REGIONAL FOCUS GROUP WORKSHOP

# From Agricultural Residues to High-value Chemicals

**Carinthia**

Funded by the European Union · Grant Agreement No 101135166

SYMBIO
MEET YOUR SUSTAINABILITY TARGET

alchemia nova research

Cardiff Metropolitan University

BABEG
Success in Carinthia.

# Agenda

01 Introduction to SYMBIO Project

02 The Value Chain: Barley Straw to Succinic Acid

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

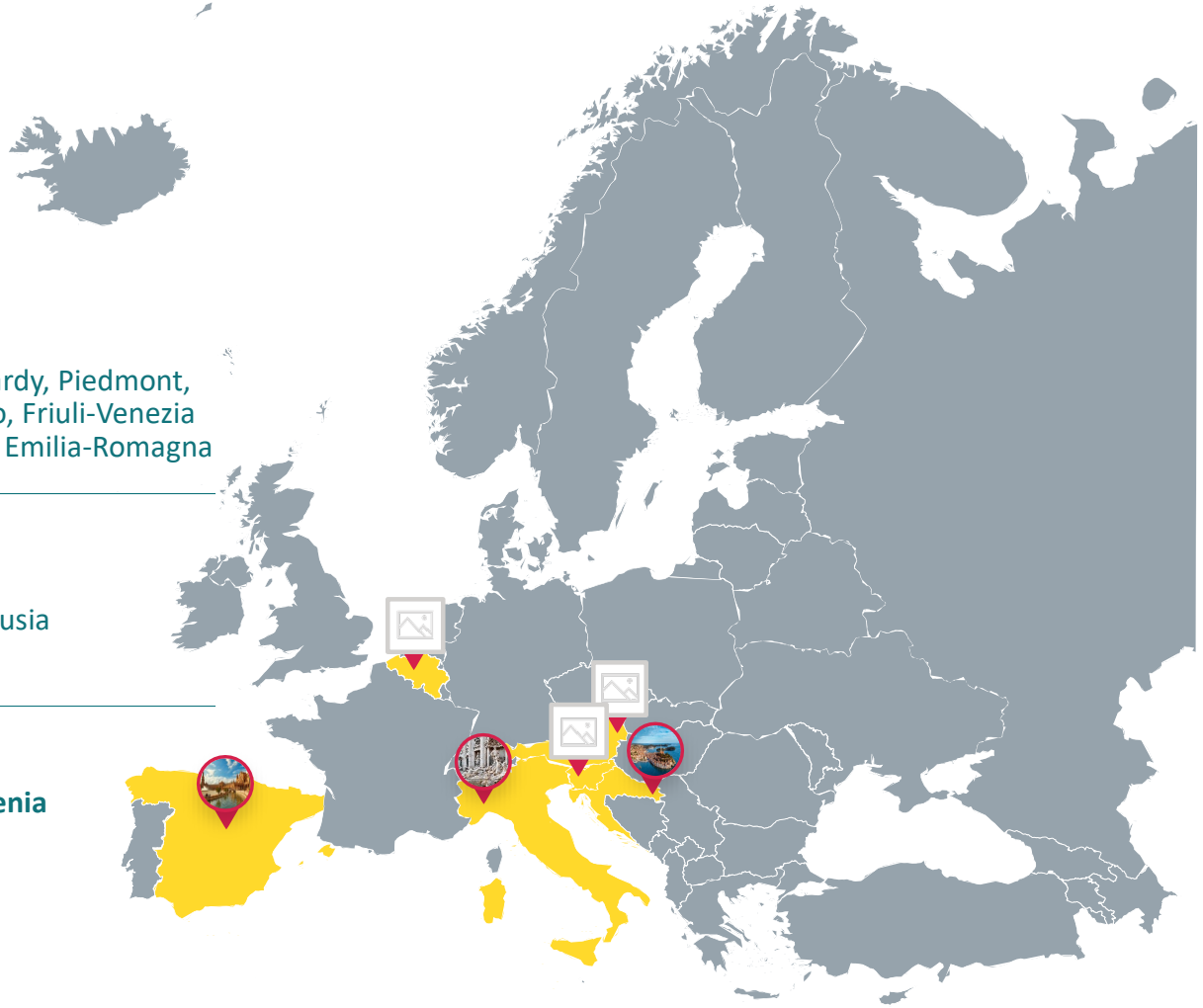


**Spain**

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**

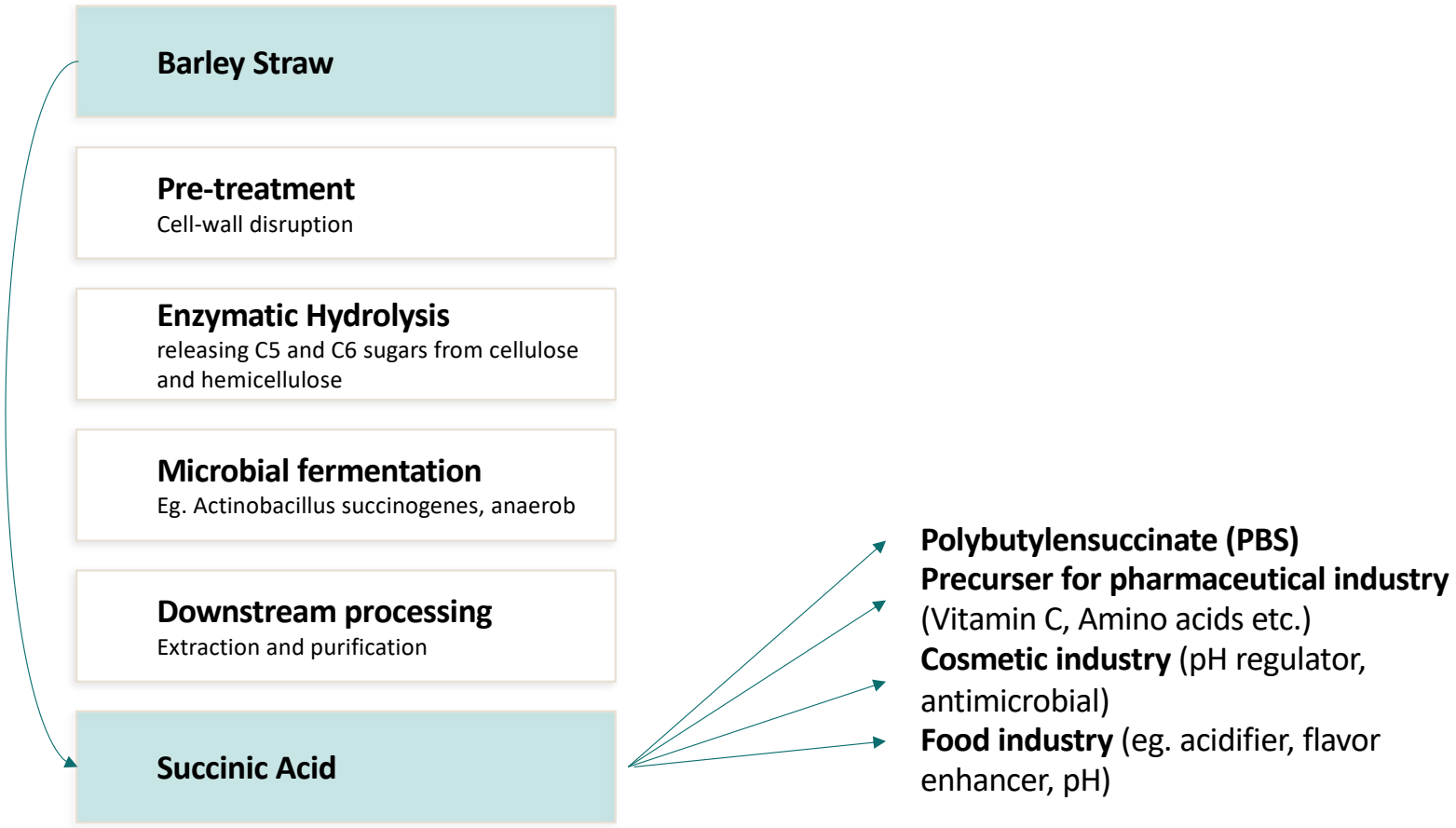
### Multi-Stakeholder Focus Groups

- 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 Succinic Acid Production

## PRODUCTION CASCADE



# From Barley straw to Succinic Acid

## Barley Straw

**Barley straw is a secondary biomass generated as a byproduct during the barley harvest. In Carinthia, barley is the third most important cereal crop, used mainly for animal feed (winter barley) and malting (summer barley).**

| ~ 3.72 t/ha | 65% |
|---|---|
| Straw yield | Carbohydrate content |

### Traditional uses

- Animal bedding & low-nutrition roughage
- Left on the field for soil improvement
- Waste-to-energy recovery

## Succinc Acid

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

| USD 156 M | 12.25% |
|---|---|
| global market (2025) | CAGR growth rate (2025-2034) |

### Key applications

- **Bioplastics:** Polybutylene succinate (PBS) for packaging and films.
- **Pharmaceuticals:** pH buffers, antibiotics, and vitamins.
- **Industrial:** Solvents, surfactants, coatings, and deicers

