REGIONAL FOCUS GROUP WORKSHOP

# From Agro-Industrial Residues to High-value Chemicals

## Italy

Funded by the European Union · Grant Agreement No 101135166

SYMBIO
MEET YOUR SUSTAINABILITY TARGET

alchemia nova research

Cardiff Metropolitan University

Green Chemistry Association Lombardy

# Agenda

| | |
|---|---|
| 01 | Symbio Project |
| 02 | Italy’s 4 Value Chains & online co-creation: Agricultural residues to high-value products |
| 03 | North Italy’s Regional Bioeconomy Ecosystem |

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# 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

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# 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.

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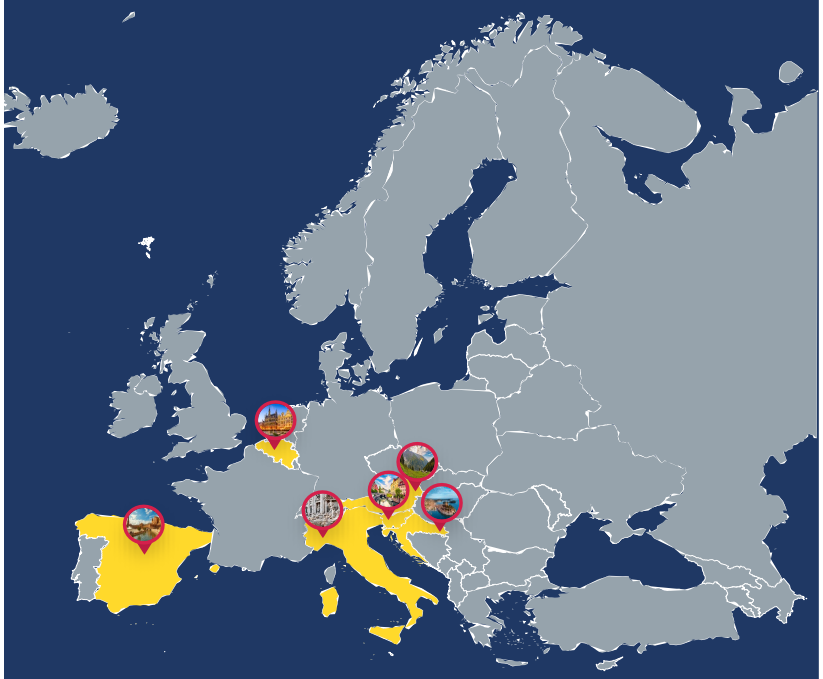
# Promising value chains in Italy's Regions



**Examination of 4 strategic value chains through interactive expert co-creation**

1. Whey to Proteins (Friuli Venezia Giulia)
2. Corn Residues to Succinic Acid (Piedmont)
3. Barley Straw to Succinic Acid (Veneto)
4. Wheat Straw to PHA (Piedmont)

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# ① WHEY TO PROTEINS

*Via membrane seperation and spray drying*

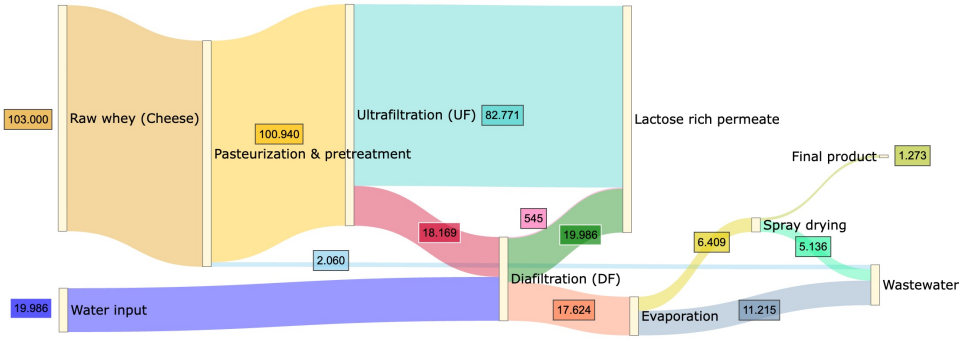
📍 **Friuli Venezia Giulia, Italy**




## Material Flow Results:

**103 kt/yr**
Whey Available (FVG)

**1.27 kt/yr**
WPC-80 Output




## Multi – Criteria – Overview:

### 💰 Economics

- Growing market demand in sports nutrition
- Spray drying = critical energy & cost factor
- Recovery of high-quality proteins and lactose
- Advancment in separation technologies

