



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

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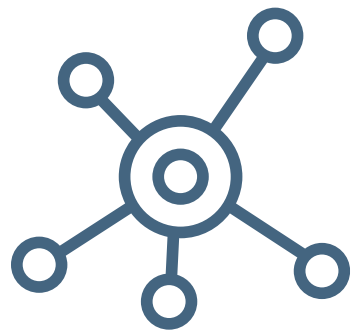


SYMBIO's Regional Hub Handbook and Data Collection Inventory

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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.

12 target European pilot regions



Austria
Carinthia



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



Belgium
Brussels Capital,
Wallonia, Flanders



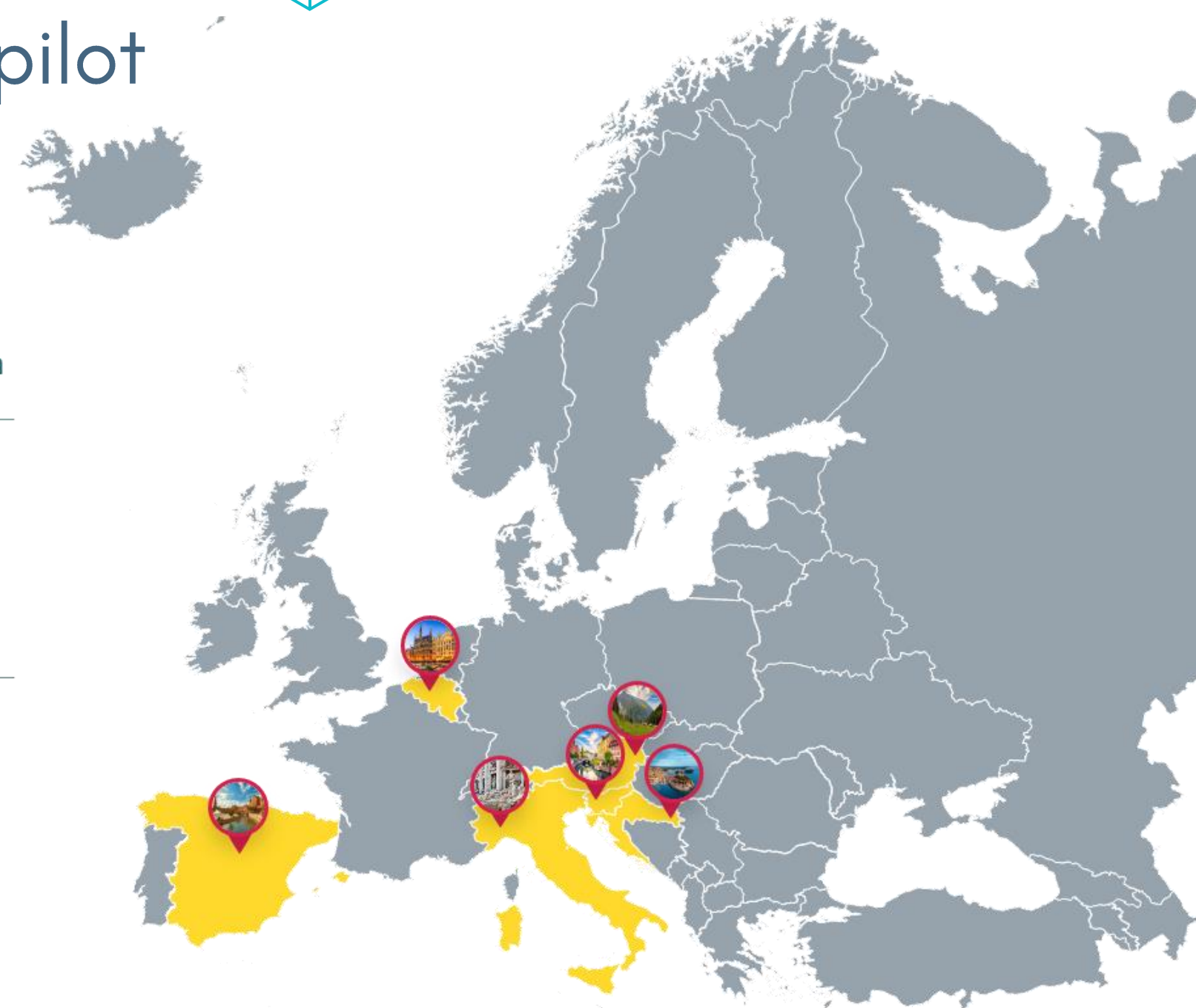
Spain
Andalusia



Croatia



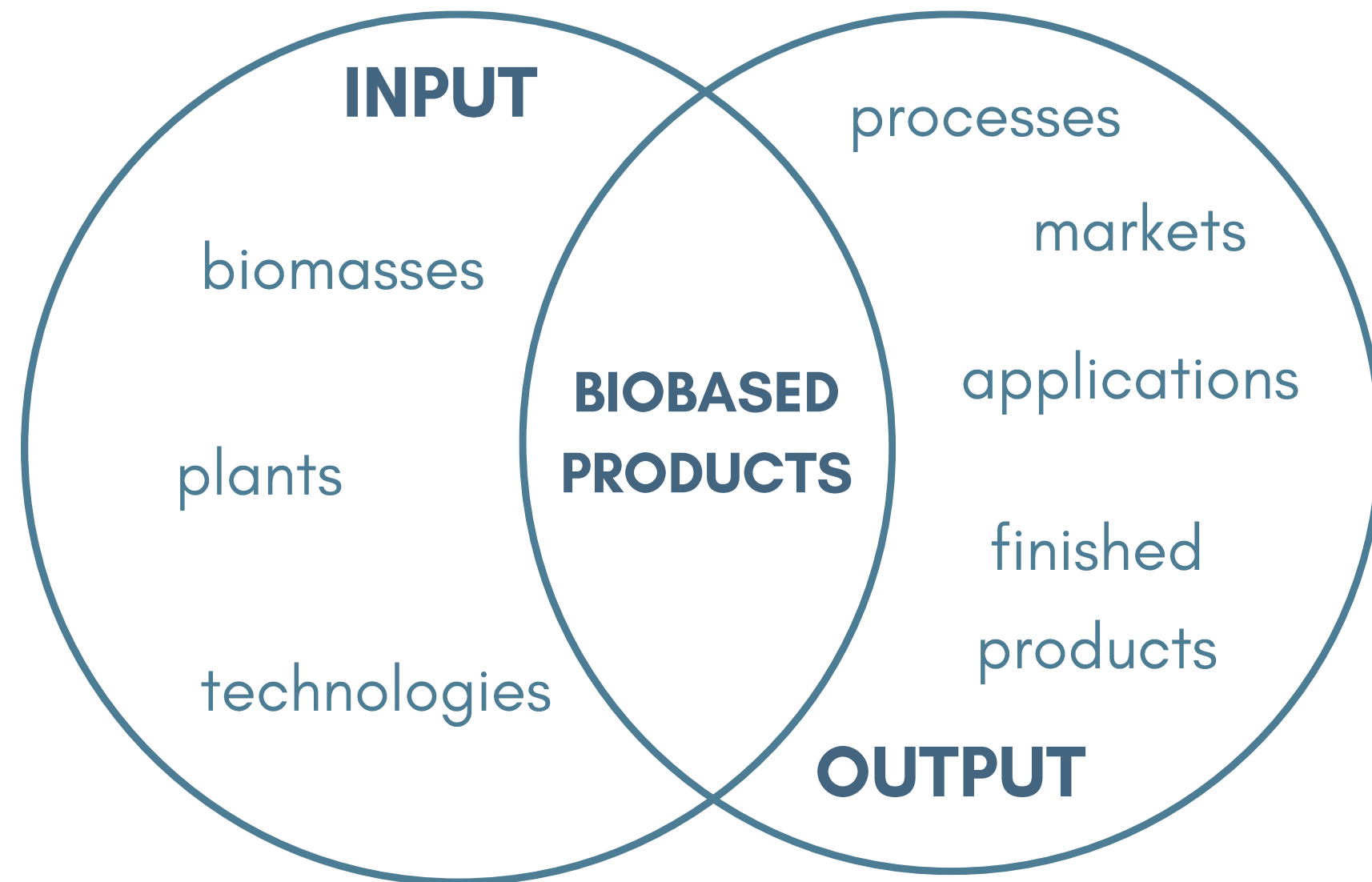
Slovenia



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.

Regional Data Hubs





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 availability 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

