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Cascade use of olive waste towards a highly competitive olive sector: high value byproducts, advanced biobased materials and advanced biofuels integrated production

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Outline of Presentation

- Olive Sector in Portugal
- Technological concept of the study
- Objectives
- Results
- Conclusions

60 years of progress? (Reflection)

1948: 7.5 litres/100km

2008: 7.5 litres/100km

Introduction: Types of Olives Production System in Portugal

Traditional Production

Intensive Production

Superintensive Production

Introduction: Main Challenges for Biomass Residues of Olive Oil Value Chain in Portugal

Traditional Production (very small production area)

Less than 1 ha

Harvest and collection business model

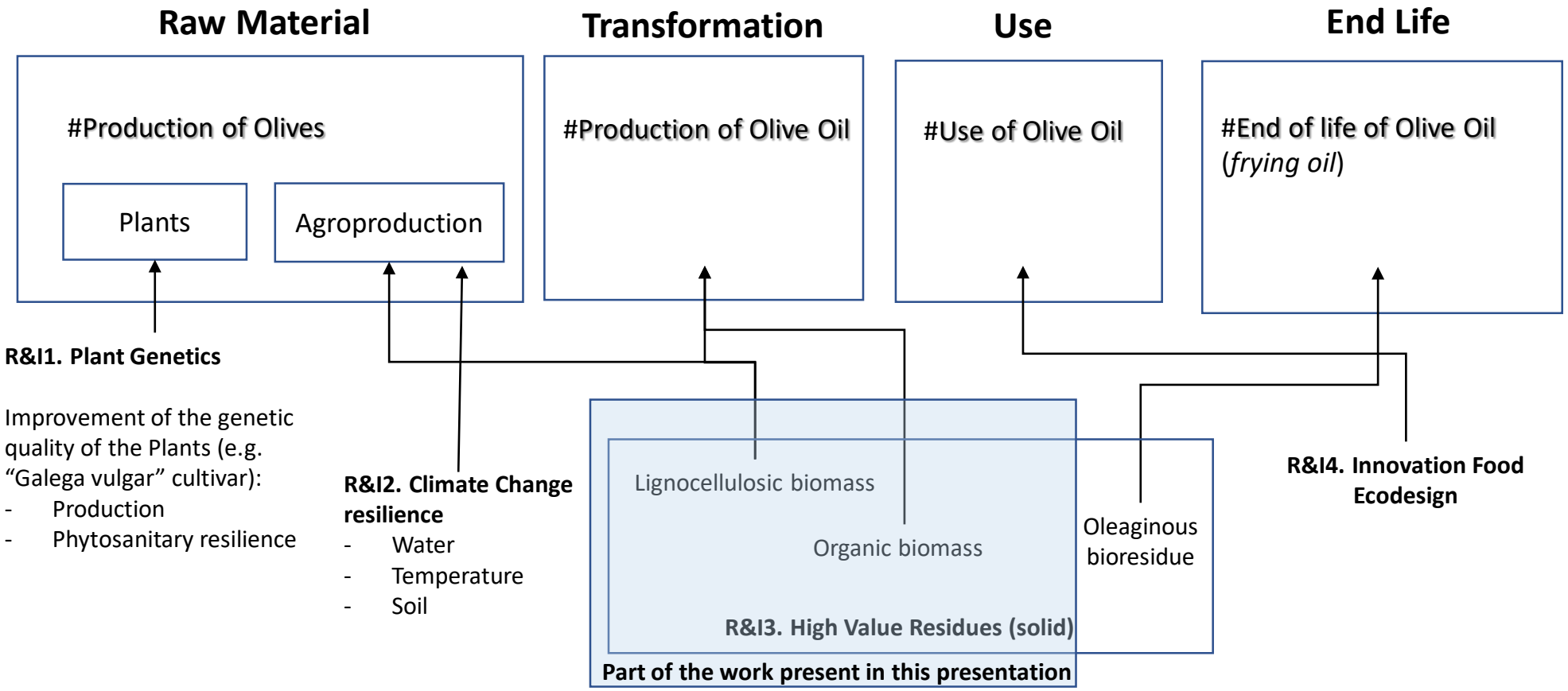
Combustion without energy recovery (Zero Energy Efficiency)