### 🚚 Logistics & Market

- Strong dairy tradition
- Raw whey transport critical ( >94% water)
- Dispersed dairy enterprises in mountainous regions (challenging) – pre-concentration at site recommended!
- Technologically mature
- Increasing competition from plant-based proteins

### 🌿 Environment

- No aggressive chemicals input and water reuse
- GHG emissions depends on renewable energy share, transport distance
- High circularity potential
- Lactose can be used for bioplastic, or bioethanol production

### 👥 Social

- "IO SONO FVG" regional identity label
- Consumer acceptance tied to animal welfare
- Deeply embedded in regional dairy culture
- Policy support for sustainable farming
- Potential skills gap

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# WHEY TO PROTEINS

## CO-CREATION SURVEY

**Q1:** How strong is the potential of whey to proteins value chain to be implemented at scale in Italy within the next 5–10 years?

**Q2:**What barriers is Italy facing and which type of support would be most effective in overcoming them?

# 2 CORN RESIDUES TO SUCCINIC ACID

*Via enzymatic hydrolisis and microbial fermentation*

📍 **Piedmont, Italy**

**Key Applications:**

- **Food**
- **Biodegradable plastics (PBS)**
- **Pharmaceutical & cosmetics**

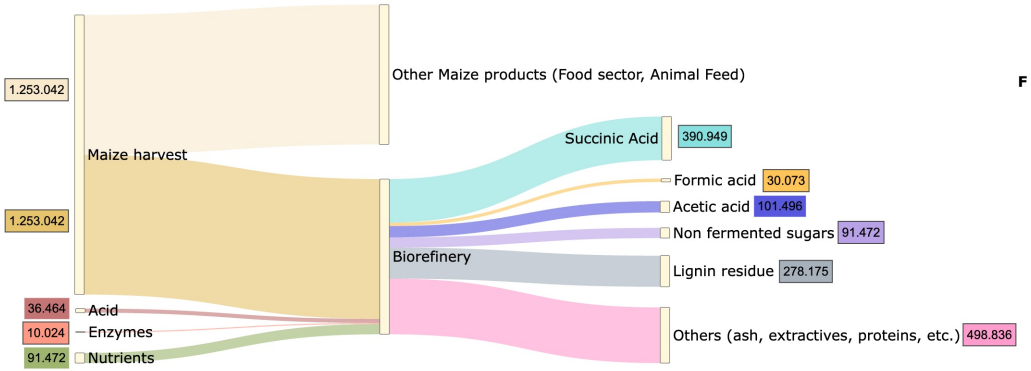
## Material Flow Results:

**1,25 Mt/yr**

Corn residues available

**390 kt/yr**

Succinic Acid Output




## Multi – Criteria – Overview:

### 💰 Economics

- DSP exceeds 50% of total production costs
- Feedstock price volatility
- Bio-SA CAGR 12.1% (2024-2030)
- Integrated biorefineries improve viability, eg. Lignin, organic acid valorization

### 🚚 Logistics & Market

- Hgher costs than petrochemical alternatives
- Feedstock competes with livestock feed & bioenergy
- Low bulk density complicates collection
- Spatial dispersion of corn residues a challenge
- Biomass availability season dependent

### 🌿 Environment

- Fermentation binds $CO_2$ (0.15 kg/kg straw)
- Potential negative net emissions
- Reduces pressure on natural ecosystems
- Concerns in land-use resilience, soil health and climate change (drought etc.)

### 👥 Social

- Region benefits from Know-how, strong chemical & biotech clusters & bioplastics production
- Demand stems from interest in natural products – Bio-SA is non-toxic & renewable
- Competition to food & energy

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# CORN RESIDUES TO SUCCINIC ACID

## CO-CREATION SURVEY

**Q1:** How strong is the potential corn residue to succinic acid value chain to be implemented at scale in Italy within the next 5–10 years?

