Mapping Bio-based Technologies & Raw Materials: SYMBIO's Regional HubHandbook Data Collection Inventory

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SYMBIO's Regional Hub Handbook and Data Collection Inventory

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SYMBIO objectives

01. Identify and evaluate resources and technical solutions that allow industrial symbiosis and circularity right from design in the bio-based ecosystem.

02. Shaping symbiotic value chains using a zero-waste approach through big data and artificial intelligence tools.

03. Develop an integrated reporting system to measure and monitor industrial symbiosis based on regional multi-stakeholder co-creation approaches.

04. Demonstrate zero-waste industrial symbiosis models' economic, social, and environmental impacts.

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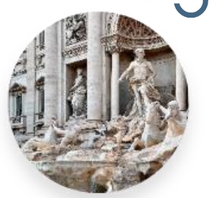
📍 12 target European pilot regions

Austria

Carinthia



Italy

Lombardy, Piedmont, Veneto, Friuli-Venezia Giulia, Emilia-Romagna

Belgium

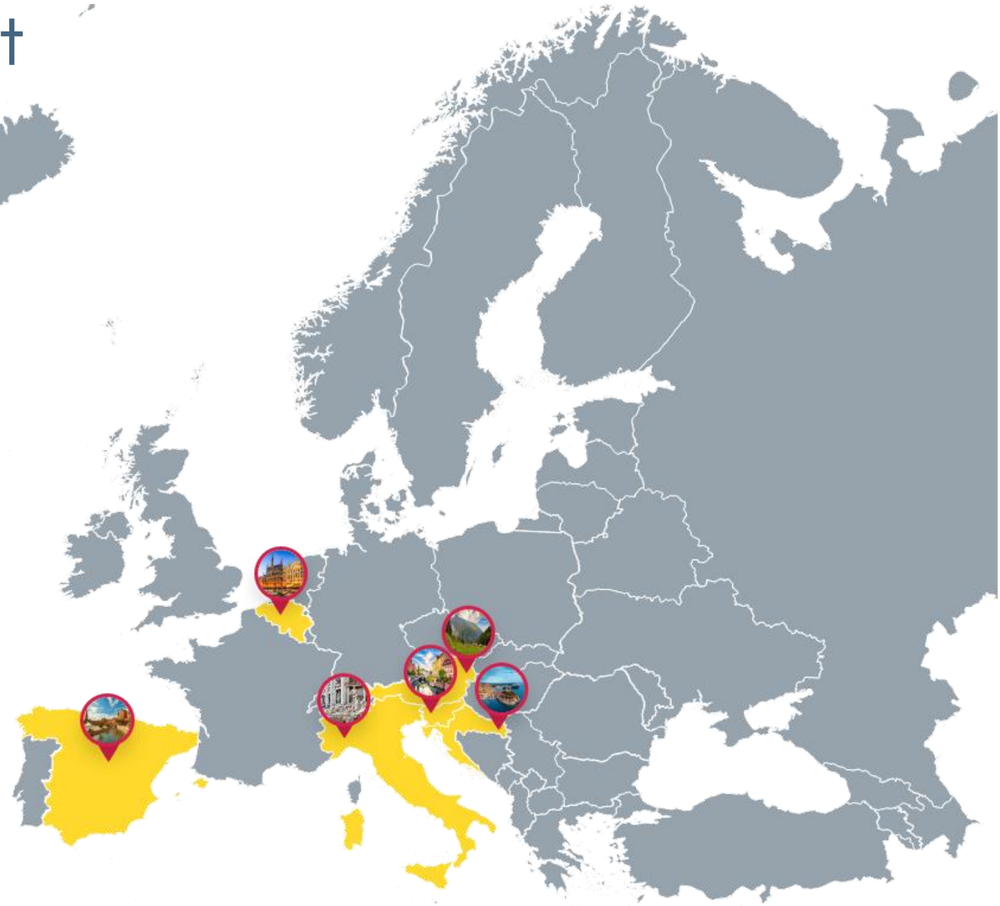
Brussels Capital, Wallonia, Flanders

Spain

Andalusia

Croatia

Slovenia



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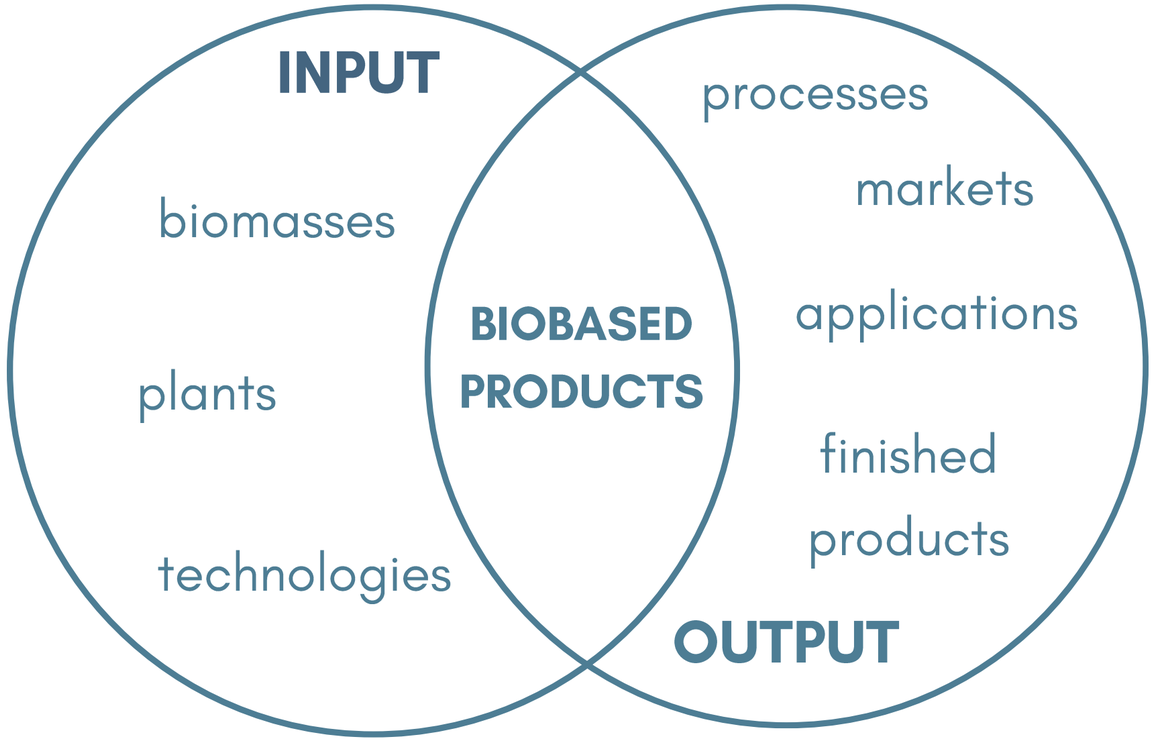
Mapping and assessing resources and technical solutions enabling industrial symbiosis



Evaluate the state-of-the-art and perspectives of the most relevant biobased products, biological resources, technologies, and facilities in each pilot region from the point of view of industrial symbiosis.

