III FORO ASEBIO DE AGROBIOTECNOLOGIA 2019

CENER

CENTRO NACIONAL DE ENERGÍAS RENOVABLES
NATIONAL RENEWABLE ENERGY CENTER OF SPAIN

A novel biorefinery concept for mushroom compost

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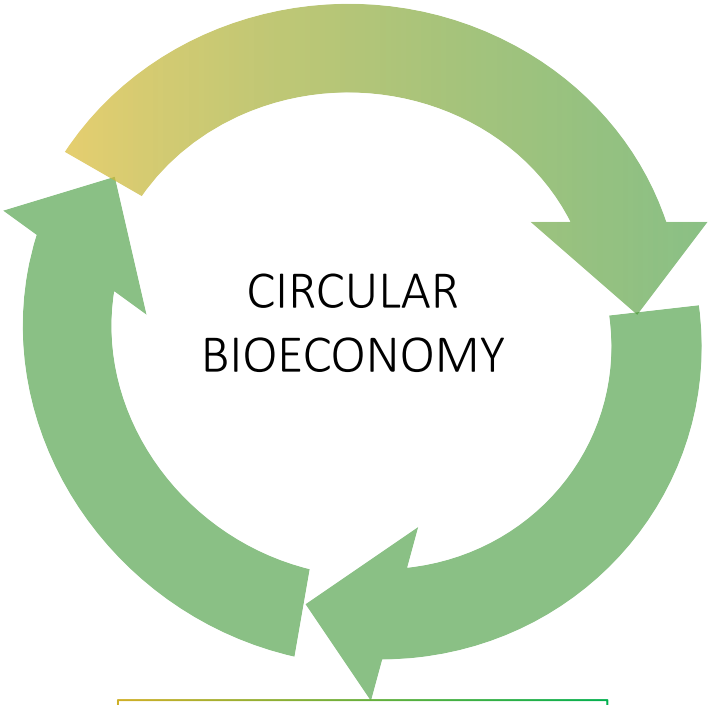
STRATEGY AND IDEA CREATION

BIORESIDUE & RESIDUAL BIOMASS valorisation

BIOREFINERY concepts



BIOBASED PRODUCTS

ADVANCED LIQUID BIOFUELS

SOLID BIOFUELS

BIO-BASED INDUSTRIES Public-Private Partnership

Bio-based Industries Consortium

Horizon 2020 European Union Funding for Research & Innovation

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BIOREFINERY – BIOENERGY-BIOPRODUCTS – BIOFUELS – CIRCULAR ECONOMY

RAW MATERIALS TO PRODUCTS

2002-2019

LAB

PILOT

DEMO

LIGNOCELLULOSIC BIOMASS

Cereal straw
Energy crops
……
Forest residues
……
Food industry residues
Compost
……
Black liquor
Spent mushroom substrate
Organic fraction MSW
Sugar cane trash
Sewage sludge

TECHNOLOGY DEVELOPMENT AND VALIDATION

BIOFUELS - BIOENERGY

Bioethanol
Biodiesel
Bio-Power
……
Pellets
…..
Biobutanol
……

Biopesticides
Bioplastics
Biosurfactants
Biofertilizers

BIOWASTE

BIOFUELS- BIOENERGY-BIOPRODUCTS

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GENERAL INFORMATION

- **10 partners** from **7 different countries**
- Duration: **3 years** (September 2016-August 2019)
- **Coordinated by CENER** with the support of Monaghan Mushrooms as Technical Coordinator
- Co-funded by the **Bio-Based Industries Joint Undertaking**

- Program: **H2020-EU.3.2.6. - Bio-based Industries Joint Technology Initiative** (BBI-JTI)
- Topic: **BBI.R10-2015** - Innovative efficient biorefinery technologies
- Type of Action: BBI-RIA - Bio-based Industries **Research and Innovation action**

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SCOPE AND ROLES

CENER Pre-treatment Unit. Continuous Horizontal Reactor

CENER High solids enzymatic hydrolysis 200L stirred tank reactor

https://biorescue.eu/

PROJECT SCOPE	CENER ROLE
To develop and demonstrate a new innovative **biorefinery concept** based on the **cascading use of spent mushroom substrate** (SMS) supplemented by wheat straw & other seasonal underutilised lignocellulosic feedstocks.	**Project Coordinator**
To avoid disposal and allow for the **production of some biodegradable bio-based** products and **bioactive compounds ,**	To lead the research line of SMS **conditioning** and two step **fractionation** process of the SMS into **different valuable fractions** (high glucan solid and enriched lignin liquid),
	Secondary conversion related to sugar **fermentation for biopesticides production**
	Sustainability Assessment