Waste-to-value = 0.16-0.18 Euros/kg (low *Gross Value Added*)

Conventional Technologies use for Waste-to-value:
Direct Combustion
Co-generation

Low energy efficiency and oxidation problems

Life Cycle Thinking and R&D Strategy
Innovation Value Chain Olive Sector: Work of BLC3 and Consortium



Objectives

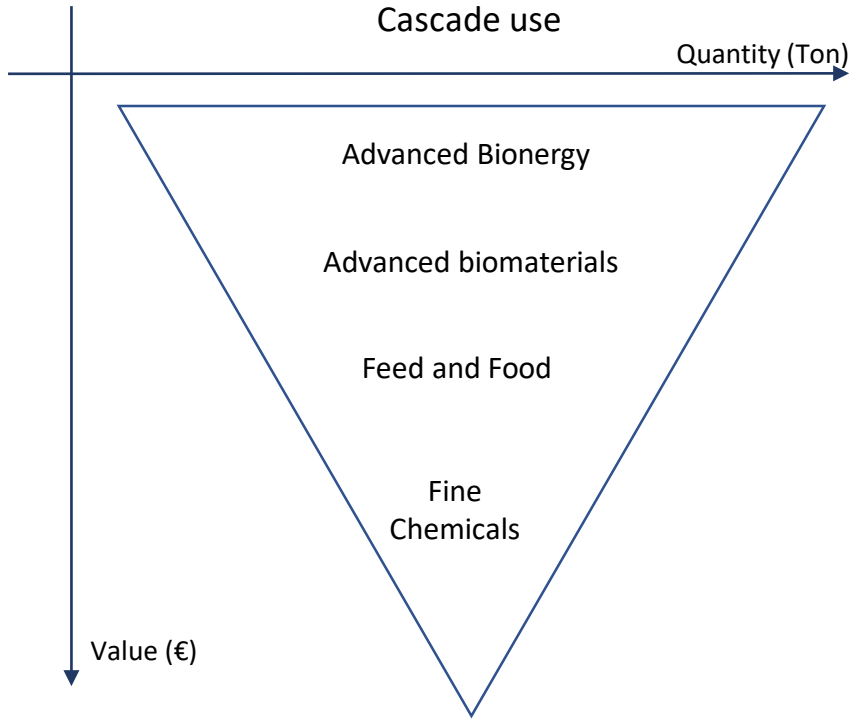
O1. Design of new pathways for Olive Residues valorisation from Olives & Olive Oil production.

O2. Development of new byproducts from Olive Residues for non-energetic and energetic applications by an integrated process.

O3. Development of a new process for byproducts production with high value, based on a cascade use approach (integral valorisation).

Cascade use of the biomass residues from Olive Value Chain

Principle 1



Principle 2

Non competitive with food and feed

Principle 3

. Zero Waste
. High energy efficiency process

Results (1) – Life Cycle Inventory
Residues Generation Main processes in Portugal

#Process A: Olives Production

In terms of moisture content, there was a variation between 10.50-45.50% weight.

723,000 ton/year dry basis

#Process B: Olive Oil Production

10 olive oil producers (where the percentage of pomace generation was obtained for each litre of oil produced, in a 2-phase mill system (mostly process used in Portugal).

540,000 ton/year dry basis

Life Cycle Inventory divided the value chain into two main parts:
Process A, related to the **tree bioresidues**, originated during the cultivation and harvesting operation.
Process B, related to the **Olive Pomace bioresidue** from the conversion of olives into olive oil.

