REGIONAL FOCUS GROUP WORKSHOP

From Lignocellulosic Biomass to Bioplastics

Slovenia

Funded by the European Union · Grant Agreement No 101135166

SYMBIO
MEET YOUR SUSTAINABILITY TARGET

alchemia nova research

Cardiff Metropolitan University

Anteja

Agenda

01 Introduction to SYMBIO Project

02 The Value Chain: Wheat Straw to PHA

03 Material Flow Analysis

04 Economic, Ecological & Social Aspects

05 Ecosystem Map

06 Designing the Implementation Blueprint

07 Validating Slovenia’s Ecosystem Map

08 Networking and light Lunch

The SYMBIO Project

WP1

DATA-HUB BUILDING

Explored and analyzed regional resources that trigger symbiotic activities close to the market.

- Quantified biomass availability
- Mapped 12 promising bio-based products and transformation pathways
- Ecosystem mapping

WP2

VALUE-CHAIN DESIGN

Connecting companies in circular value chains based on their specific material flows and available technologies

- 47 prioritised value chains
- selected based on local feedstock supply, conversion technologies, and clear local market demand
- Use of AI-tool VCG.AI

Have a look at VCG-AI:

WP3

BUSINESS MODELLING

Development of a circularity index and reporting system to support companies in building a circular business model

- 11 regional value chains were prioritized via Multi-criteria decision-making analysis (MCDMA)
- Visualization through Material Flow Analysis
- Multi-criteria overview
- Followed by multi-stakeholder workshop
- Policy recommendations

WP4

BUSINESS DEPLOY

Accelerate business case development by measuring social, economic and environmental impact

- LCC, LCA, social and sociological benefits assessment
- Building Synergies with EU projects, networks, initiatives
- Exploitation routes

Pilot regions

Methodology designed, tested and validated in **12 EU pilot regions** selected based on their biological resources, infrastructure and potential for developing close-to-market CBE supply chains.