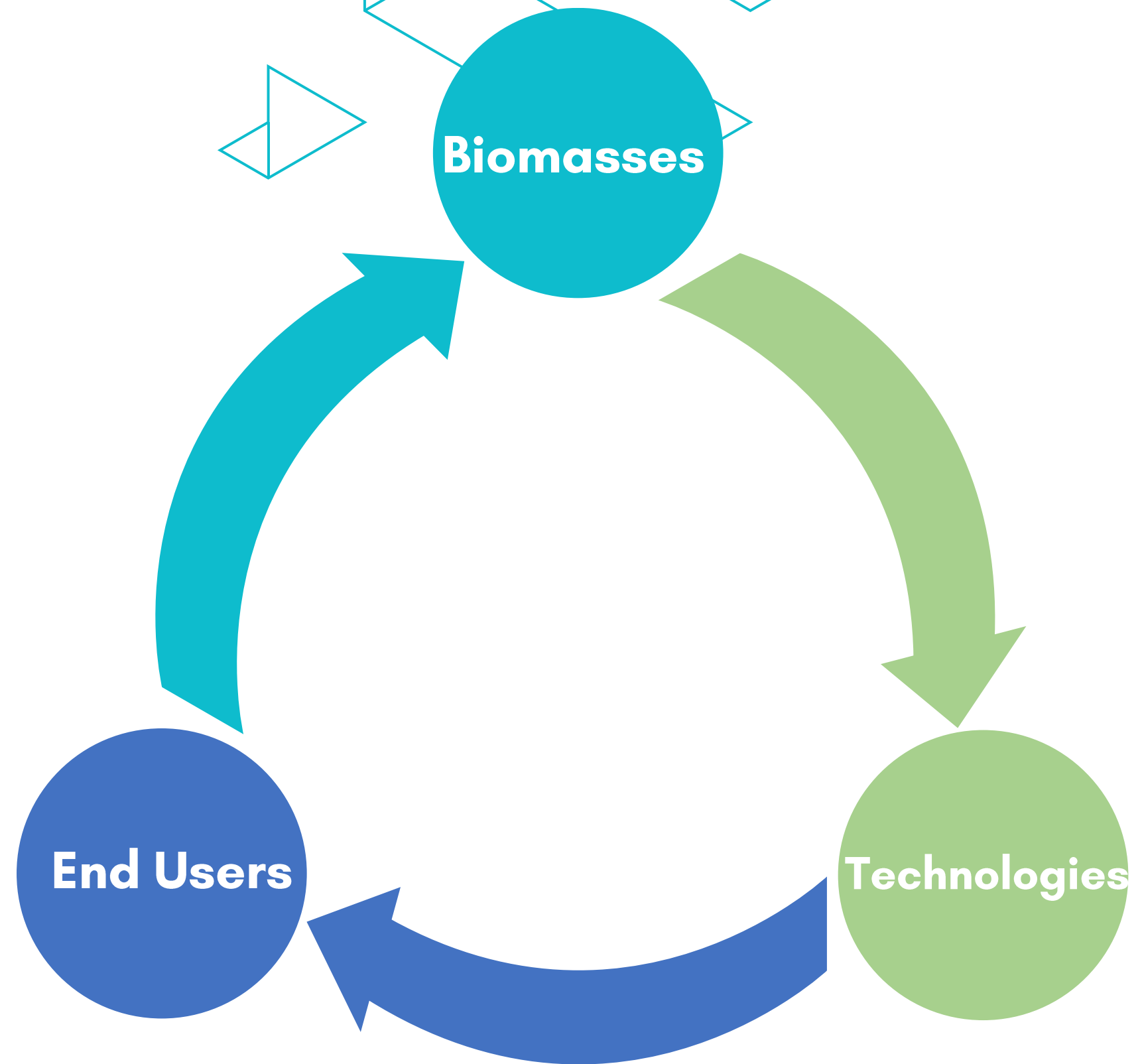


Data Collection Inventory



- 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

Circular Value Chain Analysis



European Biomass Availability

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Biomass Analysed

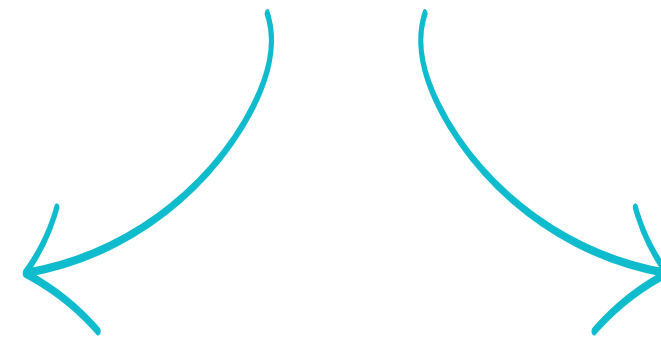
2 Types of Biomass Screened



Primary Biomass

Directly harvested plant materials

(e.g., crops, forest products).