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Regional Hub Handbook

based on the systematisation of data collected from various sources, providing a detailed picture of local biobased supply chains.

1. Selection criteria for biobased products, biomass, and technologies.
2. Guidelines for the data collection
3. Data collection and harmonisation methodology

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Selection Criteria for Biobased Products

Market Demand

- Driven by consumer preferences, regulations, sustainability goals, and market trends.
- Identifies niche markets and growth opportunities.
- Multiple applications to assess economic avaiability and affordability.

Biomass Availability

- Biomass must be abundant, renewable, and economically viable.
- Factors: geographical distribution, seasonality, and competing uses.

Environmental Sustainability

- Products with lower carbon footprints and reduced resource consumption preferred.
- Supports climate change mitigation and resource efficiency.

Technological Maturity

- Focus on well-established, reliable, and scalable technologies.
- Reduces risks associated with novel or experimental technologies.

Economic Viability

- Assessed through production costs, market prices, and potential revenue.
- Competitive products attract investment and ensure commercial success.

Accessibility and Scalability

- Focus on technologies scalable from pilot to commercial scale without major modifications.
- Ensures market reach and economies of scale

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12 biobased products

- Product overview
- Market value
- Biomass
- Technologies/Production process
- Market applications
- SWAT analysis

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Data Collection Inventory

1. Mapping available resources & technologies
2. Creating an inventory of biomass, industrial processes & applications
3. Standardizing data collection across regions
4. Promoting industrial symbiosis & supply chain efficiency

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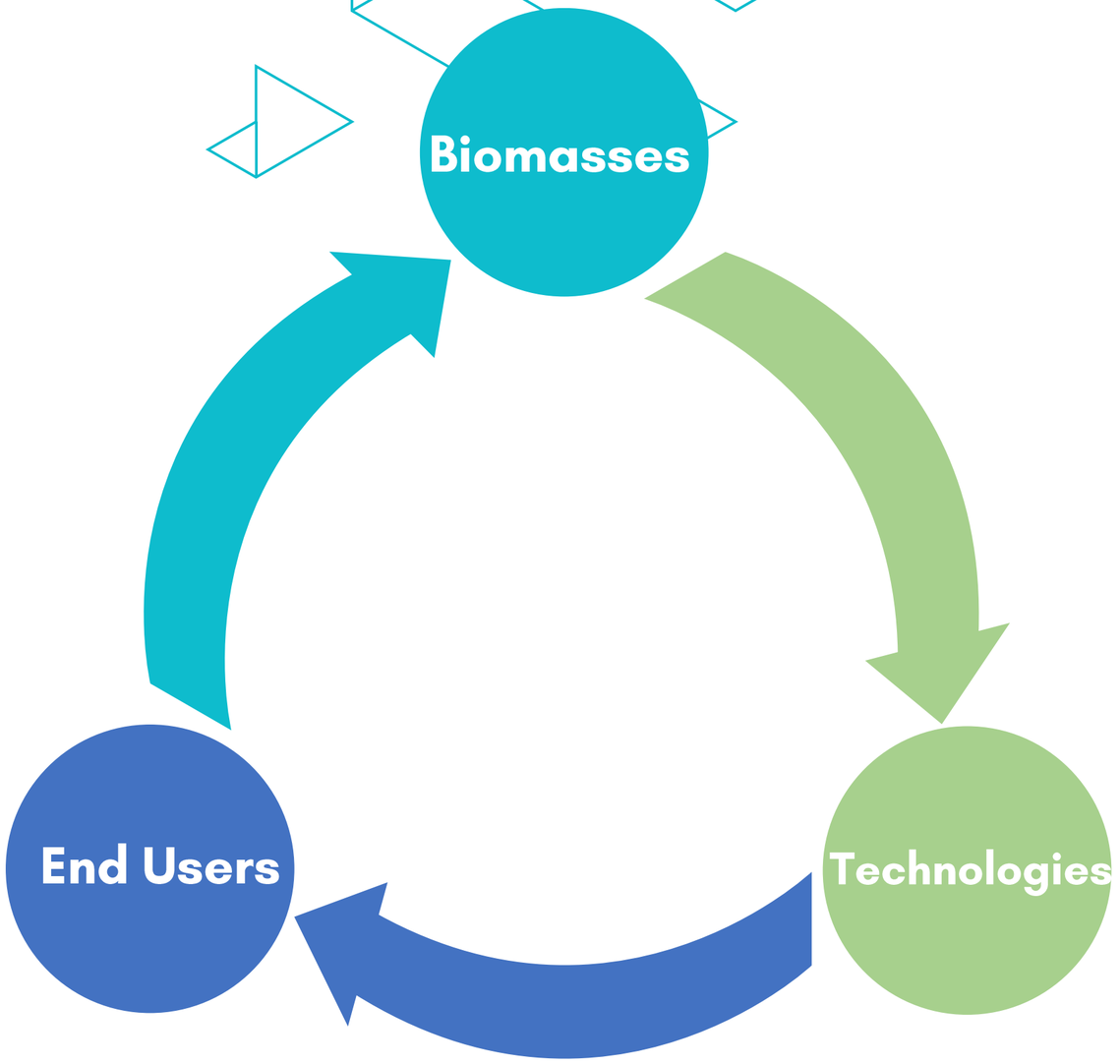
Circular Value Chain Analysis



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European Biomass Availability

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Biomass Analysed

2 Types of Biomass Screened

Primary Biomass

Directly harvested plant materials (e.g., crops, forest products).

Seconday Biomass

Residues & by-products from agriculture, forestry, and industry.