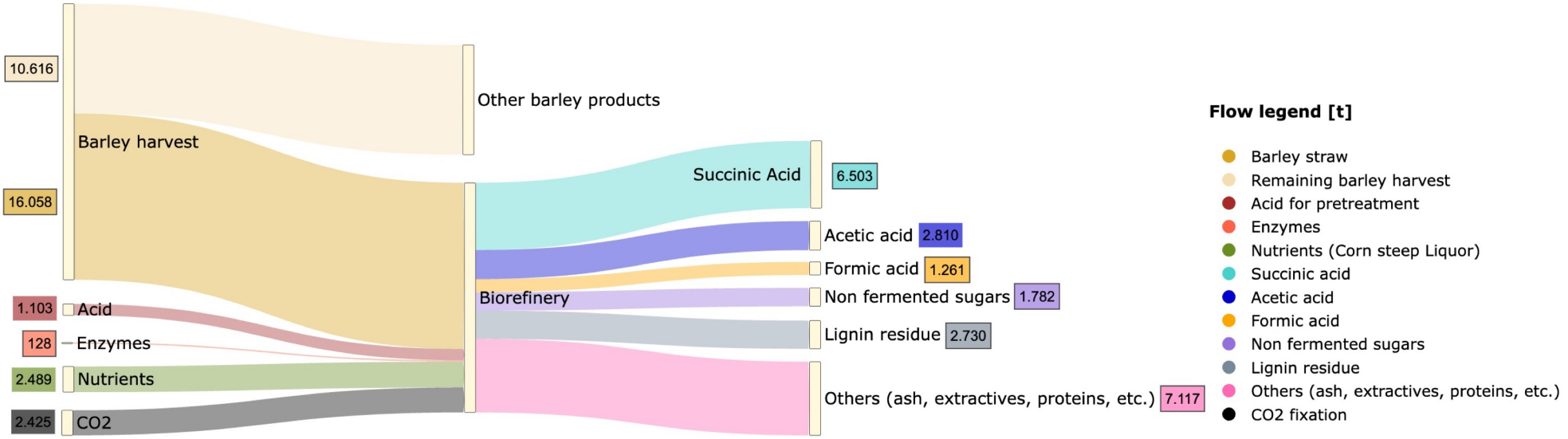
# Material flow analysis

**16 kt/y**
Barley straw available

**7 kt/y**
Succinic acid production potential

**41 %**
Mass conversion efficiency

**Residues as co-products**



# Economic Reality: Opportunities vs Challenges

**Feedstock Cost Advantage**
Utizilizing agricultural residues provides an abundant, low-cost raw material

**Multi-product revenue and multi-feedstock biorefineries**
Viability is enhanced by a biorefinery model that valorizes side streams (acetic & formic acid) and uses lignin for eg. energy production

**Market growth**
There is a strong regional and EU-wide demand for sustainable chemical alternatives driven by environmental regulations

**High Downstream Processing Costs**
Purification and recovery from complex fermentation broths are very expensive, accounting for 50% to 70% of total production

**Feedstock availability and supply chain stability**
Bulky, low value biomass makes transportation expensive, need for localized collection and pre-processing.



# Environmental Profile

**CO2 fixation**

~0.15 kg $CO_2$ sequestered per kg straw during fermentation

**Net to Negative Carbon Footprint**

**Replaces Fossils**

## STRENGTHS

- **BioPBS** mitigates microplastic pollution
- **High share of renewable energy**, which significantly improves the net greenhouse gas balance
- **Reduces GHG emissions** compared to fossil-based SA
- **Reduced pressure on ecosystem** by valorization of secondary resources

## RISKS

- Excessive removal of barley straw from fields threatens soil health, biodiversity and long-term yields
- Climate variability (heat / drought) threatens supply security

# Social & Regulatory Landscape

## Policy Framework

- Increasingly **strict EU packaging and sustainability regulations** (PPWR, REACH etc.)
- Updated **EU Bioeconomy Strategy** and upcoming **Circular Economy Act**
- Supported **by regional funding** (eg. KWF)

## Social Landscape

- **Green Tech Valley** with a network of +250 companies active in climate protection offers research infrastrucute and potential scale-up partnrs
- offers farmers an additional **stable income stream**
- **Fragmented farm structure** and **mountainous terrain** necessitates high levels of coordination

## Social Impact

- Local Biorefineries can enhance regional resilience and local value creation
- Generation of high- and mid-tech employment opportunities
- No direct conflict with food supply
- Tackles rural depopulation