Secondary Biomass

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



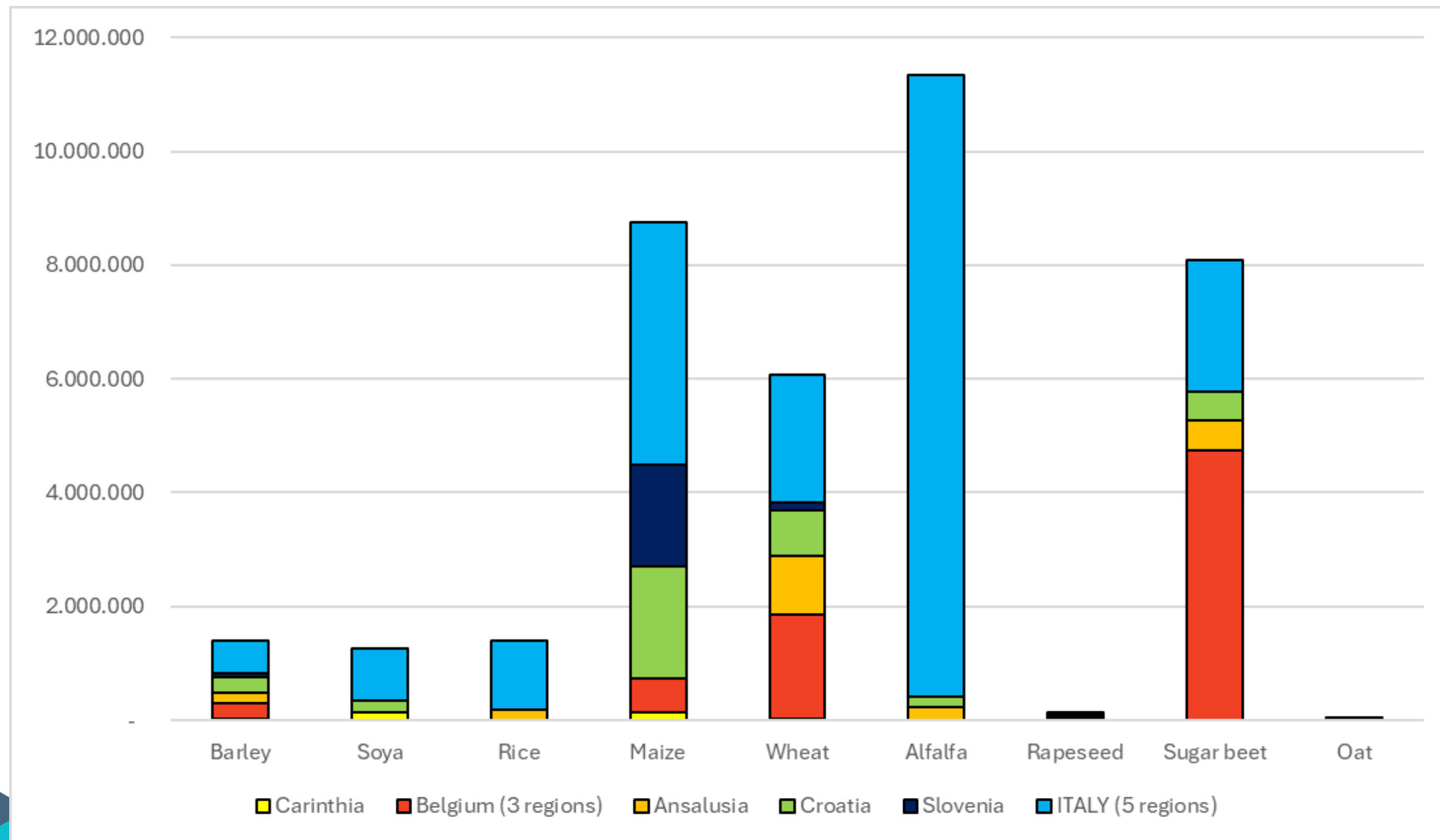
Regional Availability

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



Primary Biomasses



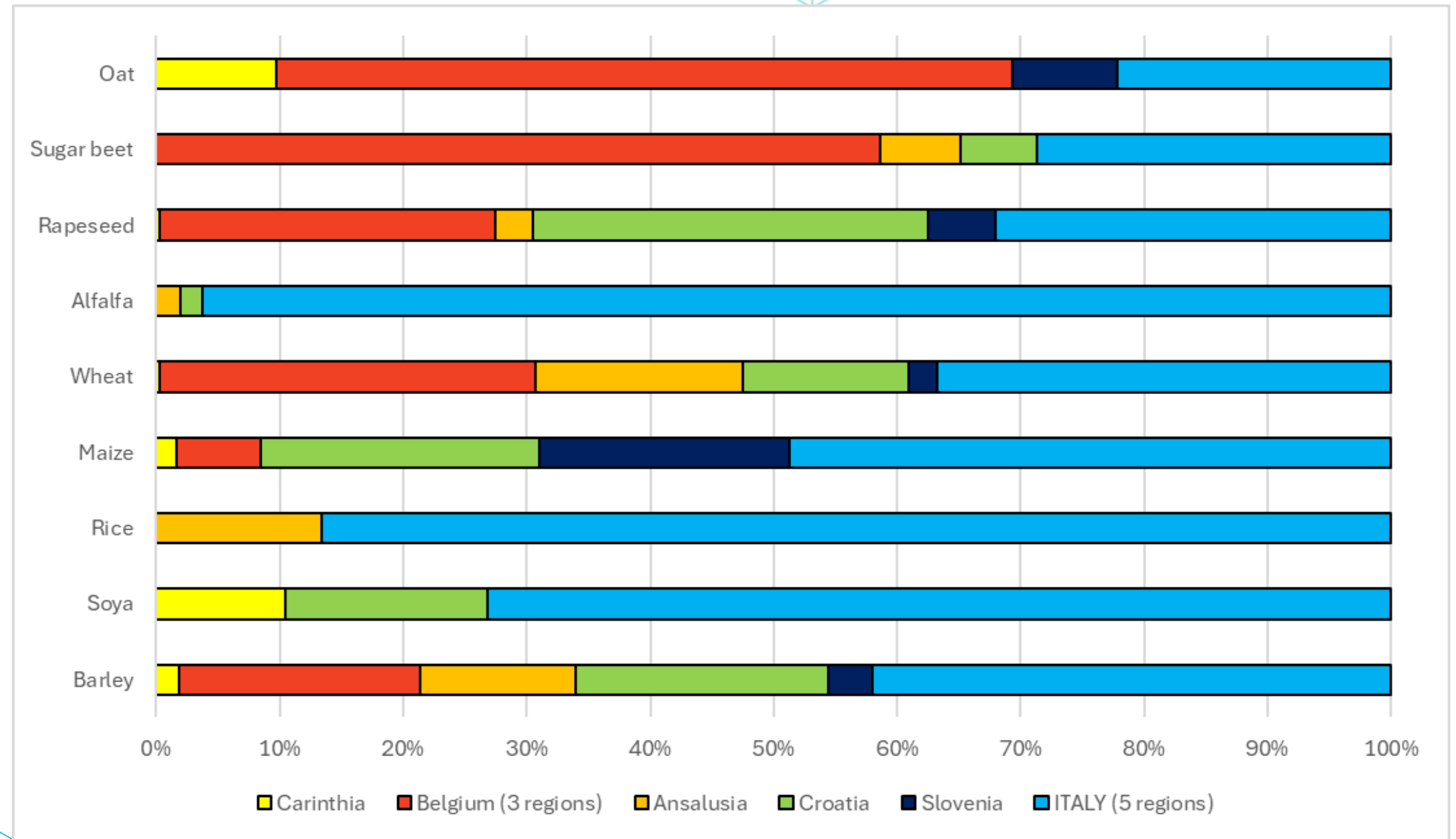
Eurostat

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.

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)



Eurostat

Regional Availability

Biomass **Presence** varies due to:

1

Climate

2

Agricultural Practices

3

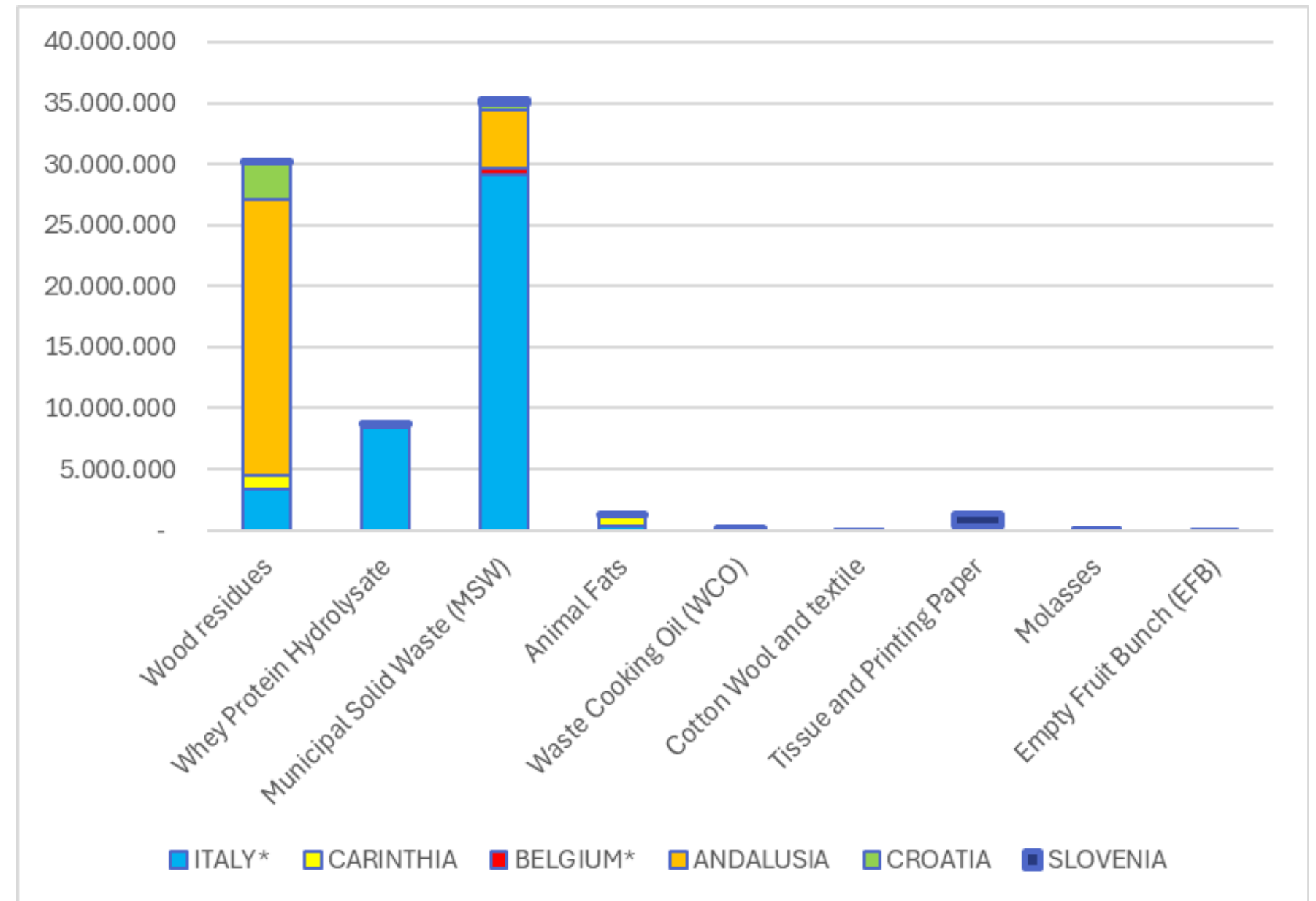
Resource Presence

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

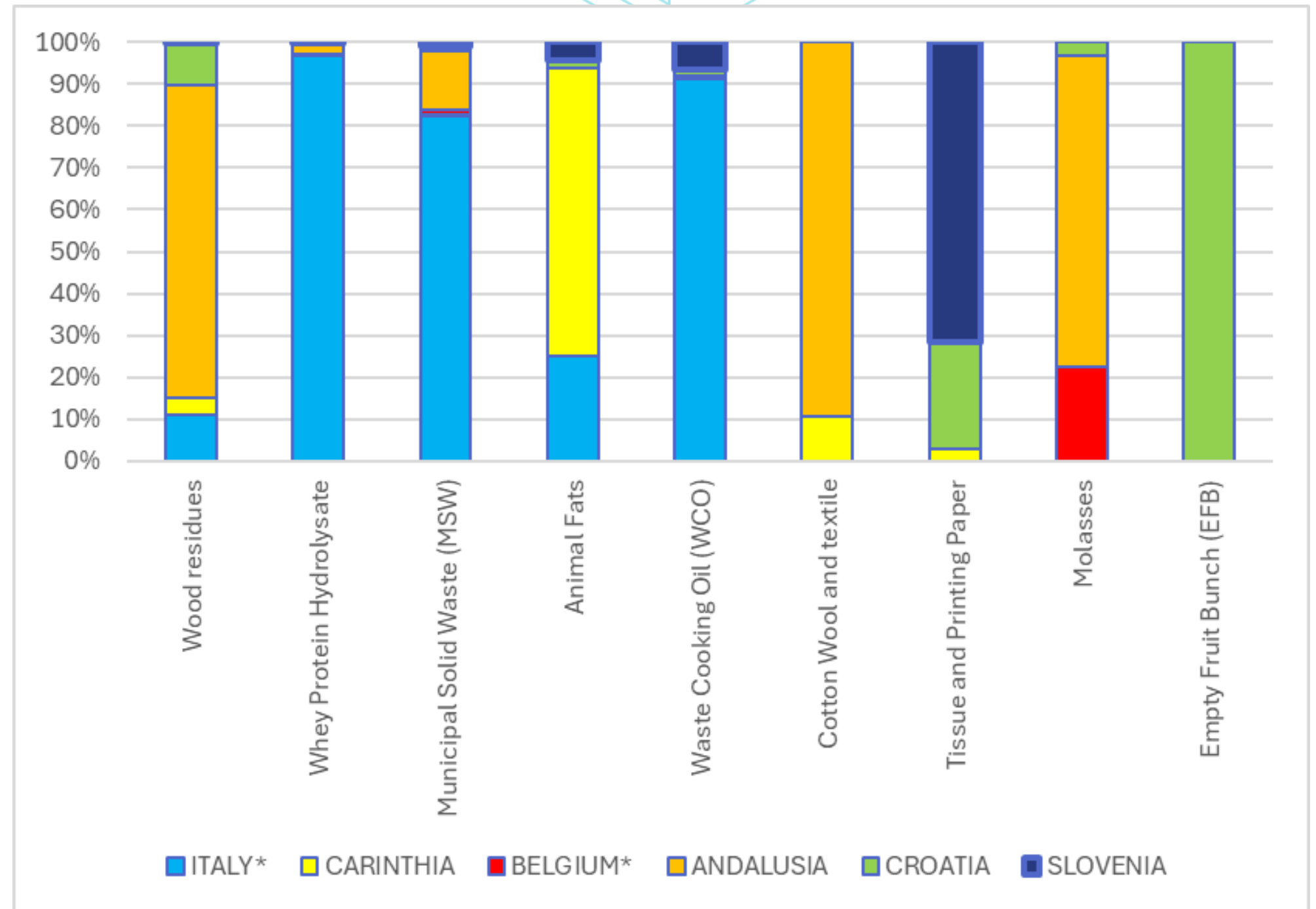


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European Distribution

- 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

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.

PRIMARY BIOMASS



20% oil content

40% meal content



SECONDARY BIOMASS



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.