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Regional Availability

Main Primary Biomasses Available in Europe

1. Oat
2. Sugar beet
3. Rapeseed
4. Alfalfa
5. Wheat
6. Maize
7. Rice
8. Soya
9. Barley

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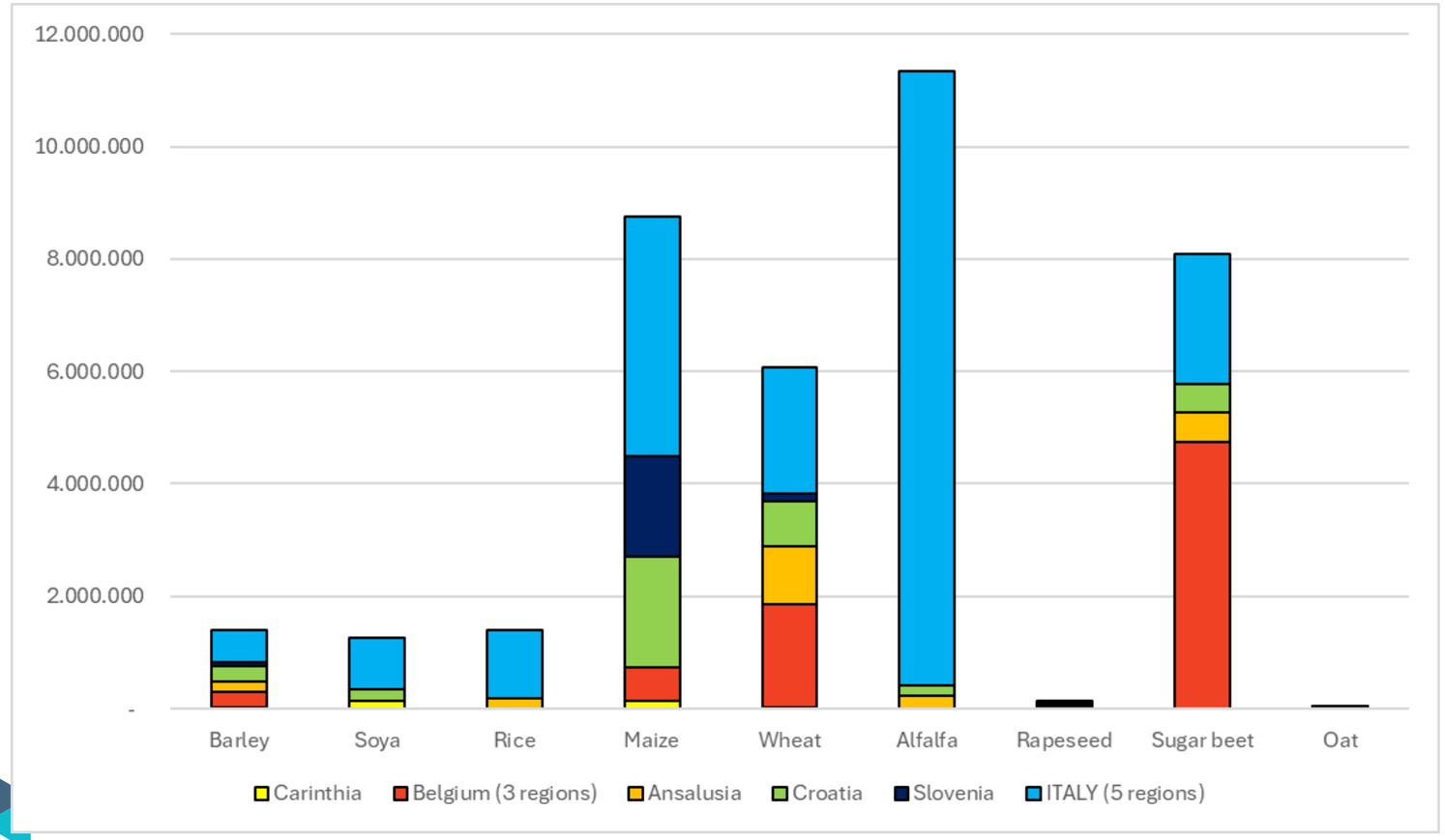
Primary Biomasses



Eurostat

The main **3** EU biomasses for Production Volume:

- **Alfalfa**, a leguminous, is valued for its high nutritional content and its role in crop rotation.
- **Maize**, being a staple crop, is extensively cultivated for both human consumption and livestock feed, thriving in the warm, temperate regions
- **Sugar beet** is widely used for sugar production.

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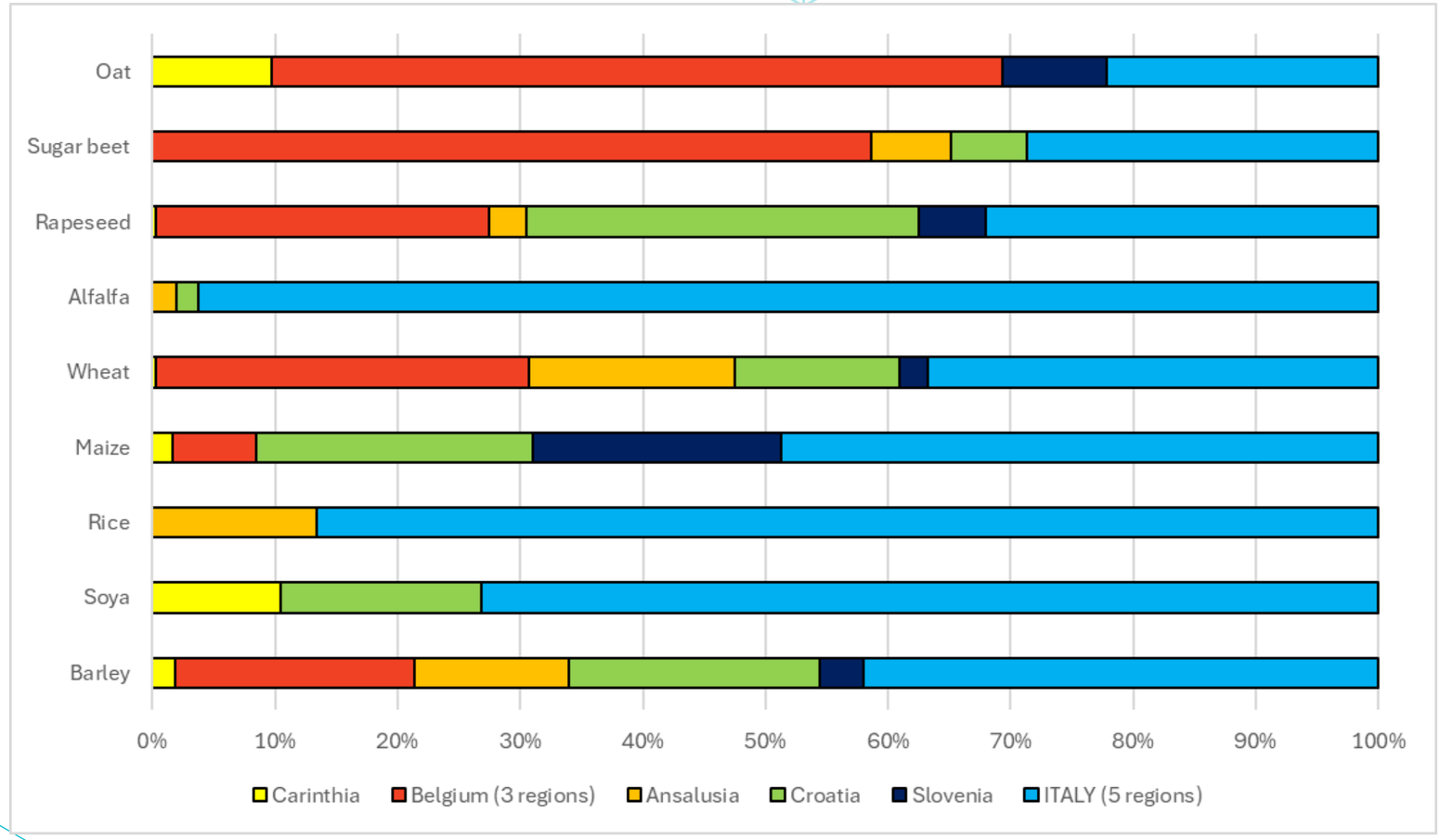
European Distribution