Results (1): Byproducts Conversion

#Process A
Olives Production

Bioresidues (mainly lignocellulosic)

Advanced Biomaterial

FT Diesel

Phosphorus separation

(future work)

#Process B
Olive Oil Production

Olive Pomace

Bioingredients

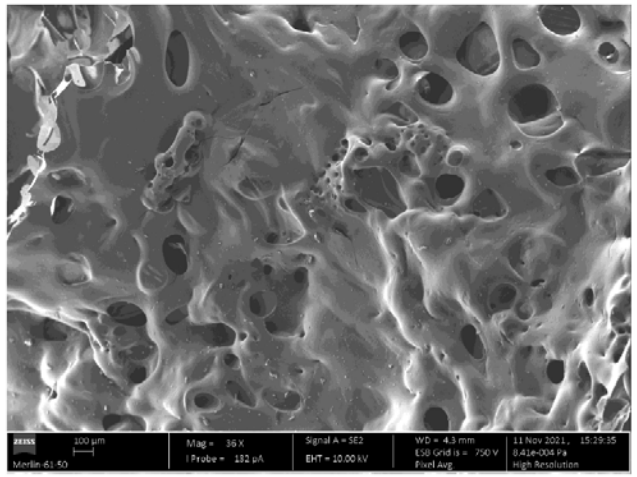
. Fiber
. Phenolic Compounds
. Carbohydrates