Austria

Carinthia



Belgium

Brussels Capital, Wallonia, Flanders



Croatia



Italy

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

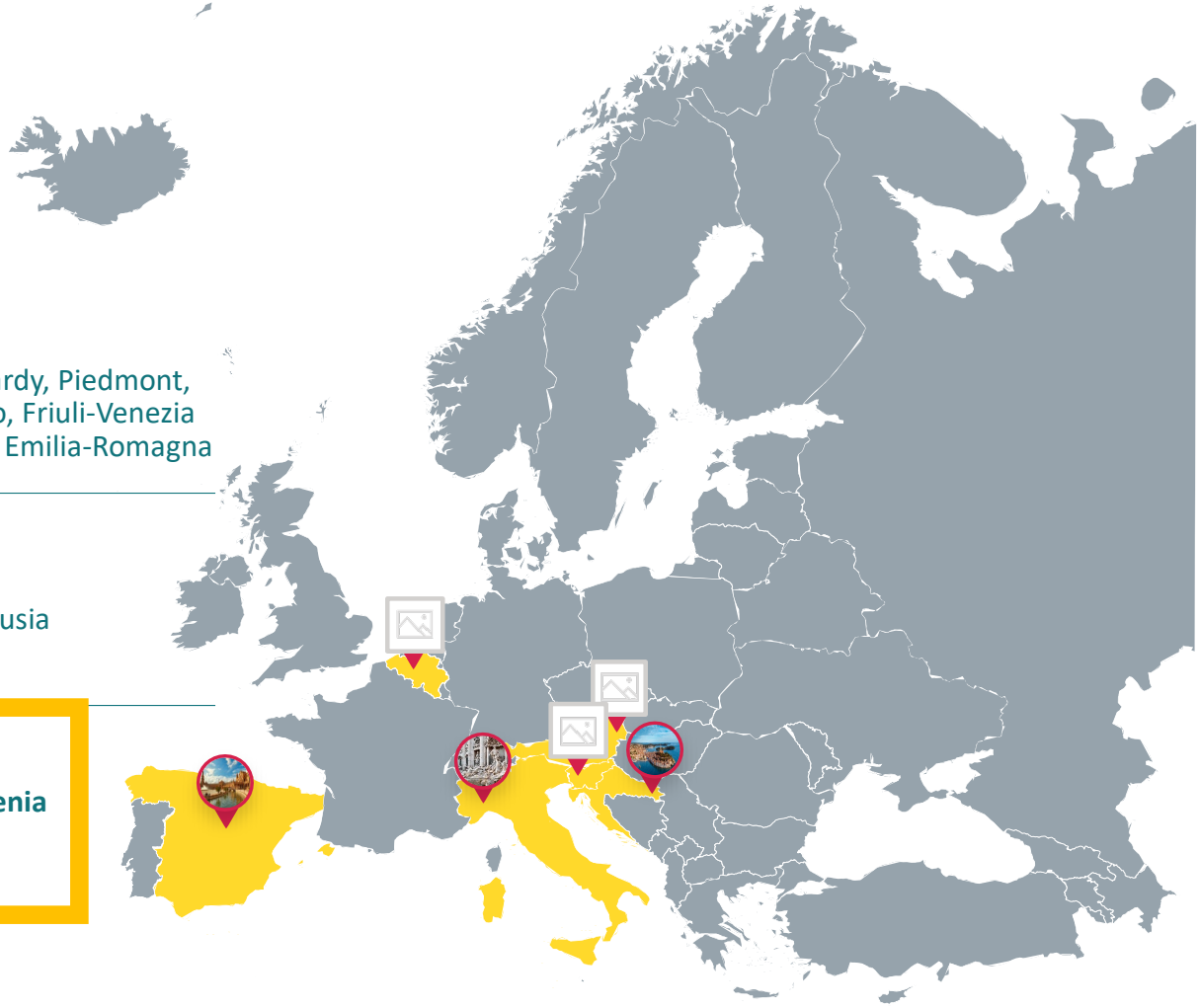


Spain

Andalusia



Slovenia



Strategic Decision-Making

Multi-Criteria Decision Analysis (MCDMA)

- Integrates **environmental, economic & social criteria**
- Enables **transparent comparison** of options
- **Ranks value chains** based on overall **performance**

Material Flow Analysis (MFA)

- Quantifies **material inputs and outputs**
- **Visualises resource flows** through the system
- Assesses **circularity and resource efficiency**
- Applicable for **ESRS E5 corporate reporting**

Multi-Stakeholder Focus Groups

- Brings together **all actors across the value chain**
- Identifies **barriers, enablers** and financing options
- Validates **implementation potential** in practice

Combining data, sustainability metrics, and stakeholder insight to guide strategic decisions.

Lignocellulosic Biomass for PHA Production

BIOMASS COMPOSITION

35–50%
Cellulose
C6 sugars
(Glucose)

20–35%
Hemicellulose
C5 sugars
(Xylose, Arabinose)

5–30%
Lignin
Aromatic polymer
(protects biomass)

PRODUCTION CASCADE

1. **Pre-treatment**
2. **Hydrolysis**
3. **Fermentation**
4. **Extraction**

BENEFITS

Carbon neutral
Closed CO_2 cycle

No food competition
2nd generation feedstock

Circular economy
Residue valorisation

From Wheat straw to PHA

Wheat Straw

Wheat straw is a secondary biomass consisting of the stem and leaf material remaining after wheat grains are harvested

~ 5.5 t/ha	63%
Straw yield	Carbohydrate content

Traditional uses

- Livestock bedding
- Left on the field for soil improvement
- Waste-to-energy recovery

Polyhydroxyalkanoates (PHA)

Bacterially synthesised biopolyesters that are 100% bio-based, fully biodegradable, and biocompatible — sustainable alternatives to petroleum-based plastics.