- The Highest production for primary biomasses is in **Italy and Belgium** – it may be due to the wider territory analysed
- Some biomasses are cultivated **only in some project regions** (e.g. Rice, Soya, Oat)



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Regional Availability

Biomass **Presence** varies due to:

1. Climate
2. Agricultural Practices
3. Resource Presence

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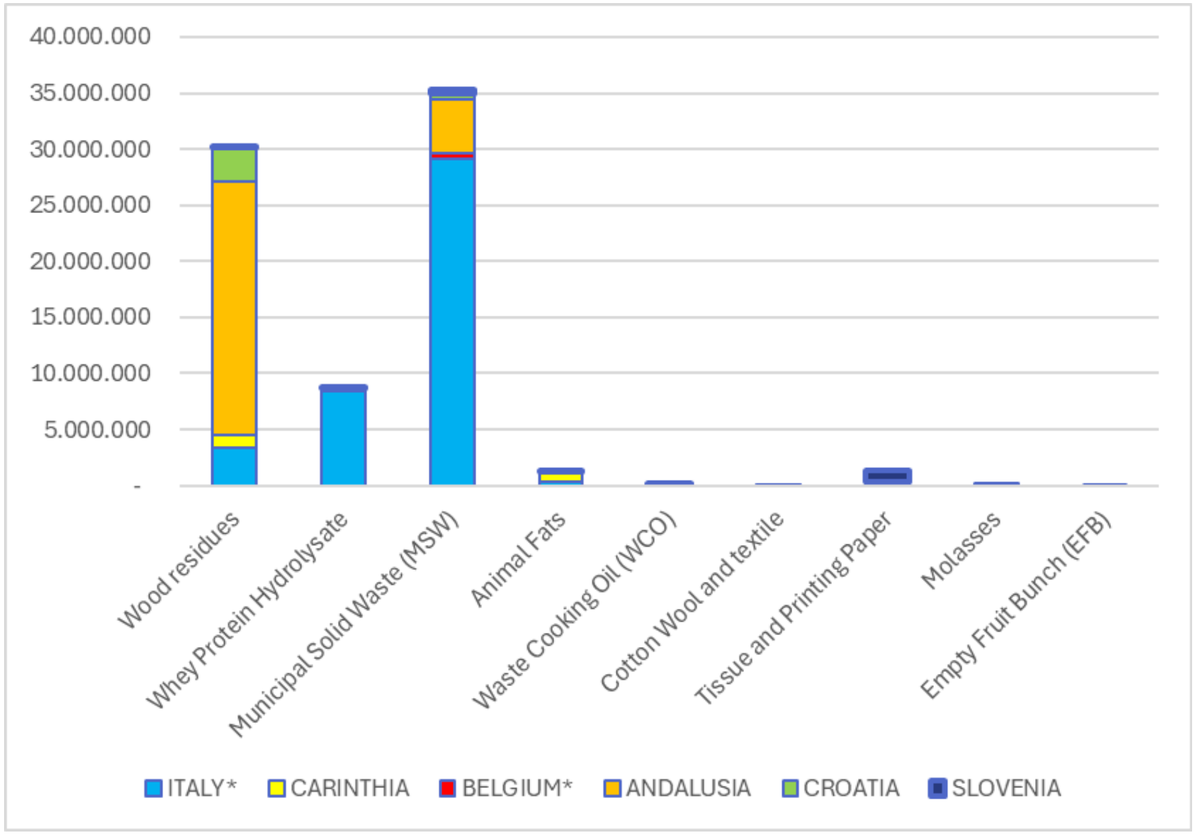
Industrial residues

The main **industrial residues** for Production Volume are:

- **Wood residues**: generated from industrial roundwood processing and forest management activities exhibit notable variability across the project regions.
- **Municipal solid waste** (MSW): the abundance varies based on the separation process of each project region.
- **Whey Protein Hydrolysate:** is a solution derived from whey's hydrolysis composed of amino acids and peptides.