**Q2:**What barriers is Italy facing and which type of support would be most effective in overcoming them?

# 3 BARLEY STRAW TO SUCCINIC ACID

*Via enzymatic hydrolisis and microbial fermentation*

📍 **Veneto, Italy**

**Key Applications:**

- **Food**
- **Biodegradable plastics (PBS)**
- **Pharmaceutical & cosmetics**

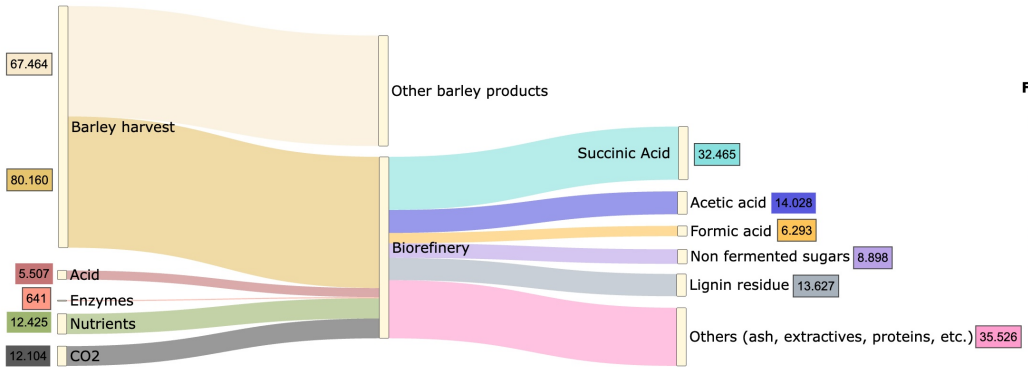
## Material Flow Results:

**80 kt/yr**

Barley straw available

**32 kt/yr**

Succinic Acid Output




## Multi – Criteria – Overview:

### 💰 Economics

- High DSP costs
- Low-cost feedstock
- Established bio-SA market in italy
- Integrated biorefineries improve viability, eg. Lignin, organic acid valorization

### 🚚 Logistics & Market

- Hgher costs than petrochemical alternatives
- Feedstock competes with livestock feed & bioenergy
- Biomass availability season & weather dependent
- Long-term storage infrastructure needed
- Feedstock price volatility

### 🌿 Environment

- Fermentation binds $CO_2$ (0.15 kg/kg straw)
- Potential negative net emissions
- Reduces pressure on natural ecosystems
- Concerns in soil health
- Reduces illegal open burning of straw

### 👥 Social

- Supports local value creation
- Farm-level constraints
- Strong chemical & biotech clusters
- Demand stems from interest in natural products – Bio-SA is non-toxic & renewable
- Competition to food & energy

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# BARLEY STRAW TO SUCCINIC ACID

## CO-CREATION SURVEY

**Q1:** How strong is the potential barley straw to succinic acid value chain to be implemented at scale in Italy within the next 5–10 years?

**Q2:**What barriers is Italy facing and which type of support would be most effective in overcoming them?

# 4 WHEAT STRAW TO PHA

*Via enzymatic hydrolisis and microbial fermentation*

📍 **Piedmont, Italy**

**Key Applications:**

- **Food**
- **Biodegradable Packaging**
- **Pharmacy**
- **Automotives**

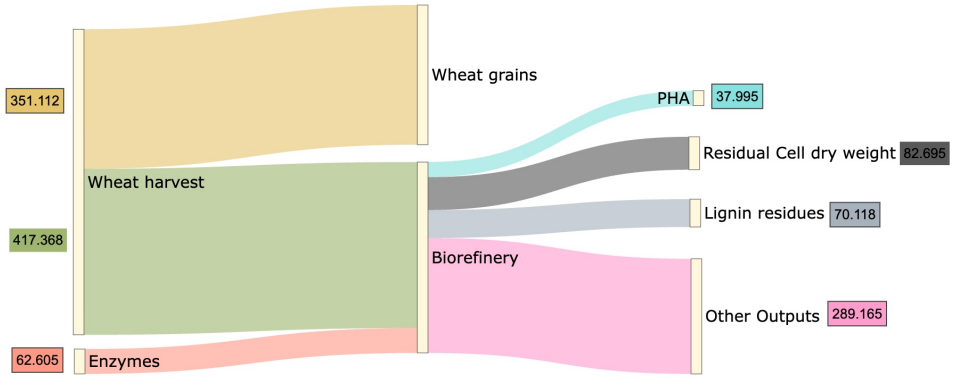
## Material Flow Results:

**417 kt/yr**

Wheat straw available

**38 kt/yr**

PHA Output




## Multi – Criteria – Overview:

### 💰 Economics

- Straw substrate 40–50% cheaper than refined sugars
- Extraction & purification ≈ 50% of total costs
- Flexible valorization pathways from released sugars
- Integrated biorefinery model key for economic success

### 🚚 Logistics & Market

- Market driven by medical & packaging niches
- Seasonal and wheather dependent
- Bulky residues and dispersed fields require reliable collection chains
- Long-term storage needed
- PHA more expensive than fossil-based
- Competing uses in feed and energy

### 🌿 Environment

- Mitigates microplastic pollution
- Offers circularity potential
- Biodegradable, renewable and biocompatible replacement for fossil plastics
- Considered as carbon neutral process
- Excessive straw removal pose ecological risks

### 👥 Social

- Stable additional income for farmers
- Contractual stability key for farmer supply
- Supports rural bioeconomy development
- Feedstock security exposed to extreme heat events
- Growing concern against microplastic

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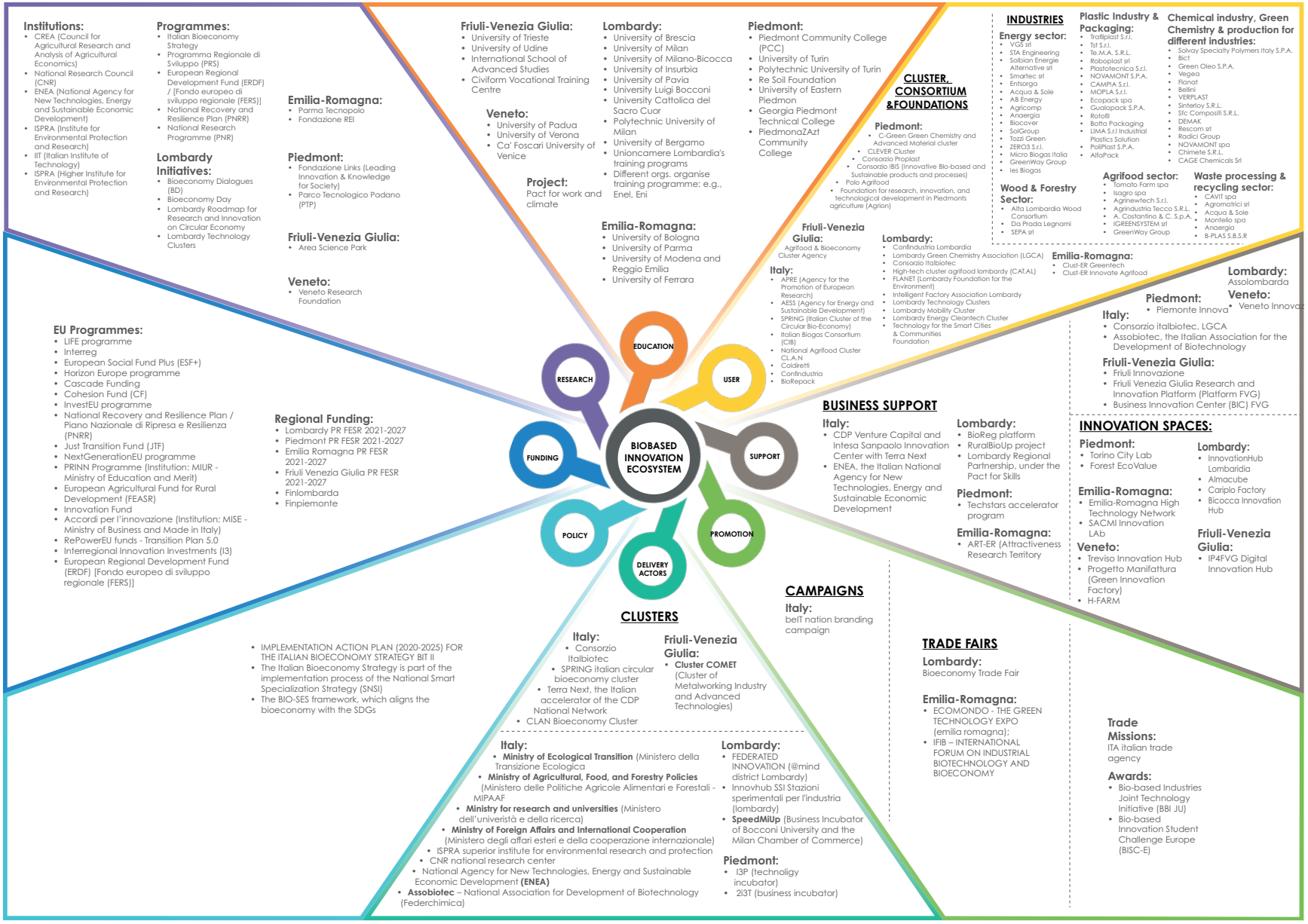
# WHEAT STRAW TO PHA