USD 650M	11.8%
global market (2023)	CAGR growth rate (2025-2034)

Key applications

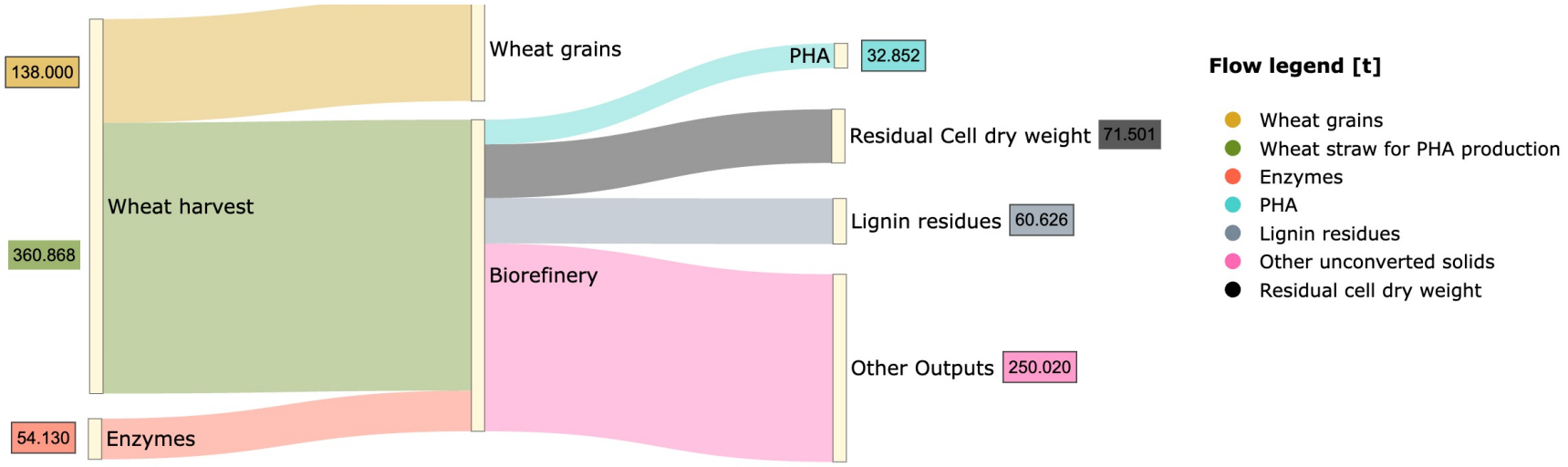
- Biodegradable packaging
- Pharmacy: Tissue engineering & drug delivery
- Agriculture

Material flow analysis

360 kt/y
Wheat straw Available

32 kt/y
PHA production potential

60 kt/y
Lignin residues



Economic Reality: Opportunities vs Challenges

Feedstock Cost Advantage
Utilizing lignocellulosic feedstocks can reduce raw material costs by approximately 40–50% compared to using refined sugars

Value-added by-products
Lignin residues can be used for renewable energy, or high-value chemicals. Residual biomass as animal feed or fertilizer.

Stable Farmer Supply
High willingness among farmers to supply straw if prices are competitive and supported by reliable, long-term offtake agreements. Competition!

High Production Costs
PHA production remains 3 to 12 times more expensive than petroleum-based plastics. Pretreatment & Downstream Bottlenecks.

Logistics & Infrastructure
Bulky, low value biomass makes transportation expensive, need for localized collection and pre-processing. Slovenia currenly lacks large-scale demonstration.



Environmental Profile

100 %
Biobased, biodegradable and biocompatible

Net Carbon Cycle

Circularity

STRENGTHS

- Mitigates microplastic pollution
- CO_2 is absorbed during growth of wheat
- Reduces GHG emissions compared to fossil-based plastics
- Valorization of secondary resources reduces pressure on natural ecosystems

RISKS

- Excessive removal of wheat straw from fields threatens soil health
- Chemical- and energy-intensive processes needed
- Net greenhouse gas reduction potential depends on regional energy mix
- Large water inputs needed