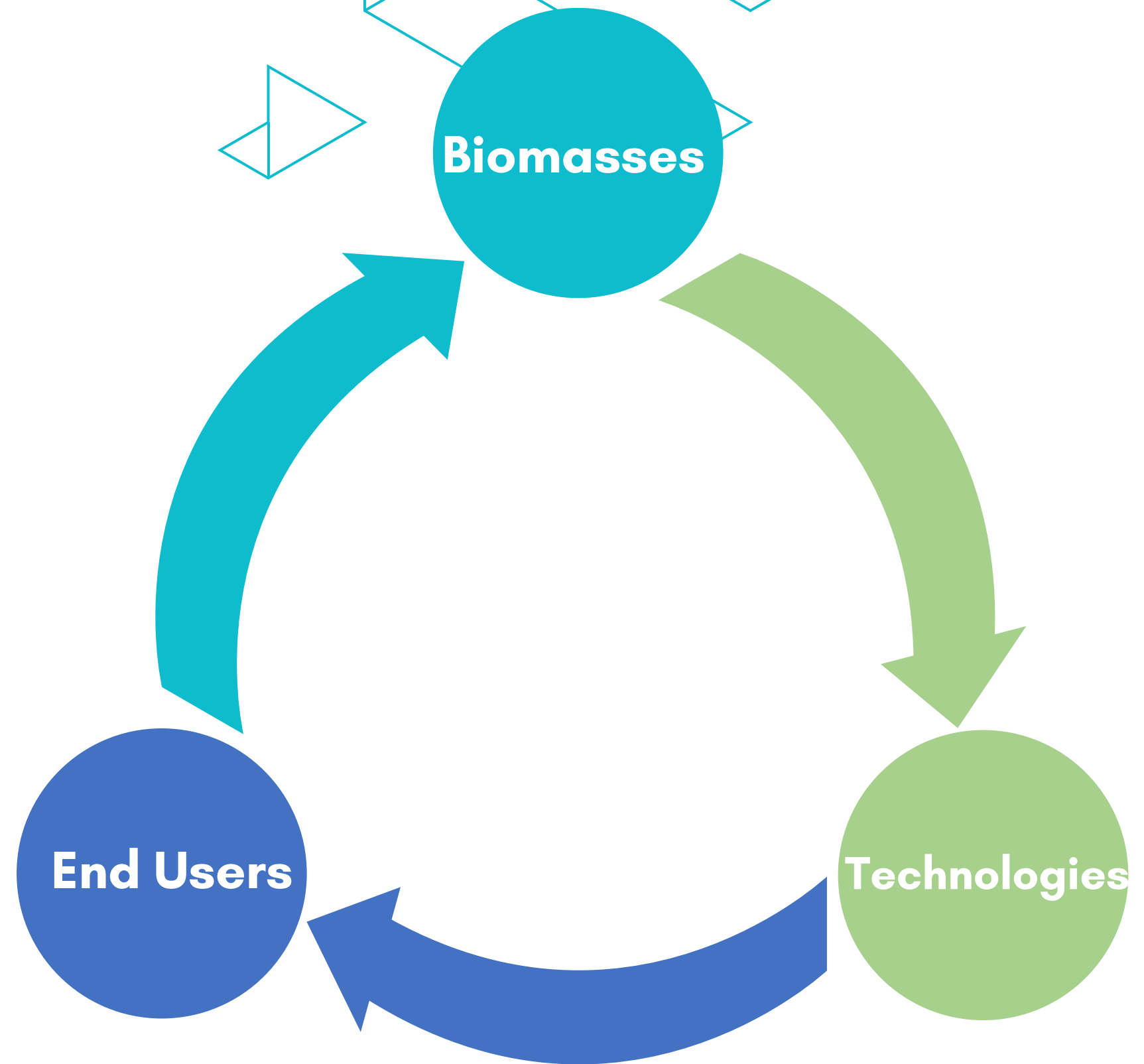
→ Alfalfa residues, Maize stover and straw, and Sugarbeet residues.

Considerations from biomasses analysis

- ✓ **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.



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

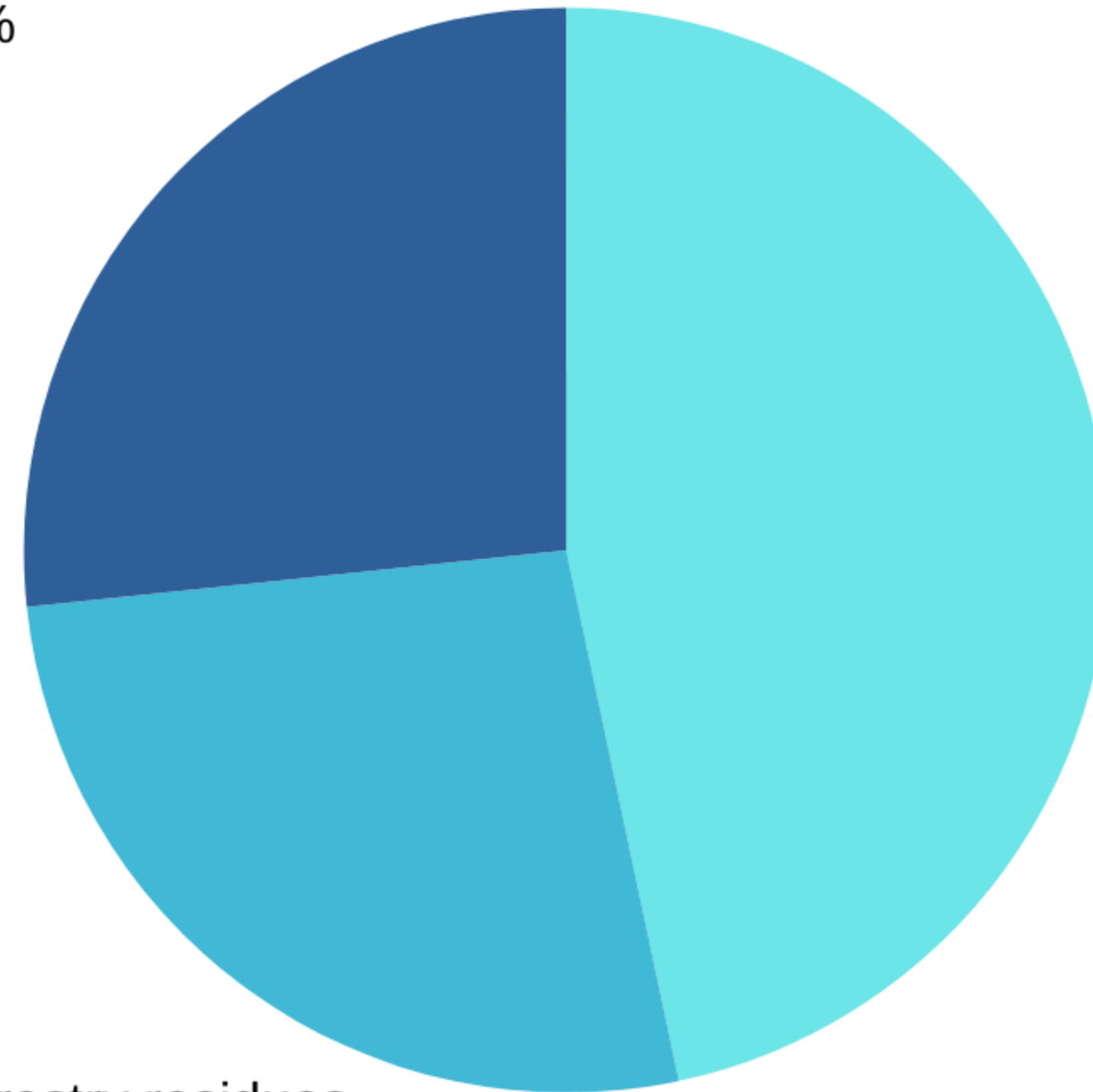
The regional mapping process has allowed us to:

- 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.