Eurostat

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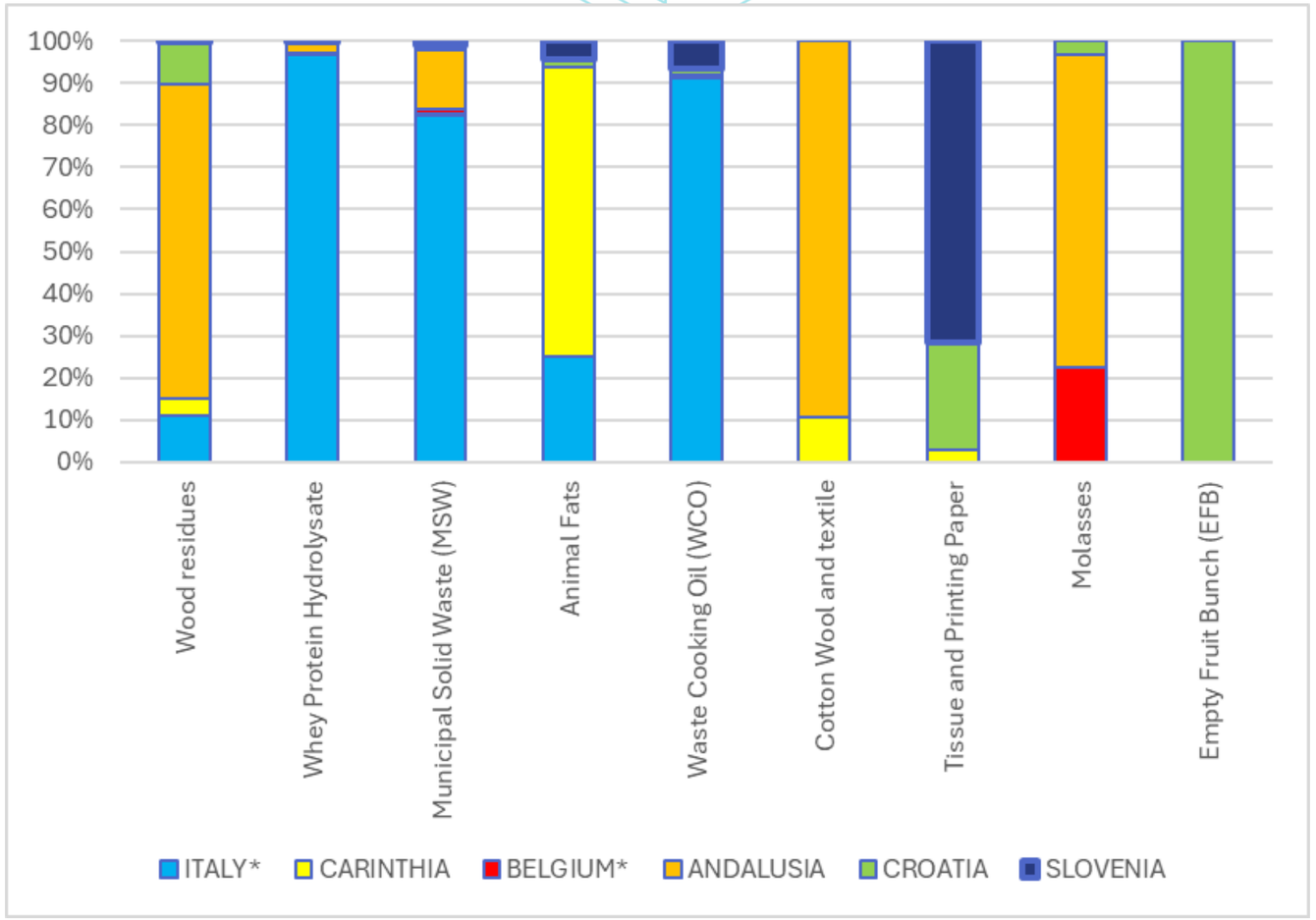
European Distribution

- The Highest production for industrial byproducts is in **Italy** and **Andalusia**- it may be due to the dataset used in the analysis and waste collecting systems used in each region.
- Some byproducts are produced and available **only in some project regions** (e.g. EFB, Cotton, Molasses)



Eurostat

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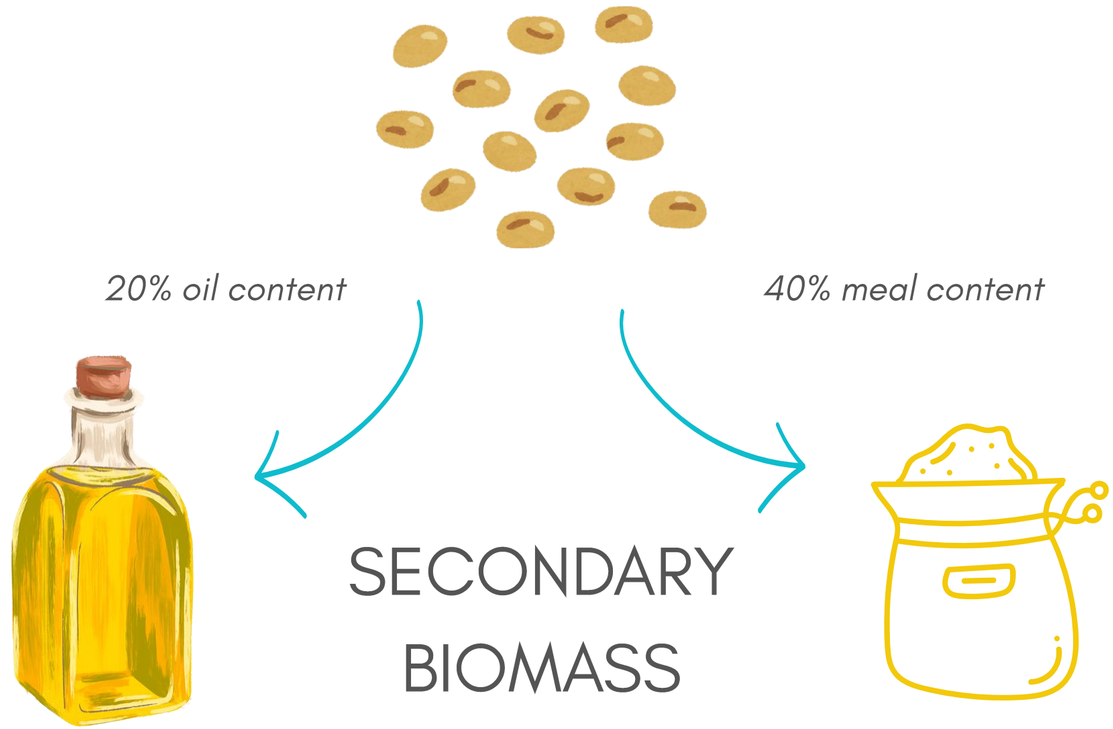
Secondary Biomasses

Starting from the provided data on primary biomass we have calculated the availability of secondary waste biomass using **conversion rates** from the literature.



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Secondary Biomasses

The abundance of **secondary biomasses** follows the abundance of primary biomass in each project region because it is dependent on the main biomass produced.

→ Alfalfa residues, Maize stover and straw, and Sugarbeet residues.

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Considerations from biomasses andalysis

✅ **Significance of Biomass –** Biomass remains a crucial renewable source to support Europe's energy transition and carbon neutrality goals.

✅ **Regional Variability** – Biomass potential varies across Europe due to differences in climate, land use, and policies, requiring tailored strategies for each region.

✅ **Sustainability Challenges** – Ensuring biomass production aligns with sustainability goals (biodiversity protection, land use balance, and carbon neutrality) is essential.