# 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.

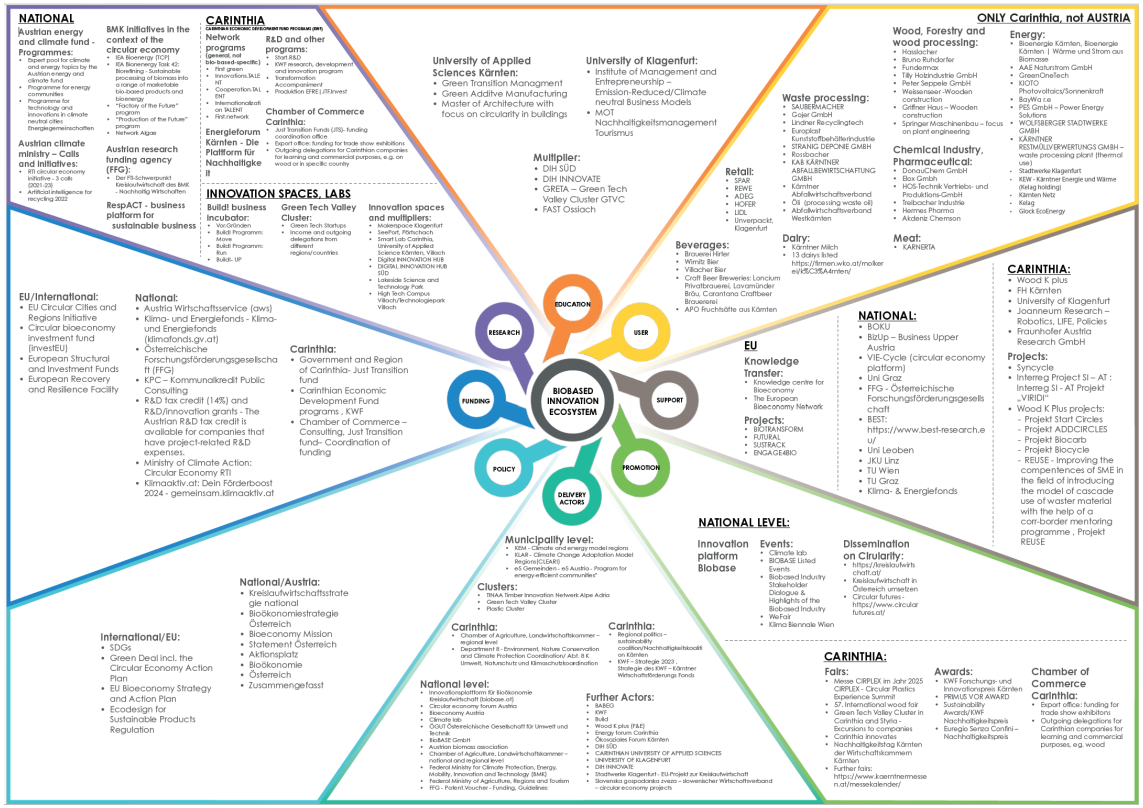
**3** Ecosystems enable collaboration, knowledge transfer, investment and scale-up of circular bio-based solutions.

**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.

# Carinthia's Bioeconomy Innovation Ecosystem – Snapshot

- **Research & Education:** FH Kärnten, University of Klagenfurt, Fraunhofer Austria, Wood K+
- **Innovation & Support:** Carinthian Economic Development Fund (KWF), BABEG, Build! Incubator, Start R&D / Produktion EFRE-JTF
- **Networks & Collaboration:** Biobase platform, Green Tech Valley, Chamber of Commerce Carinthia, Energieforum Kärnten
- **Policy & Initiatives:** EU Green Deal & Bioeconomy Strategy, Just Transition Fund, Carinthian Sustainability Coalition

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# Key Drivers and Challenges in Carinthia

## Drivers

- Strong circular economy policy alignment
- Active regional support and funding landscape
- Cross-industry collaboration networks
- Strong research and applied innovation base

## Challenges

- Complex and fragmented support landscape
- Limited dedicated bioeconomy funding
- Need stronger coordination across actors
- Gap between research and industrial uptake

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# 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

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)

2

## Step 2: Bottlenecks & Enablers

STICK on the poster:

- Write critical **bottlenecks** on **RED sticky notes** (e.g. technology gaps, policies, logistics, market demand)
- Add **GREEN sticky notes** for enablers, opportunities and supporting conditions
- 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.

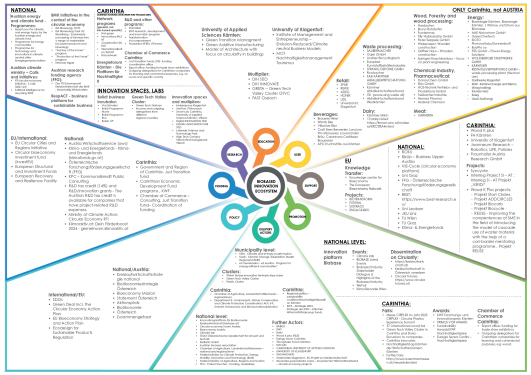
# Carinthia's Bioeconomy Innovation Ecosystem – Snapshot

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.

