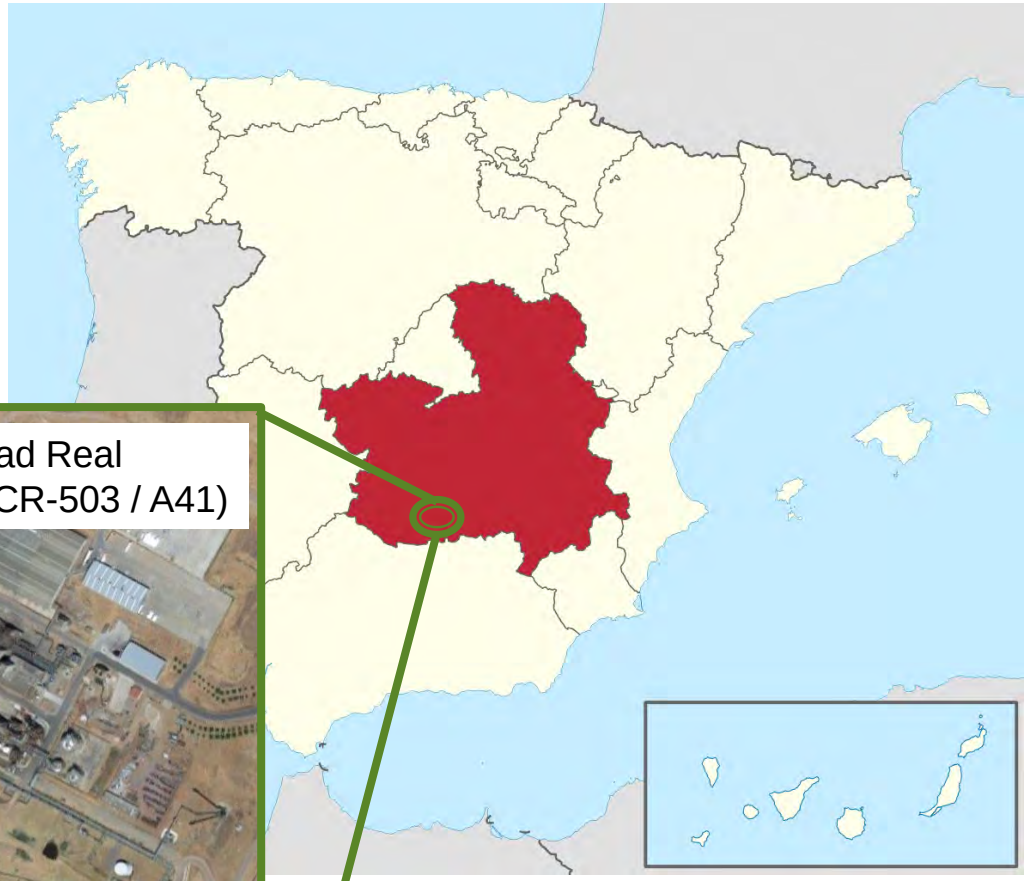
- **Location CLaMber R&D Biorefinery:**

  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 availability in Castilla-La Mancha

WASTE BIOMASS AVAILABLE FOR ENERGY RECOVERY

BIOMASS			t/year
AGRICULTURAL	HERBACEOUS	Cereal straw	649.939
		Stem and cob corn	221.908
		Waste of sunflower fields	258.473
		Subtotal	**1.130.320**
	WOODY	Vine pruning	621.437
		Olive pruning	354.982
		Fruit pruning	60.172
		Vine grubbing up	109.807
		Subtotal	**1.146.398**
FOREST		Firewoods, branches, etc.	121.416
		Subtotal	121.416
WOOD INDUSTRY		Sawmill	66.895,50
		Boards	3.524,60
		Construction	115.945,59
		Containers	8.961,50
		Others and bobber	2.628,80
		Furniture	49.973,20
		Subtotal	**247.929,19**
FOOD AND AGRICULTURAL INDUSTRY		Brewers	25.000
		Grape pomace	105.000
		Olive pomace	38.000
		Subtotal	**168.000**
TOTAL			**2.814.063,19**