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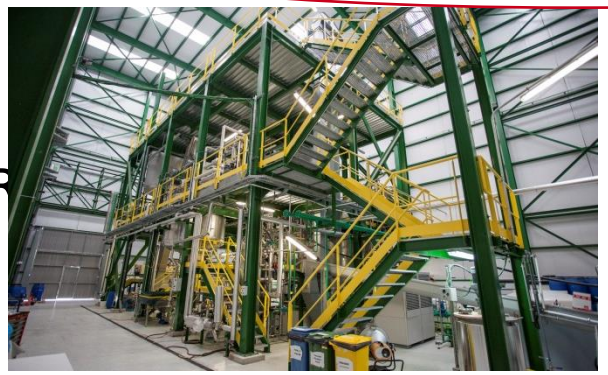
BIOMASS 2 AREAS STRONGLY INVOLVED IN THE PROJECT

1 – SOLID BIOFUELS

- Process development:
  - Torrefaction
  - Pelletizing
  - Gasification
- Solid Biofuels Characterization
- Simulation of Ash behaviour

2 – BIOPROCESSES



- Process development:
  - Enzymatic and fermentative processes
  - Fractionation of lignocellulosic biomass
  - Lignin depolymerization processes
  - Separation and purification technologies
- Feedstock Characterization

3 – SUSTAINABILITY

- Ad-hoc Sustainability services for:
  - Bio-based products and processes
  - Biofuels
  - Bio-Power
  - Thermal uses

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OBJECTIVES

- To demonstrate an innovative and resource-efficient **biorefinery concept** for mushroom compost conversion;
- **To create valuable bio-based products** from mushroom compost and other lignocellulosic feedstocks;
- To achieve a **20% overall cost-reduction** in the enzymatic hydrolysis process;
- **To reduce disposal costs** for mushroom compost and generate a new income stream for mushroom producers.

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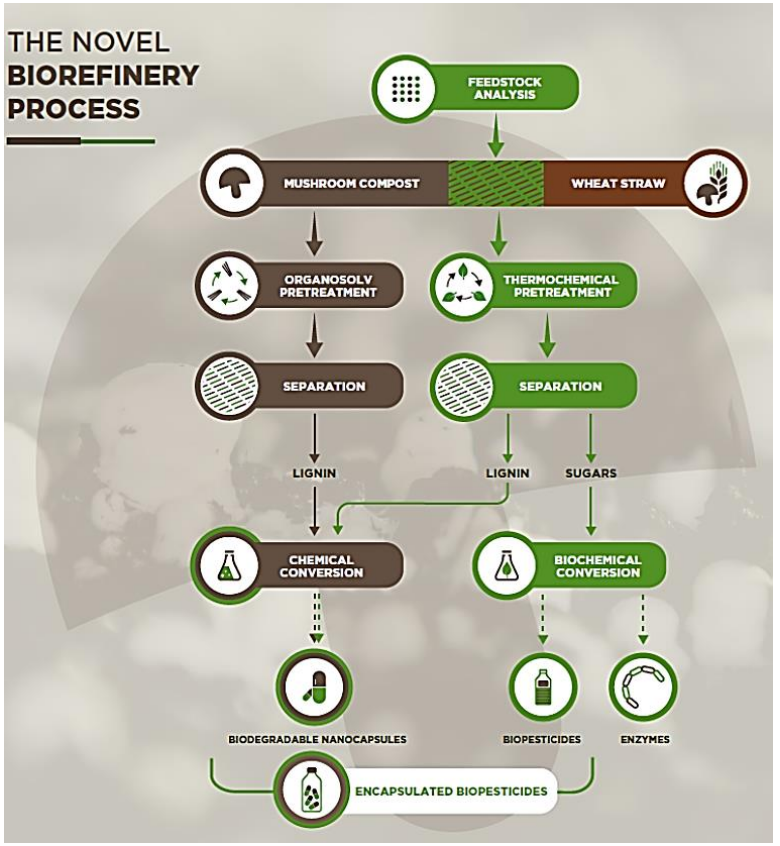
NOVELTY OF THE PROCESS

- **Characterisation** of biomass feedstocks
- **Fractionation**
  - Thermochemical pretreatment
  - Organosolv treatment
- **Enzyme development & enzymatic hydrolysis**
- **Chemical and biochemical conversion**
- **Environmental, resource, techno-economic and social assessment**