Social & Regulatory Landscape

Policy Framework

- Increasingly **strict EU packaging and sustainability regulations** (PPWR, REACH etc.)
- **Slovenia Smart Specialisation Strategy** includes bioeconomy & circular business models
- **'Deep Demonstration' initiative** with EIT Climate-KIC
- **Circular Bioeconomy Strategy** of the **Podravje Region**

Social Landscape

- growing consumer **concern regarding microplastic pollution**
- offers farmers an additional **stable income stream**
- Offers **new job potential**
- Low maturity in social innovation
- Fragmented farm structure necessitates high levels of coordination

Policy Gaps

- Lack of dedicated regional programs and funding
- Inconsistent waste classifications
- absence of harmonized definitions for bio-based intermediates
- Limited policy coherence for cross-sectoral exchange

Why Ecosystems Matter for Bio-based Value Chains

1 Bio-based value chains depend on strong regional innovation ecosystems.

2 Industrial symbiosis requires coordination between businesses, research, policy and funding actors.

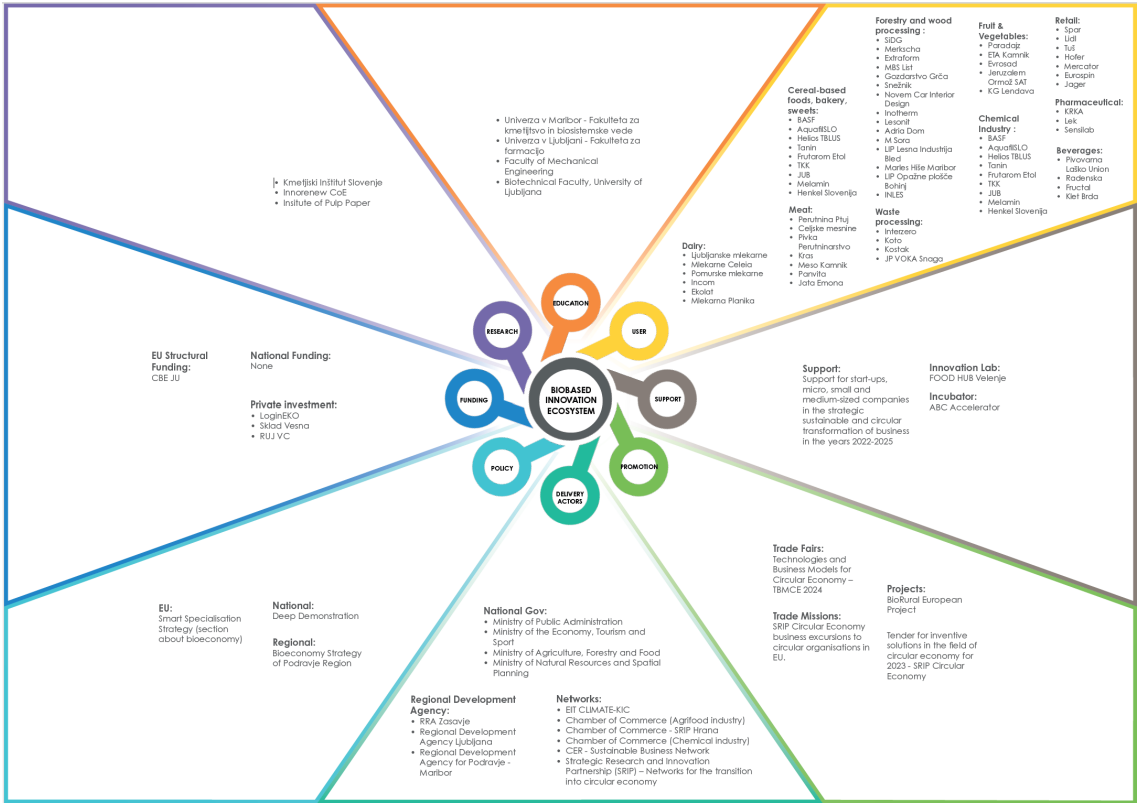
3 Ecosystems enable collaboration, knowledge transfer, investment and scale-up of circular bio-based solutions.