Biomass availability in Castilla-La Mancha

Castilla-La Mancha CLaMber

WASTE BIOMASS AVAILABLE FOR DIGESTION

WASTE	t/year
Pig manure	1.545.616
Cow manure	890.133
Poultry manure	618.835
Other species manure	1.043.121
Slaughterhouse raw material	81.293
Poultry Slaughterhouse raw material	14.829
Housing raw material	27.876
Meat and bone meal	0
WWTP sludge – meat	15.799
WWTP sludge – dairy	10.989
Whey	478.598
Dairy raw material	1.190
Fish raw material	27
WWTP sludge – fish	22
Surplus vegetables	4.146
Surplus citrics	0
Surplus fruit	56
Nonconforming vegetables	83.336
Nonconforming tubers	4.768
Nonconforming citrics	0

WASTE	t/year
Nonconforming fruits	1.325
Vegetable transformation	28.471
Tuber transformation	379
Citric transformation	0
Fruit transformation	1.078
Brewer	97.290
Alperujo 2Phases	235.240
Alpechín 3Phases	52.038
Vine raw material	414.180
Cider raw material	0
Sugar raw material	77.091
Cereal straw	3.447.943
Sludges IWWTP – Vegetable Transf.	3.734
Energetic crops	5.660
Glycerin	23.780
Raw material DDGS (bioethanol)	16.130
Raw material beet pulp (bioethanol)	0
Wholesale	34.281
Bars and Restaurants	26.870
Hotels	2.098