Main Biomasses Used

Vegetable oils and animal fats
26.7%



Agricultural residues
46.7%

Forestry residues
26.7%



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Main Bio-Based Products Obtained

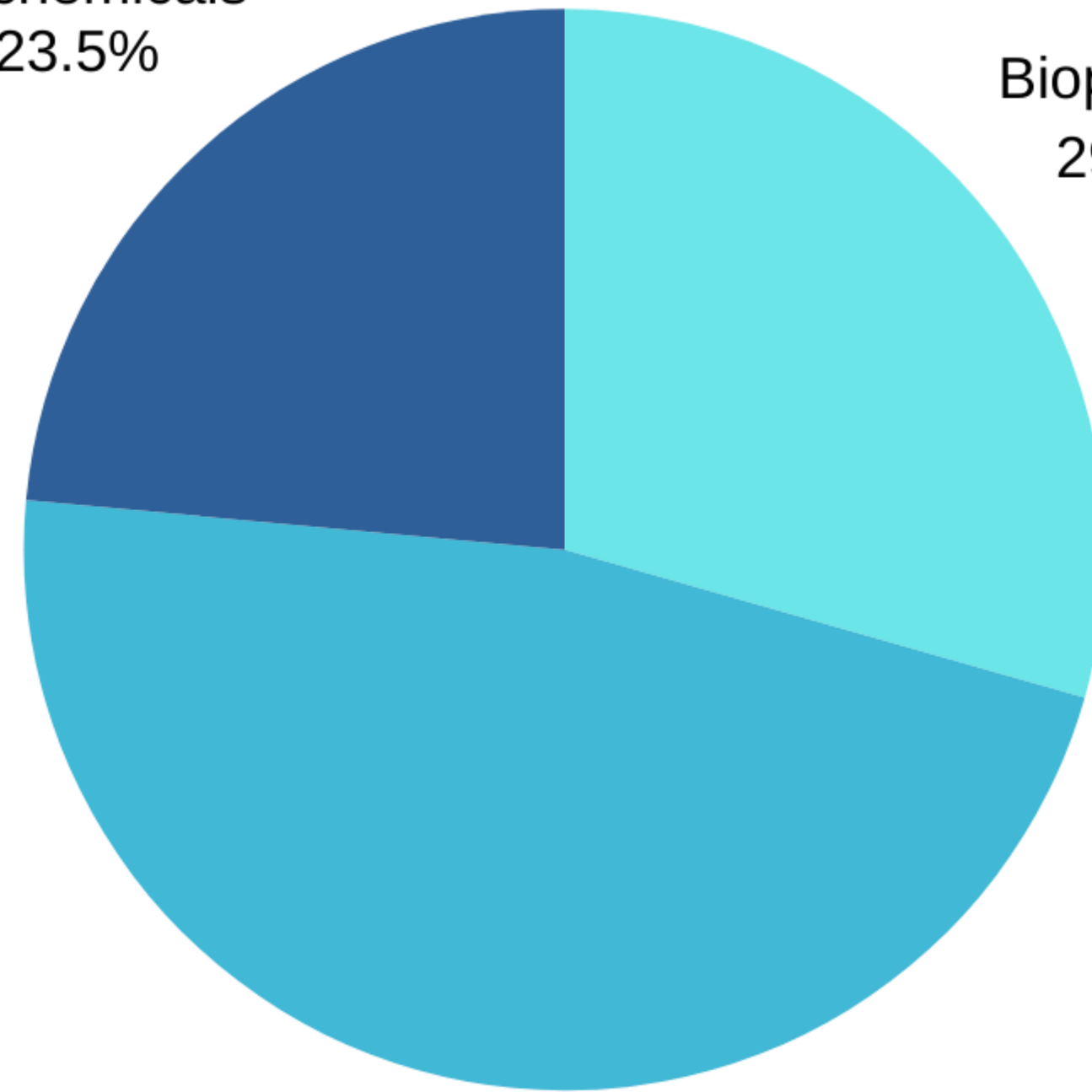
Bioplastics: like polylactic acid (PLA), polyhydroxyalkanoates (PHA), and cellulose derivatives. These materials can replace traditional plastics.

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.