4

- Businesses and value-chain actors form the core of the ecosystem.
- Supporting actors include research institutions, education providers and innovation support organisations.
- Policy, funding bodies, networks and promotion agencies create enabling conditions for innovation.

Slovenia’s Bioeconomy Innovation Ecosystem – Snapshot

- **Research & Education:** University of Ljubljana, University of Maribor, Innorenew CoE, Pulp & Paper Institute
- **Innovation & Support:** University of Ljubljana Incubator, Center Rog
- **Networks & Collaboration:** SRIP – Circular Economy, CER (sustainable business network)
- **Policy & Initiatives:** Smart Specialisation Strategy, Deep Demonstration (Climate-KIC), Podravje Circular Bioeconomy Strategy



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Key Drivers and Challenges in Slovenia

Drivers	Challenges
• Strong alignment with EU circular economy policies • Emerging funding opportunities (EU & national) • Active innovation networks and clusters • Existing research base in biomass-related sectors	• Complex and fragmented support landscape across regions • Difficult navigation of funding programmes for companies • Data sharing and confidentiality barriers between industry actors • High costs & risks for small firms developing bio-based solutions

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Contacts

Antonia Zerobin
Scientific Project Manager – Circular Bioeconomy
alchemia-nova research & innovation
antonia.zerobin@alchemia-nova.eu



Piotr Swiatek
Project Manager – Design and innovation policy
www.pdr-design.com
pswiatek@pdr-design.com

Katie Beverly
Senior researcher in sustainable design
www.pdr-design.com
kbeverly@pdr-design.com

Miha Skrokov

Co-creation session

You are now invited to share insights and co-develop solutions to help forming industrial symbiosis in the bioeconomy

Generating an Implementation Blueprint

1

Step 1: Actors and Flows (10 min)

DRAW on the poster:

- Draw the main **material flow**
  - You can add additional stages if needed.
- Identify the **lead and side actors (roles)** for each stage of the value chain (Feedstock / Biorefinery / Market)

Generating an Implementation Blueprint

2

Step 2: Bottlenecks & Enablers (15 min)

STICK on the poster:

- Write critical **bottlenecks** on **RED sticky notes** (e.g. technology gaps, policies, logistics, market demand)
- For each bottleneck, add a **GREEN sticky note** describing what would be **needed to resolve it**
- Add any existing **financing instruments** or funding opportunities you are aware of

Generating an Implementation Blueprint

3

Step 3: Key Leverage Point (10 min)

- Ask yourselves: What is the most important next step to move this value chain from concept to implementation?
- As a group, **agree on ONE concrete action** that would have the **biggest impact** on making this value chain happen.
- Write this ONE key action clearly on the poster.

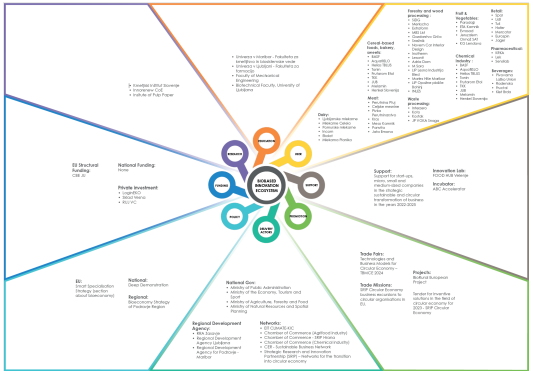
Slovenia's Bioeconomy Innovation Ecosystem – Snapshot

This session explores whether the **regional innovation ecosystem is ready to support the bio-based value chains discussed earlier.**

Rather than perfecting the map, we **focus on what enables implementation, what blocks it, and where coordination gaps exist.**

Activity

- Review the ecosystem map and consider the BioLink/value chain discussed earlier.
- Use sticky dots to mark:
  - 🟢 **Enablers** – elements already supporting implementation
  - 🔴 **Bottlenecks** – gaps, barriers, or missing capacities
- Write a short note explaining why it helps or blocks implementation.



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Feedback Survey

Before we move to networking, we would love to take a moment to hear your feedback.