TOTAL: 9.288.222 t/year

CLaMber Biomass

BIOMASS

LIGNOCELLULOSIC

Lignocellulosic crops

Herbaceous agricultural wastes

Woody agricultural wastes

SUGARED/STARCHY

Sugared crops

Starchy crops

RESIDUAL MIX

Manures

OFMSW

WWTP Sludges

Slaughterhouse wastes

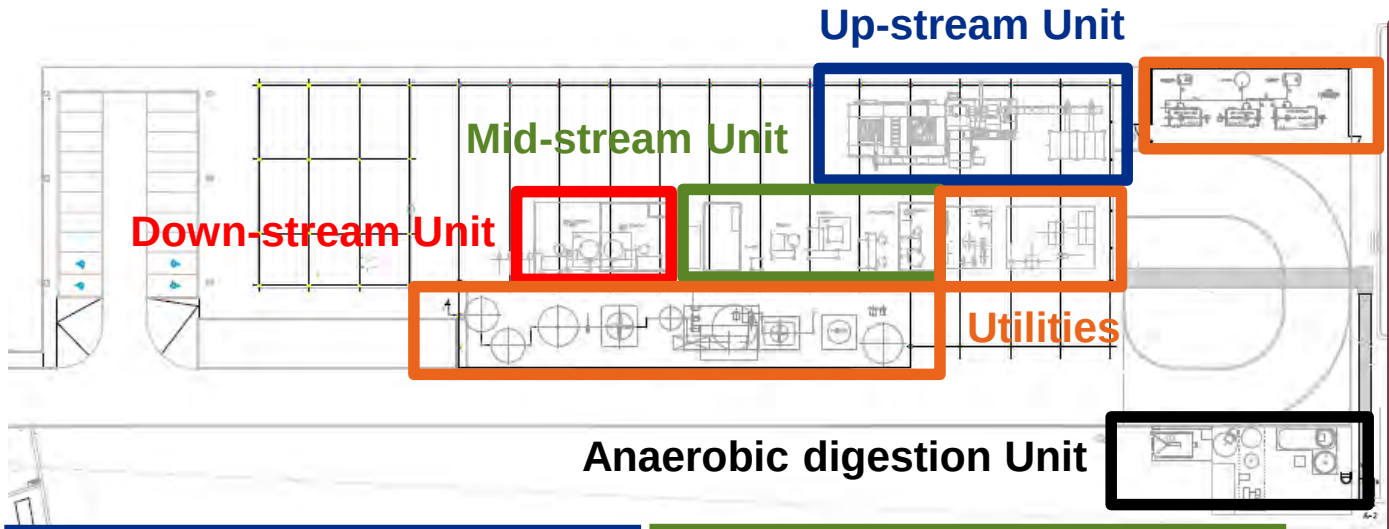
Whey

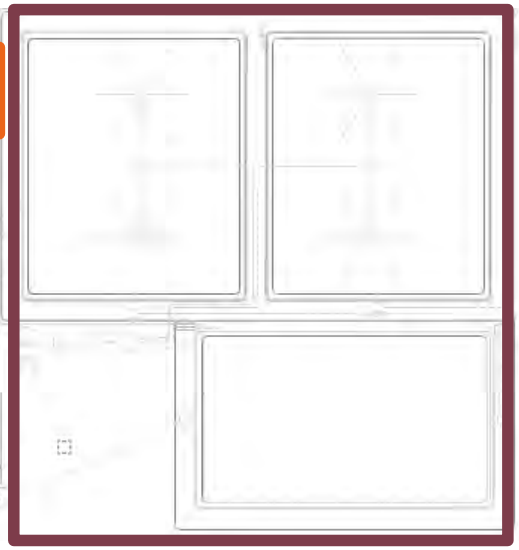
Grape marcs and lees

Alperujo

High loading WW (vinasse, alpechin),

General distribution – Biorefinery Units





Waste Management Unit

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UP-STREAM

- ***Objective:*** Conditioning and pretreatment of herbaceous and woody biomass in order to do a conversion of biomass in a fermentable carbon source

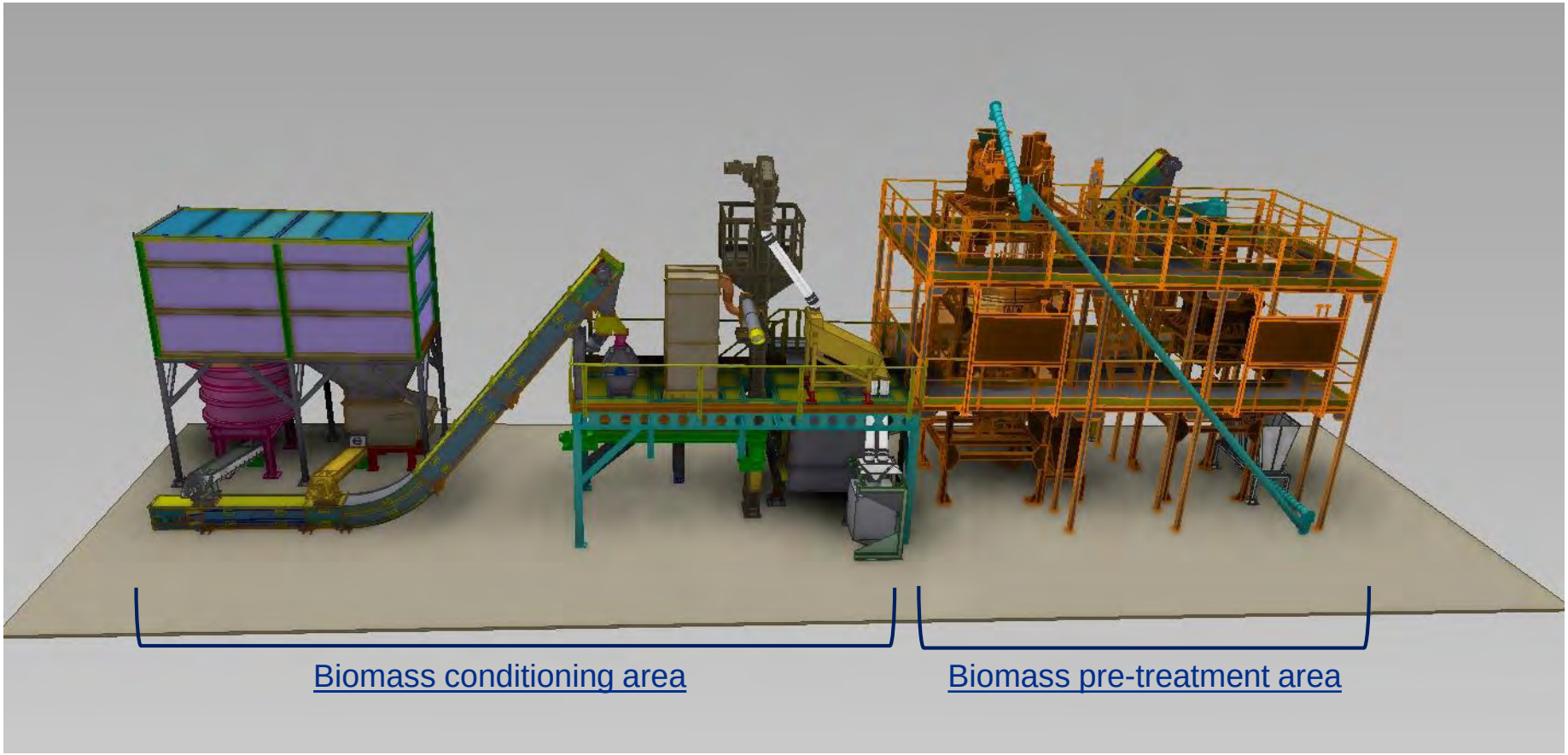
- ***Equipment Overview:***

- ✓ Solid biomass storage (4 x 35 m^3)
- ✓ Mills for herbaceous and woody biomass (200 kg/h)
- ✓ Extractor with vapour (3 m^3)
- ✓ Two-step Steam Explosion Reactor (400 l, up to 21 barg)
- ✓ Solid/liquid separators (15 m^3/h)