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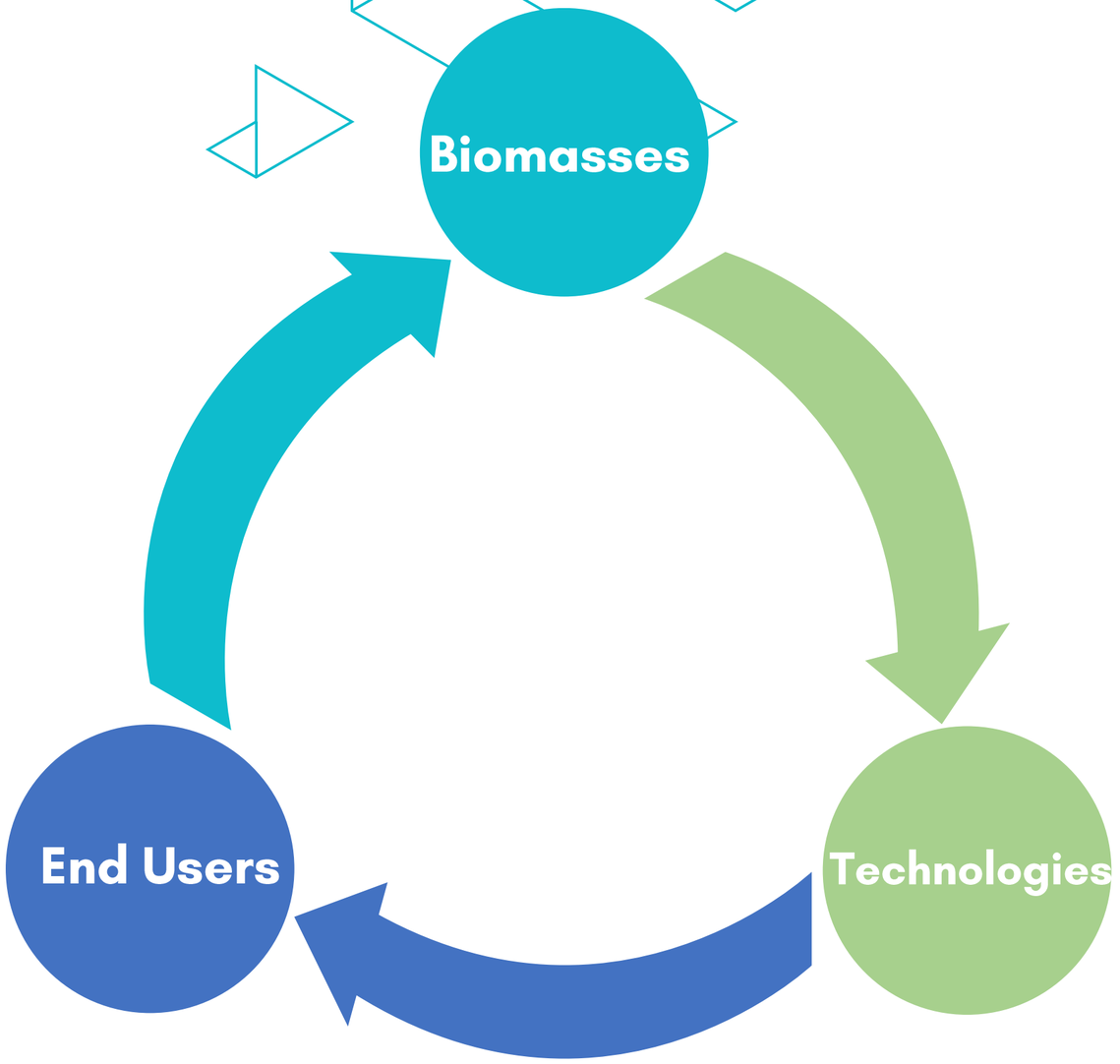
Circular Value Chain Analysis



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Technologies - Overview

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Methodology

Our methodology included:

1. Data Collection and Literature Review
2. Technology Mapping
3. Gap Analysis and Future Projections:

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Importance of Regional Mapping

The regional mapping process has allowed us to:

- Identify key technologies currently in use and their level of maturity.
- Analyze the adaptability of industrial plants in converting biomass into bio-based products.
- Highlight technological gaps that need to be addressed to enhance sustainability and economic growth.
- Assess the feasibility of expanding production facilities and optimizing supply chains.

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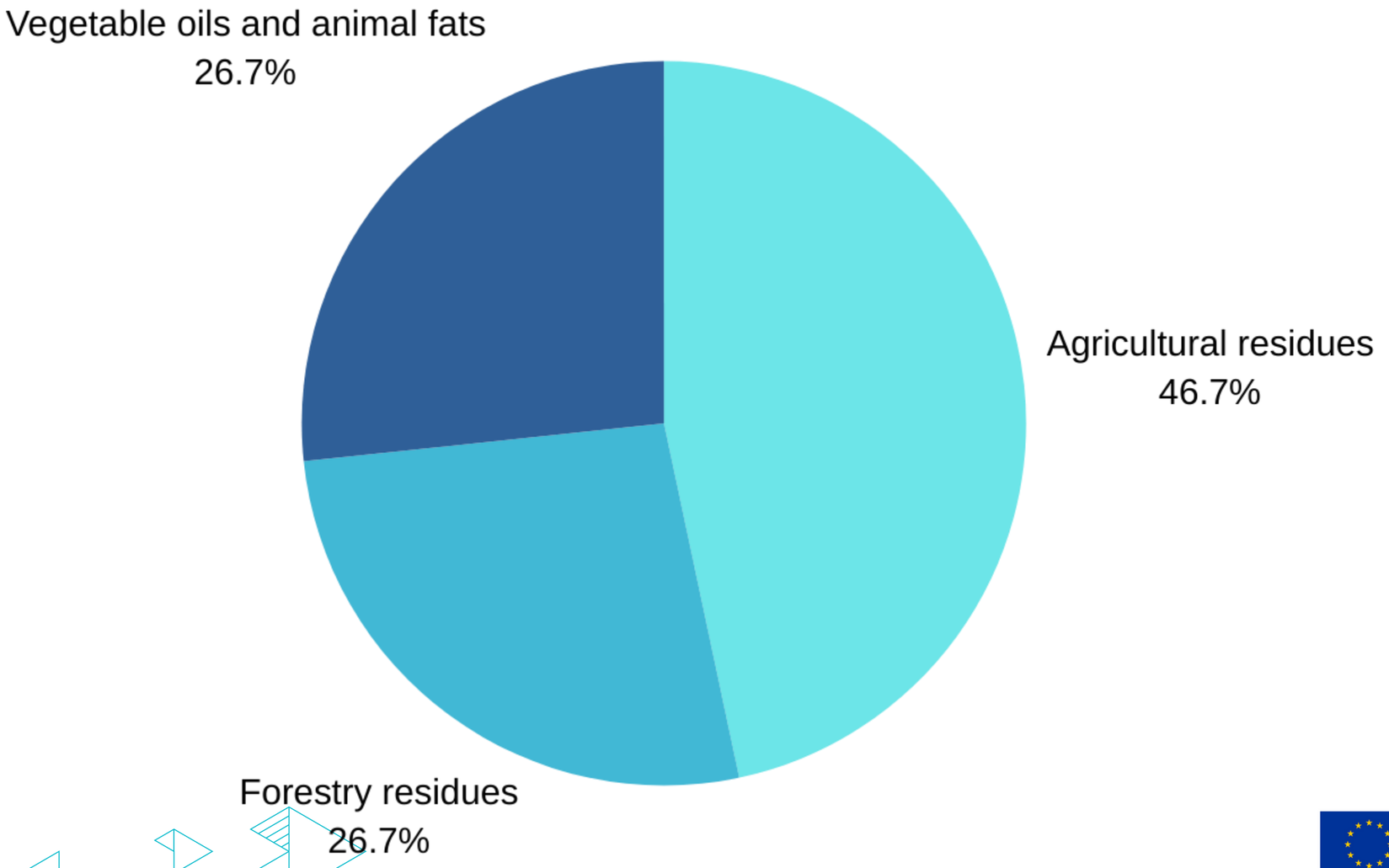
Main Biomasses Used