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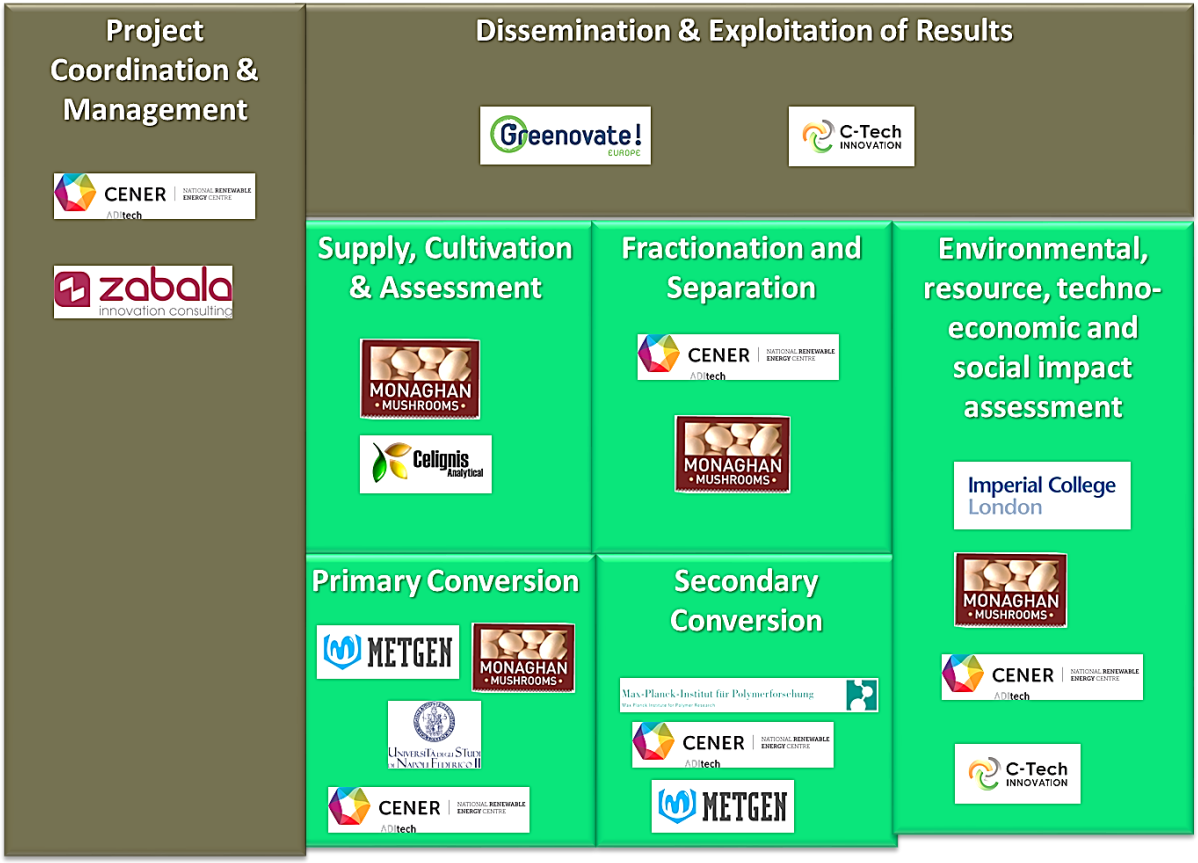
STRUCTURE OF THE PROJECT AND CONSORTIUM



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INFRASTRUCTURES TO EXECUTE THE TECHNICAL TASKS

CENER BIO2C – Biorefinery and Bioenergy Centre

The **Biorefinery and Bioenergy Centre** (BIO2C) is a semi-industrial **demonstration-scale testing facility** with different **Process Development Units** capable of **developing and validating** processes for the production of **bioproducts, solid biofuels, advanced liquid and gaseous biofuels**, as well as **biorefinery** concepts by integrating different routes of valorisation, as an intermediate stage between the laboratory and the commercialization trough the industrial **scale-up** of these technologies.

Integrated trial and **demonstration platform** designed to develop:

- processes,
- equipment and specific components,
- new bioproducts and biofuels,
- bio-refinery concepts.

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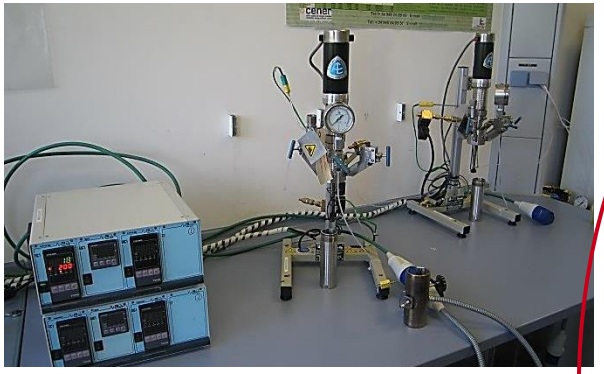
INFRASTRUCTURES TO EXECUTE THE TECHNICAL TASKS – CENER BIOCHEMICAL LABORATORY