Up-stream unit

Lignocellulosic biomass storage area

General overview of up-stream unit



Up-stream unit

Up-stream unit

Extraction and Steam Explosion reactors

Detail of Steam-Explosion reactor and Expansion vessel

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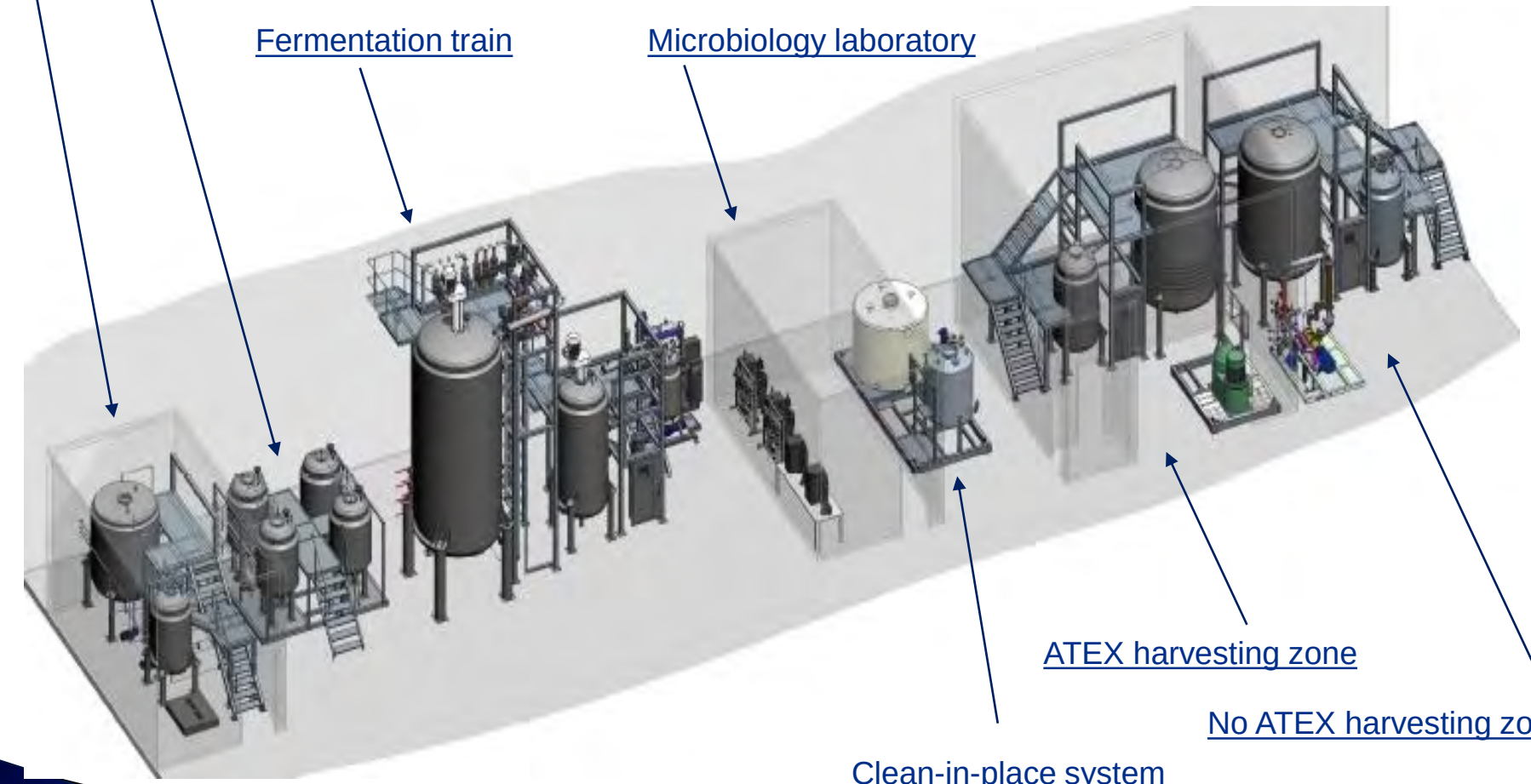
MID-STREAM

- ***Objective:*** Fermenting or biotransform the carbon source generated in up-stream into different bioproducts (bioplastics, biofuels, building blocks, etc.)