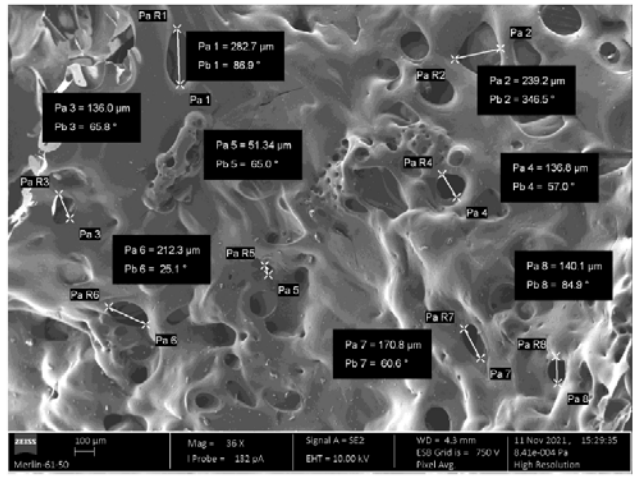
Results (2): Byproducts Conversion

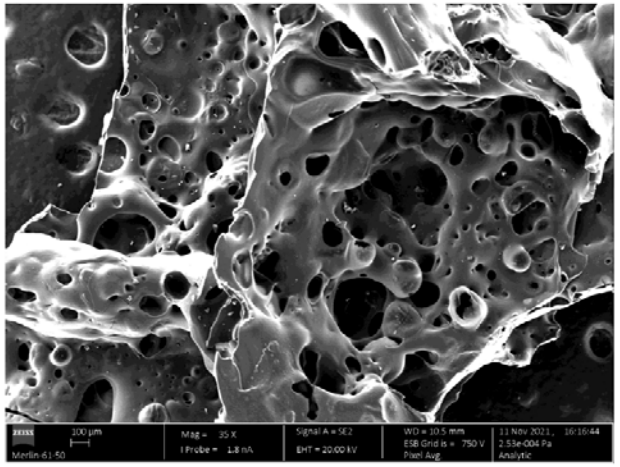
#Process A
Olives Production

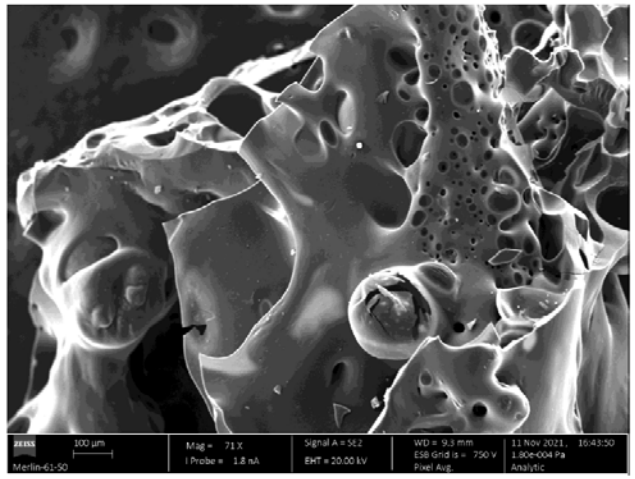
↓

Advanced
Biomaterial







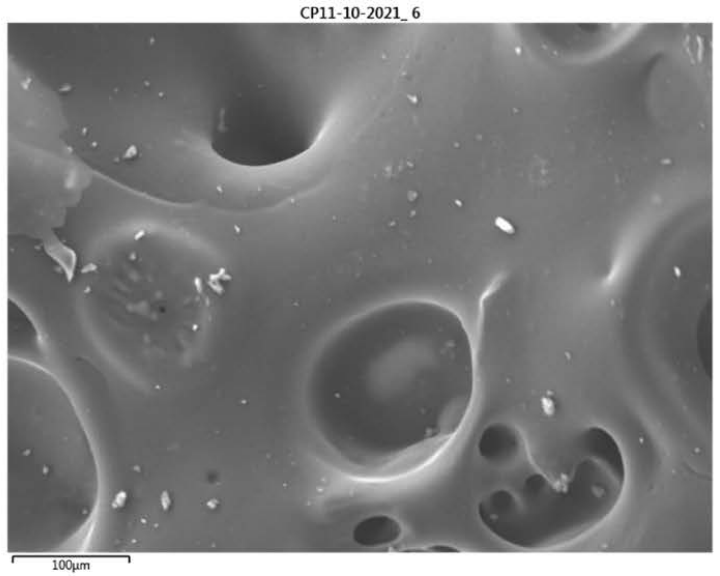


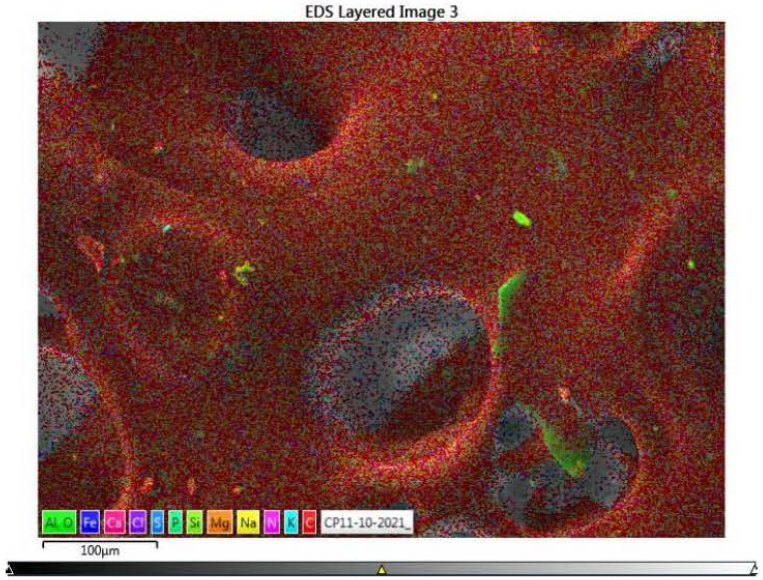
Results (3): Byproducts Conversion

#Process A
Olives Production

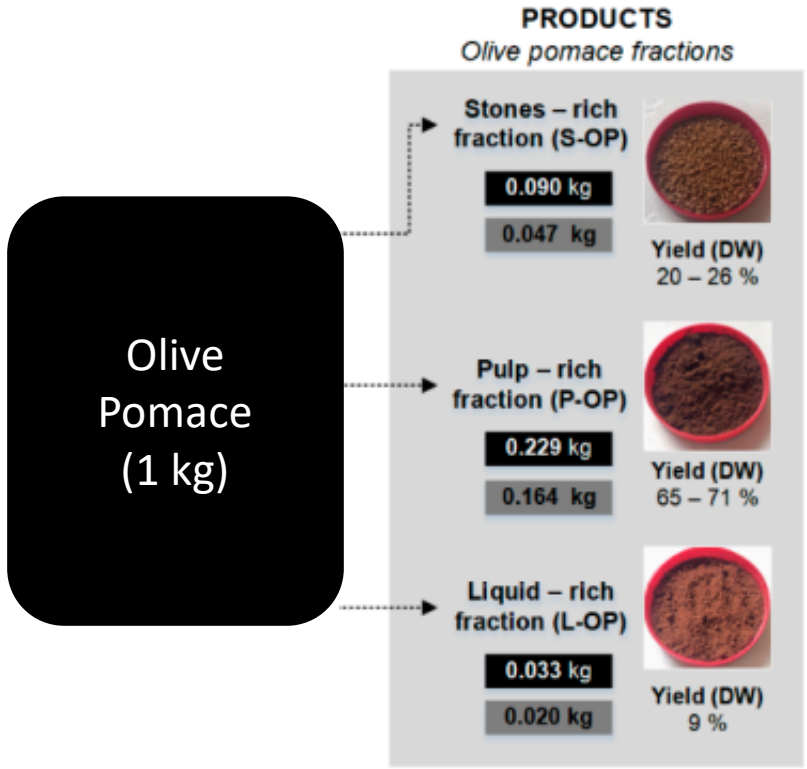
↓

Advanced
Biomaterial





Results (4): Byproducts Conversion



- **Solid Olive Pomace fraction**: source of **protein** (14%) and **neutral detergent fiber** (43,62 g/ 100g dry weight)