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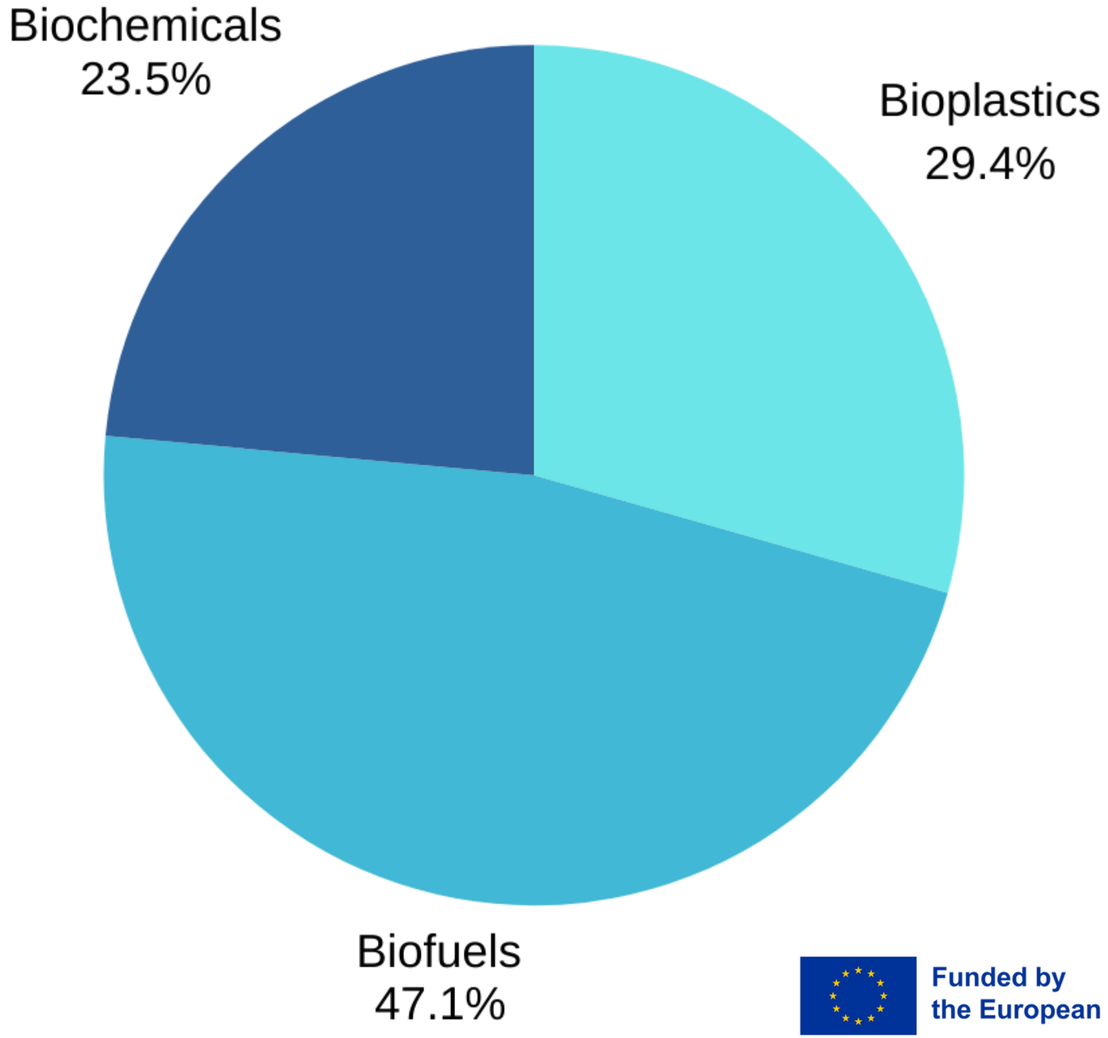
Main Bio-Based Products Obtained

Bioplastics: like polylactic acid (PLA), polyhydroxyalkanoates (PHA), and cellulose derivatives. These materials can replace traditional plastics.

Biofuels: including biodiesel and advanced bioethanol, which provide cleaner energy options.

Biochemicals: such as glycerol, adipic acid, and furfural. These are used in industries like cosmetics, food, and pharmaceuticals.