Feedstock/Product characterization

- Liquid Chromatograph HPLC
  - Carbohydrates/sugars
  - Organic acids
  - Inhibitors
  - HP-SEC average molecular weight
- Gas Chromatograph GC-FID & MS
  - Methanol, ethanol, butanol
  - Lipids
- Elemental Analysis
  - Proteins

Fractionation/Separation



- 4 pressurized stirred tank reactors (from 50 ml to 4L) :
  - Up to 220 bar
  - Up to 450ºC
  - Pressure control
  - Gas injection possibility
- Filtration system: MF, UF & NF
  - Up to 15 bar
  - Permeate flow: 0,03-6 L/h
  - Interchangeable membrane module

Enzimatic Hydrolisis & Fermentation

- Process parameters optimization in:
  - From microplates: < 1ml
  - Erlenmeyers or flasks: up to 1L
  - Bioreactors: 2-5L
    - Batch, Feed-batch, continuous
    - Adjustable agitation speed, air/gas ratios, pH, nutrients
- Chambers for aerobic/ anaerobe microorganisms
- Incubator with adjustable agitation, temperature, gas inlet

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INFRASTRUCTURES TO EXECUTE THE TECHNICAL TASKS – CENER BIOCHEMICAL PILOT PLANT

Pretreatment

- **Continuous horizontal** reactor
- Feed flow: up to **5 kg/h**
- Pressure up to **14.5 bar**
- Temperature up to **200ºC**
- High **flexibility** in **feedstocks**

Enzymatic Hydrolysis

- **High solids** enzymatic hydrolysis **stirred tank reactor**
- **200l** capacity
- Temperature**: 20-80 ºC**
- **Atmospheric pressure**

Fermentation

- **Fully monitored bioreactors**
- **40l** and **100l** capacity
- Temperature: **23-80ºC**
- **Adjustable** agitation speed, air/gas ratios, pH, nutrients

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OTHER RELATED R&D PROJECTS (H2020, BBI, Regional, etc)

SOLID BIOFUELS

- Chemical Looping gAsification foR sustainAble production of biofuels
- Advanced MEMBranes & membrane assisted procEsses for pre- and post- combustion CO2 captuRe
- Simulation and monitoring of biomass ash behavior
- Biofuels Research Infrastructure for Sharing Knowledge II

BIOPROCESSES

- Scalable Technologies for Bio-Urban Waste Recovery
- Valorisation of liquid and solid fractions of 2nd generation biofuel production processes
- Circular Urban Biorefinery in Navarra
- Sustainable Drop-In Transport Fuels from Hydrothermal Liquefaction of Low Value Urban Feedstocks
- Chemical building blocks from versatile MSW biorefinery
- Kraft Lignin biovalorisation into Vanillin
- Network of Technological Centres for the Development of a Microalgae Based Biorefinery
- Enhanced bioconversion of agricultural residues through cascading use
- Advanced biofuel production with energy system integration
- Advanced sustainable BIOfuels for Aviation

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LESSONS LEARNT AND CONCLUSIONS - PROPOSAL PREPARATION

In the **negotiation** phase important changes could arise. I.e. CENER took over coordination role

Do not underestimate **impact section**! very important!

Strong coordinator is essential → Industry or Research Entity

Search **complimentary ongoing H2020 funded projects** → Do not replicate

Relevant to **align** industry priorities with project objectives and TRL

Need to **work hard with the industry** from proposal preparation phase → Monaghan BIO

Look for **complimentary partners** to create a strong competitive consortium

In kind, in cash and industry investments are very important (**additional investments**) → real industrial commitment needed

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LESSONS LEARNT AND CONCLUSIONS - PROJECT EXECUTION (COORDINATION)

Plan, inform and contact **in advance**

Involve **WP and task leaders** in the coordination responsibility

Periodical risk analysis and **mitigation** measurements

Internal reports are always helpful

Follow the work plan, however, if problems arise, **be flexible**:

- Amendments
- Partner leaves the consortium
- Changes in the workplan

Keep updated the **project officer**

Reporting is very important: both economic and technical

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LESSONS LEARNT AND CONCLUSIONS - TECHNICAL WORK

How to **continue** with the project? IA, private funding, etc..

Don´t neglect **dissemination** and **exploitation** goals

In case of conflict, promote **win-win** approach for the global benefit

If core works seems to fail, **react ASAP and propose changes**

Keep WP **work aligned** with the proposal and between WPs

Keep partners work **collaborative**

Hold periodical meetings and telcos to **promote dialogue**

Trust on the technical expertise of each partner


THANK
YOU VERY
MUCH!