- **Pulp-enriched Oilve Pomace powder** (POPP):

. high amount of **dietary fibre** (620 g kg−1);

. antioxidant activity free phenolics (ORAC: 455–503 µM trolox equivalents/g) and **bound phenolics** (7.41 mg GAE g−1 fibre dry weight); and

. **Unsaturated fatty acid composition similar to that of olive oil** (76% of total fatty acids) and potential as **source of protein** (12%).

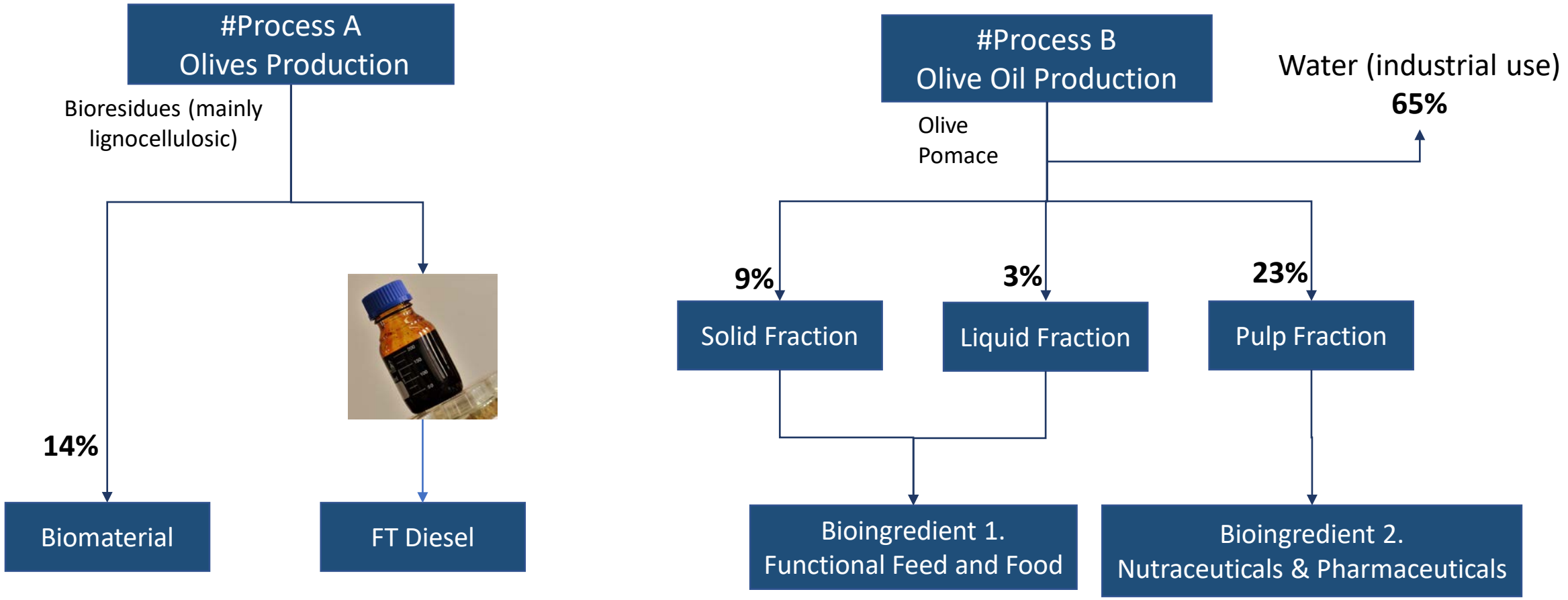
- **Liquid-enriched Olive Pomace powder (LOPP):**

. **mannitol** (141 g kg−1);

. **potassium** (54 g kg−1); and

. **hydroxytyrosol derivatives** (5 mg g−1).