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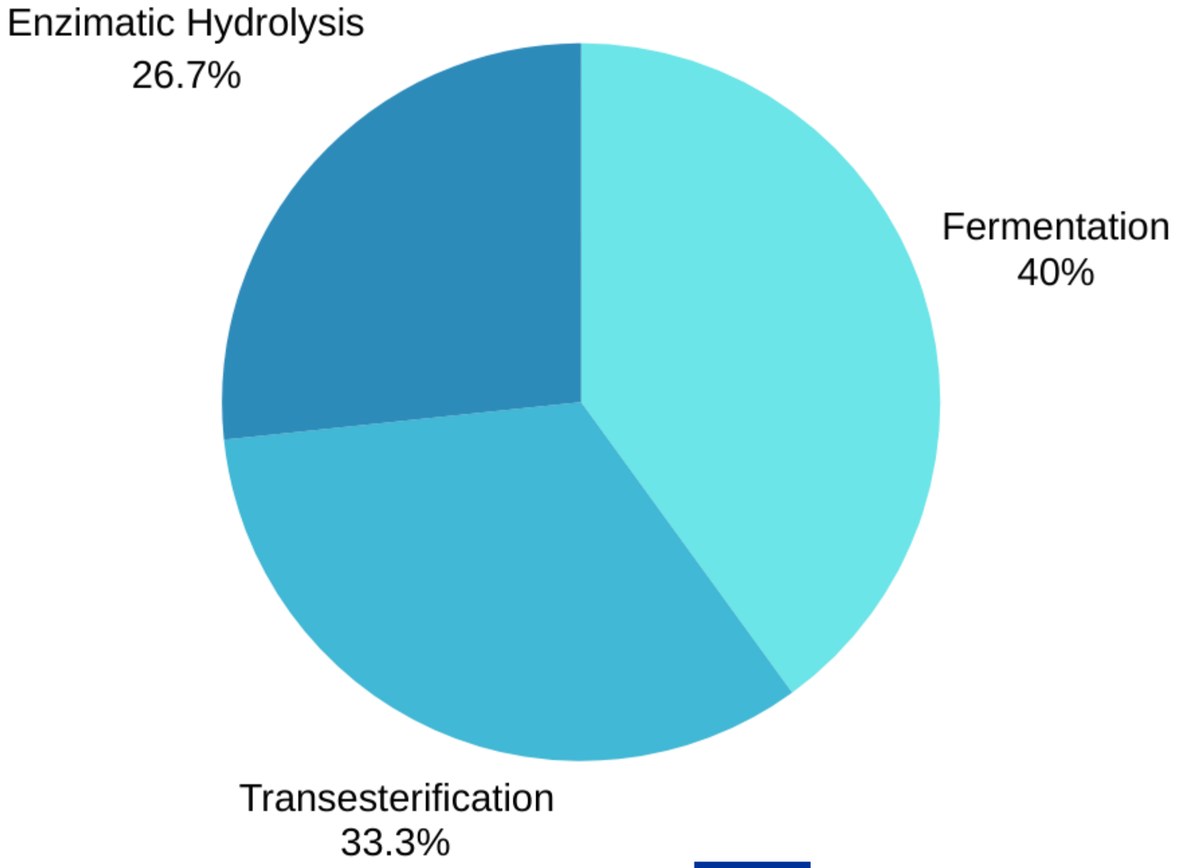
Technologies and Processes Employed

- **Advanced Fermentation:** used to produce lactic acid, ethanol, and PLA bioplastics.
- **Transesterification:** an important process for making biodiesel from vegetable oils and animal fats.
- **Enzymatic and Chemical Hydrolysis:** a method that breaks down plant materials into sugars, which can then be turned into biochemicals like succinic acid and sorbitol.



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Regional Mapping

Italy

Bio-Products
- PLA and PHA
- Bioethanol
- Biodiesel
- Bio-based chemicals

Process
- Fermentation
- Transesterification

Austria

Bio-Products
- Biogas
- Biodiesel
- Bio-based chemicals

Process
- Fermentation
- Enziamatic Hydrolysis

Belgium

Bio-Products
- PLA and PHA
- Glycerol
- Biodiesel

Process
- Fermentation
- Transesterification

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Regional Mapping

Slovenia

Bio-Products
- Biodiesel
- Bio-based chemicals

Process
- Fermentation
- Transesterification

Spain

Bio-Products
- Biodiesel
- Bioethanol
- PLA e PHA
- Glycerol

Process
- Fermentation
- Transesterification

Croatia

Bio-Products
- Biodiesel
- Bio-based chemicals

Process
- Fermentation
- Transesterification

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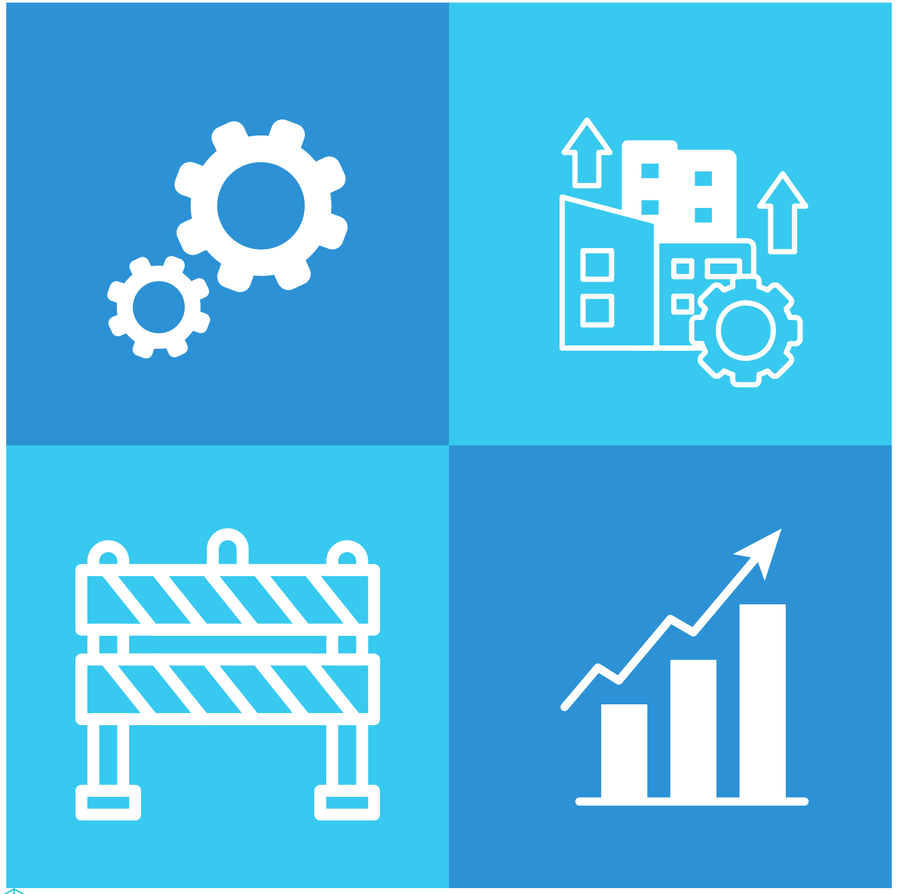
Key finding

ADAPTABILITY OF TECHNOLOGIES

Many industrial plants have the capability to process biomass and agricultural waste, but they do not necessarily produce the desired bio-based molecules as primary outputs.

CHALLENGES IN MARKET PENETRATION:

Despite the growing interest in bio-based products there might be barriers



TECHNOLOGY MATURITY AND INDUSTRIAL READINESS

The study has shown that some technologies are well-developed and widely adopted, while others are still in their early stages of commercialization.

POTENTIAL FOR GROWTH

The increasing demand for sustainable materials and bio-based chemicals opens up significant opportunities for innovation, investment, and cross-sector collaboration.

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Thank you

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