## CO-CREATION SURVEY

**Q1:** How strong is the potential wheat straw to PHA value chain to be implemented at scale in Italy within the next 5–10 years?

**Q2:**What barriers is Italy facing and which type of support would be most effective in overcoming them?

# Ecosystem Mapping


Institutions:
CREA (Council for Agricultural Research and Analysis of Agricultural Economics)
National Research Council (CNR)
ENEA (National Agency for New Technologies, Energy and Sustainable Economic Development)
ISPRA (Institute for Environmental Protection and Research)
IIT (Italian Institute of Technology)
ISPRA (Higher Institute for Environmental Protection and Research)
Programmes:
Italian Bioeconomy Strategy
Programma Regionale di Sviluppo (PRS)
European Regional Development Fund (ERDF) / [Fondo europeo di sviluppo regionale (FERS)]
National Recovery and Resilience Plan (PNRR)
National Research Programme (PNR)
Lombardy Initiatives:
Bioeconomy Dialogues (BD)
Bioeconomy Day
Lombardy Roadmap for Research and Innovation on Circular Economy
Lombardy Technology Clusters
Emilia-Romagna:
Parma Tecnopolo
Fondazione REI
Piedmont:
Fondazione Links (Leading Innovation & Knowledge for Society)
Parco Tecnologico Padano (PTP)
Friuli-Venezia Giulia:
Area Science Park
Veneto:
Veneto Research Foundation
Friuli-Venezia Giulia:
University of Trieste
University of Udine
International School of Advanced Studies
Civiform Vocational Training Centre
Veneto:
University of Padua
University of Verona
Ca' Foscari University of Venice
Project:
Pact for work and climate
Lombardy:
University of Brescia
University of Milan
University of Milano-Bicocca
University of Insurbia
University of Pavia
University Luigi Bocconi
University Cattolica del Sacro Cuor
Polytechnic University of Milan
University of Bergamo
Unioncamere Lombardia's training programs
Different orgs. organise training programme: e.g., Enel, Eni
Piedmont:
Piedmont Community College (PCC)
University of Turin
Polytechnic University of Turin
Re Soil Foundation
University of Eastern Piedmon
Georgia Piedmont Technical College
PiedmonaZAzt Community College
Emilia-Romagna:
University of Bologna
University of Parma
University of Modena and Reggio Emilia
University of Ferrara
CLUSTER, CONSORTIUM &FOUNDATIONS
Piedmont:
C-Green Green Chemistry and Advanced Material cluster
CLEVER Cluster
Consorzio Proplast
Consorzio IBIS (Innovative Bio-based and Sustainable products and processes)
Polo Agrifood
Foundation for research, innovation, and technological development in Piedmonts agriculture (Agrion)
INDUSTRIES
Energy sector:
VGS srl
STA Engineering
Solbian Energie Alternative srl
Smartec srl
Entsorga
Acqua & Sole
AB Energy
Agricomp
Anaergia
Biocover
SolGroup
Tozzi Green
ZEROS S.r.l.