- ***Equipment overview:***

- ✓ Microbiology laboratory for micro management (starters, inoculants, etc.)
- ✓ Reactors for hydrolysis and anaerobic and aerobic fermentation: 2 x 3 l, 2 x 30 l, 1 x 300 l, 1 x 3000 l and 1 x 20000 l
- ✓ Systems for sterilization, substrate preparation, addition of sterile reactants, cleaning in place, and other utilities

General overview of Mid- Down stream units



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, 3000 and 20,000 L fermenters

Fermentation train: 300 L, 3000 L and 20000 L fermenters

DOWN-STREAM

- ***Objective:*** Purification and concentration of the fermentation product of interest

- ***Equipment overview:***

- ✓ Harvesting tanks with capacity to act as a extractor: 1 x 10000 l (ATEX), 1 x 10000 l (No ATEX), 1 x 1500 l (ATEX) and 1 x 1500 l (No ATEX)
- ✓ Microfiltration system (1 m^3/h)
- ✓ Centrifugation system (1,5 m^3/h) (ATEX)

Down-stream: Harvesting tanks

Down-stream

Down-stream

No ATEX zone with microfiltration system

ATEX zone with centrifugation system

ANAEROBIC DIGESTION

- ***Objective:*** 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 overview:***

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

Anaerobic digestion

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UTILITIES

- ***Objective:*** Auxiliary services for the operation of the biorefinery units

  - ✓ Electrical supply
  - ✓ Steam
  - ✓ Process water
  - ✓ Cooling tower water
  - ✓ Chiller water
  - ✓ Glycol water
  - ✓ Compressed air and process instrumentation
  - ✓ Gases (NH_3, N_2, O_2)

Utilities

Process water, Cooling tower water (25 – 35 ºC), Chiller water (9 – 14 ºC), Glycol water (0 – 4 ºC)

Boiler room (6 and 21 barg steam), Compressors (Process and Instruments air)

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WASTE MANAGEMENT UNIT

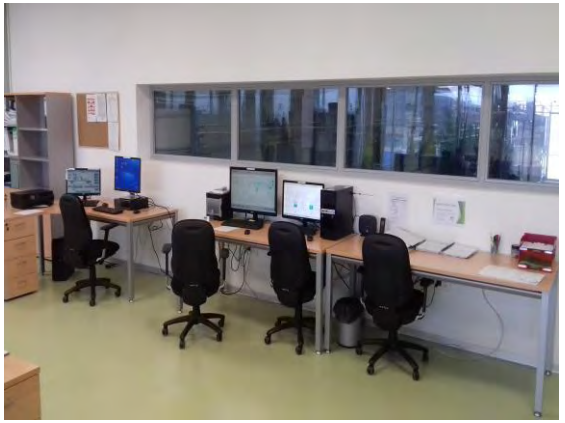
- ***Objective:*** Treatment and storage of liquid and solid wastes produced in the biorefinery.

- Delimited area for waste storage upon withdrawal by authorized waste manager, prioritizing 3 R: Reduction, Reutilization and Recycling.

- The biorefinery must be sustainable and its activity is R&D, so a waste water treatment system has been implemented based on passive natural systems, i. e. artificial wetlands. The wetlands system is also case of study as there is not a broad experience on waste water from biorefineries treatment.

Wastewater treatment

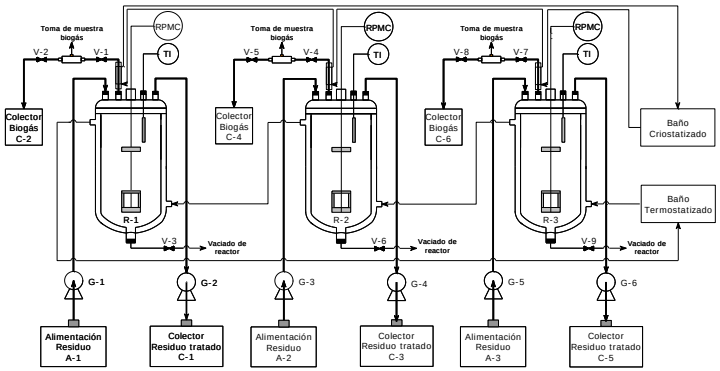
Process Control Areas



Second action involved in the CLaMber Project

Issuance of a Pre-commercial Public Procurement (PPP) (8,6 Millions €) for conducting innovative R&D projects aimed at:

- **SELECTION OF OPTIMAL RAW MATERIALS**
- **IMPROVEMENT OR DEVELOPMENT OF NEW BIOPROCESS**
- **DEVELOPMENT OF NEW BIOPRODUCTS**
- **SOCIOECONOMIC RESEARCH, NEW BUSINESS MODELS, LOGISTIC AND OTHER TECHNOLOGY CHALLENGES**



Knowledge procurement

ALIGNED WITH THE EUROPEAN R&D STRATEGY OF 2020 HORIZON PROGRAM, THE PUBLISHED TENDERS ARE RELATED TO THE SERVICE OF RESEARCH, DEVELOPMENT AND INNOVATION FOR THE COMPREHENSIVE UTILIZATION OF:

- **LIGNOCELLULOSIC BIOMASS (CROPS AND WASTES).**
- **OILY BIOMASS (CROPS AND WASTES).**
- **AGRIFOOD RESIDUAL BIOMASS.**
- **LIVESTOCK RESIDUAL BIOMASS AND NON-AGRIFOOD BIOMASS.**

Tender winners

TENDER	LOT	LOT NAME	WINNER
LIGNOCELLULOSIC	1	WOODY WASTES	F.U. ALCALÁ
	2	HERBACEOUS WASTES	NEOL
			BIOPOLIS
	3	LIGNOCELLULOSIC CROPS	NEOL
	4	LIGNIN	NATAC
OILY	-	OILY CROPS	CAMELINA COMPANY
AGRIFOOD	1	WINERY WASTES	NATAC
			AINIA
	2	ALPERUJO	INNOVAOLEO
	3	WHEY	BIOPOLIS
	4	SLAUGHTERHOUSE WASTES	BIOGAS FUEL CELL
	5	HIGH ORGANIC LOADING WASTEWATERS	ALVINESA
			BIOMASA PENINSULAR
NO AGRIFOOD	1	LIVESTOCK WASTES	AINIA
			PURINES ALMAZÁN
	2	OFMSW	BIOMASA PENINSULAR
	3	WWTP SLUDGES	AINIA
	4	GLICERIN	TECNALIA
	5	NON ENERGETIC BIOGAS	BIOPOLIS

Current R&D Project at CLaMber Biorefinery

Castilla-La Mancha CLaMber

EU Projects:

- ✓ **URBIOFIN (Call: H2020-BBI-JTI-2016)**
- ✓ **BIOREGIO (Call: Interreg Europe)**

URBIOFIN
urban biorefinery

FROM URBAN WASTE TO BIOPRODUCTS THROUGH BIOREFINERY

Demonstration of an integrated innovative biorefinery for the transformation of Municipal Solid Waste (MSW) into new BioBased products

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BIO-BASED INDUSTRIES Public-Private Partnership

BIO-BASED INDUSTRIES
Joint Undertaking
www.bbi-europe.eu

Table 1.1a Targeted biobased products to be obtained at demo scale during URBIOFIN project

Biobased product	*Use/ final application*
Bioethanol	*Chemical building block for bioethylene production and VFAs elongation*
Mcl fatty acids (MCFA)	*Chemical platform for mcl-PHA production*
Biogas	*Chemical building block for scl-PHA*
Bioethylene gas	*Ripening Gas in Post-Harvest Fruit Chambers*
Short chain polyhydroxyalcanoates (scl-PHA)	*Agriculture Bioplastic and use for household bags*
Medium chain polyhydroxyalcanoates (mcl-PHA)	*Bioplastic for packaging*
Biocomposites of scl and mcl-PHA	*Cosmetic and hygienic applications*
Aminoacids rich liquid fertiliser	*High added value liquid biofertilisers*
Dry Organic-Mineral Granules	*Solid Biofertiliser*

https://www.urbiofin.eu/

Total budget 15 M€

Jun 2017
Jun 2021

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.

https://www.interregeurope.eu/bioregio/

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THANKS FOR YOUR ATTENTION

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

Contact: clamber@jccm.es

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