Results (5): Mass balance conversion



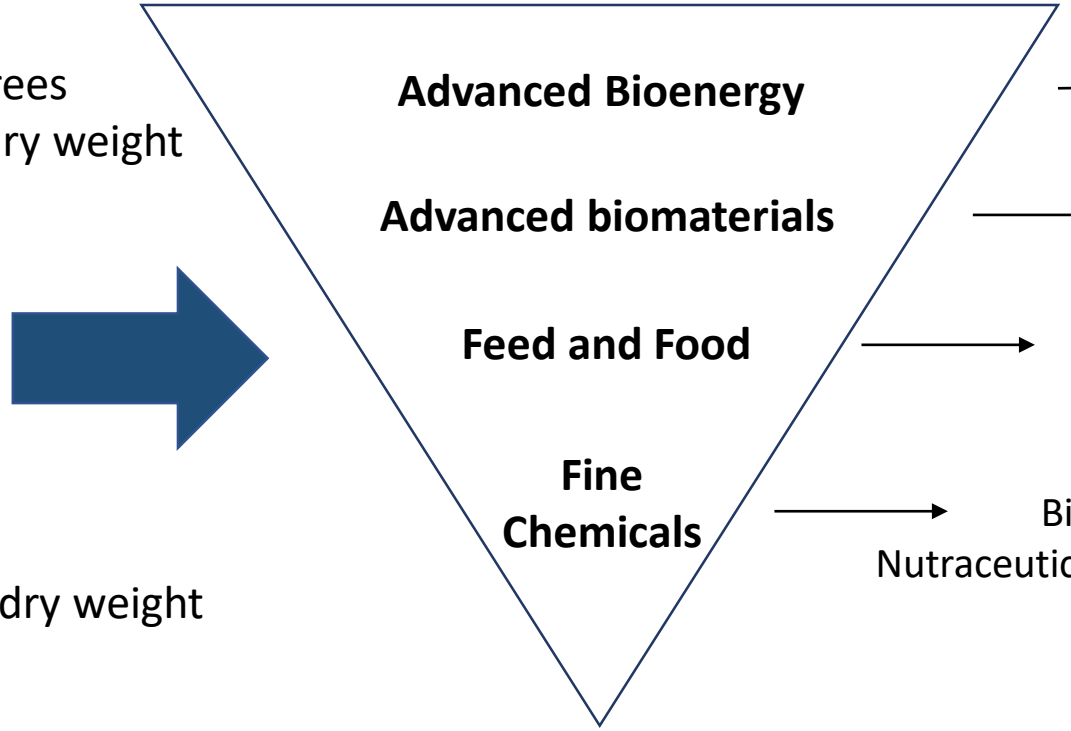
A 64-68% mass efficiency conversion of olive solid waste into bio-liquid
33% of the overall efficiency of advanced biofuel production.

Results (6): High value byproducts potential production from Olive Setor in Portugal

Life Cycel Inventory & Mass Balance Conversion

Bioresidues from trees
723,000 ton/year dry weight

Olive Pomace
540,000 ton/year dry weight



FT Diesel	**238,590 ton/year** 6% of the diesel consumption 5% of the total fuel used in land transport
Biobased filter	**101,220 ton/year**
Bioingredient 1 Functional Food	**124,200 ton/year**
Bioingredient 2 Nutraceutical and Pharmaceutical	**64,800 ton/year**

Conclusions and Future Work

An integrated bioprocess concept is proposed by the present work for the conversion of olive biowaste into **non-energetic byproducts**, with high value:

multifunctional bioingredients for Feed and Food sector and Nutraceutical and Pharmaceutical
+
biobased materials with technical proprieties

in combination with the **energetic byproducts** production (advanced biofuels for the transport sector: Fischer Tropsch Diesel).