Biochemicals
23.5%

Bioplastics
29.4%



Biofuels
47.1%



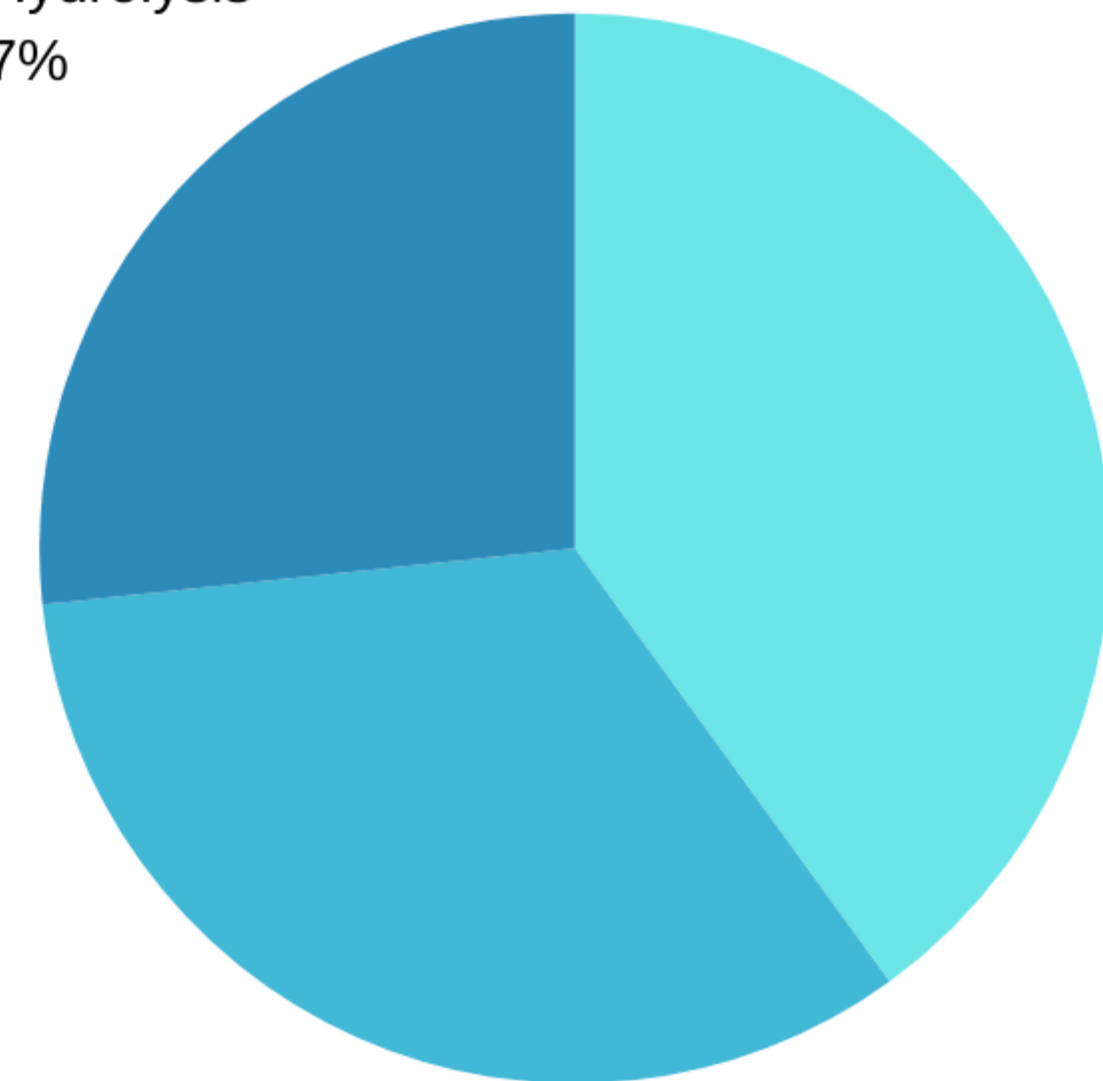
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Technologies and Processes Employed

- **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.

Enzymatic Hydrolysis
26.7%



Transesterification
33.3%

Fermentation
40%



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
- Enzymatic Hydrolysis

Belgium

Bio-Products

- PLA and PHA
- Glycerol
- Biodiesel

Process

- Fermentation
- Transesterification

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

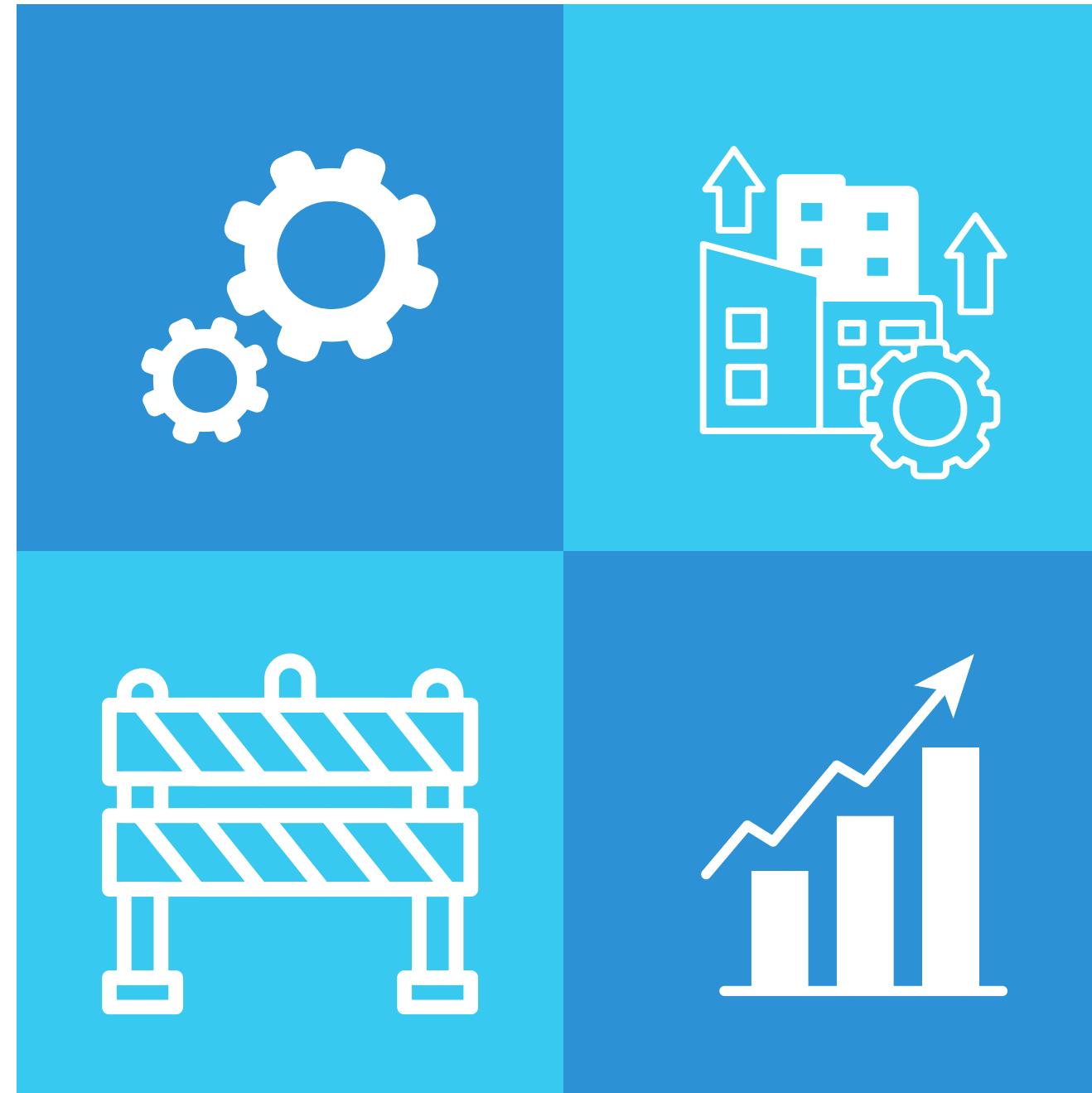
Key finding

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.



Thank you

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