The **mass flow dimension** of solid residues from Olives and Olive Oil production with **high potential for circular bioeconomy transition in Portugal.**

FUTURE WORK

- **Phosphorus separation and recovery** from #Process A for fertilizer application

- **Technical Economic** and **Life Cycle Cost Assessment**

- **Scale Up** Technology

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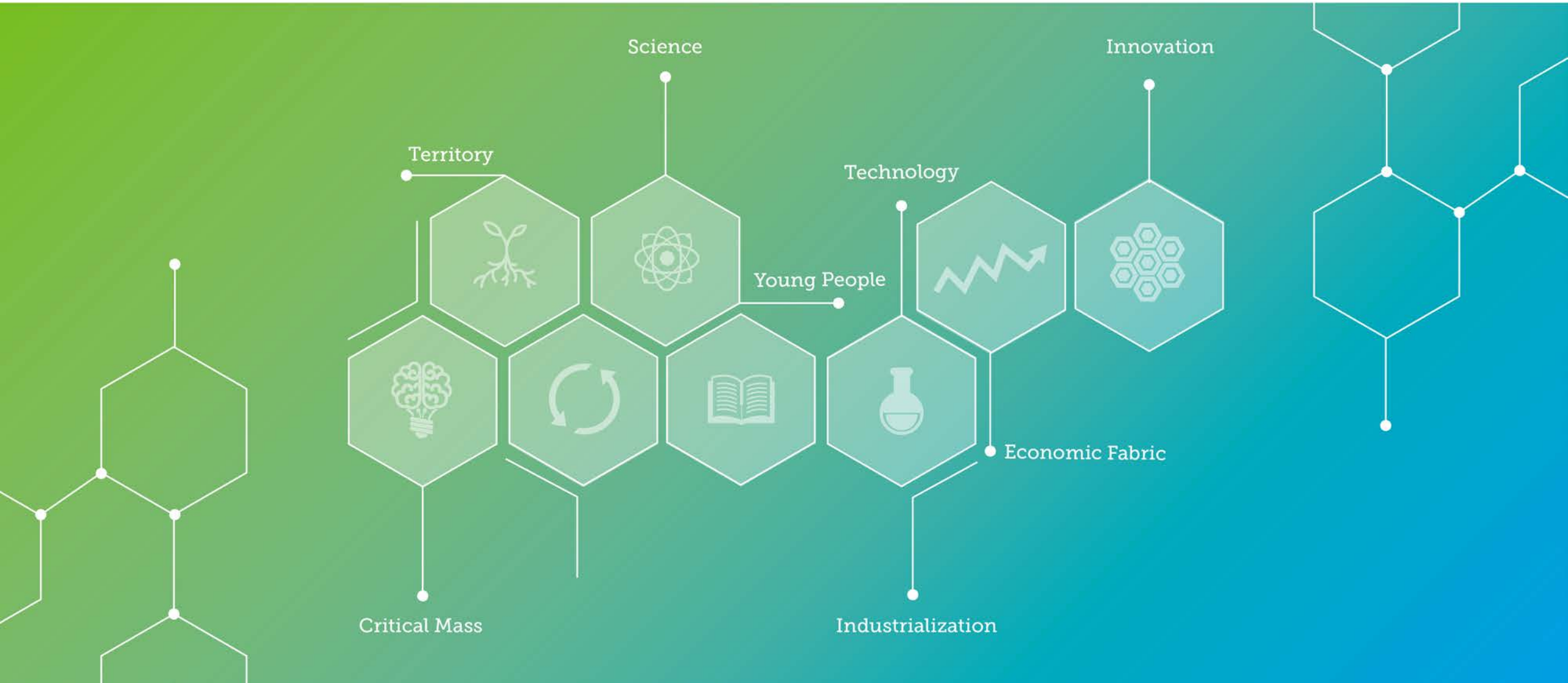

Efcharistó |Obrigado | Thank you!

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