Micro Biogas Italia
GreenWay Group
Ies Biogas
Wood & Forestry Sector:
Alta Lombardia Wood Consortium
Da Prada Legnami
SEPA srl
Plastic Industry & Packaging:
Trafilplast S.r.l.
Tst S.r.l.
Te.M.A. S.R.L.
Roboplast srl
Plastotecnica S.r.l.
NOVAMONT S.P.A.
CAMPLA S.r.l.
MOPLA S.r.l.
Ecopack spa
Gualapack S.P.A.
Rotofil
Botta Packaging
LIMA S.r.l Industrial Plastics Solution
PoliPlast S.P.A.
AlfaPack
Chemical industry, Green Chemistry & production for different industries:
Solvay Specialty Polymers Italy S.P.A.
Bict
Green Oleo S.P.A.
Vegea
Planat
Bellini
VERPLAST
Sinterloy S.R.L.
Sfc Compositi S.R.L.
DEMAK
Rescom srl
Radici Group
NOVAMONT spa
Chimete S.R.L.
CAGE Chemicals Srl
Agrifood sector:
Tomato Farm spa
Isagro spa
Agrinewtech S.r.l.
Agrindustria Tecco S.R.L.
A. Costantino & C. S.p.A.
IGREENSYSTEM srl
GreenWay Group
Waste processing & recycling sector:
CAVIT spa
Agromatrici srl
Acqua & Sole
Montello spa
Anaergia
B-PLAS S.B.S.R
Friuli-Venezia Giulia:
Agrifood & Bioeconomy Cluster Agency
Italy:
APRE (Agency for the Promotion of European Research)
AESS (Agency for Energy and Sustainable Development)
SPRING (Italian Cluster of the Circular Bio-Economy)
Italian Biogas Consortium (CIB)
National Agrifood Cluster CLAN
Coldiretti
Confindustria
BioRepack
Lombardy:
Confindustria Lombardia
Lombardy Green Chemistry Association (LGCA)
Consorzio Italbiotec
High-tech cluster agrifood lombardy (CAT.AL)
FLANET (Lombardy Foundation for the Environment)
Intelligent Factory Association Lombardy
Lombardy Technology Clusters
Lombardy Mobility Cluster
Lombardy Energy Cleantech Cluster
Technology for the Smart Cities & Communities Foundation
Emilia-Romagna:
Clust-ER Greentech
Clust-ER Innovate Agrifood
Lombardy:
Assolombarda
Veneto:
Veneto Innovac
Piedmont:
Piemonte Innova
Italy:
Consorzio italbiotec, LGCA
Assobiotec, the Italian Association for the Development of Biotechnology
Friuli-Venezia Giulia:
Friuli Innovazione
Friuli Venezia Giulia Research and Innovation Platform (Platform FVG)
Business Innovation Center (BIC) FVG
INNOVATION SPACES:
Piedmont:
Torino City Lab
Forest EcoValue
Emilia-Romagna:
Emilia-Romagna High Technology Network
SACMI Innovation LAb
Veneto:
Treviso Innovation Hub
Progetto Manifattura (Green Innovation Factory)
H-FARM
Lombardy:
InnovationHub Lombardia
Almacube
Cariplo Factory
Bicocca Innovation Hub
Friuli-Venezia Giulia:
IP4FVG Digital Innovation Hub
BUSINESS SUPPORT
Italy:
CDP Venture Capital and Intesa Sanpaolo Innovation Center with Terra Next
ENEA, the Italian National Agency for New Technologies, Energy and Sustainable Economic Development
Lombardy:
BioReg platform
RuralBioUp project
Lombardy Regional Partnership, under the Pact for Skills
Piedmont:
Techstars accelerator program
Emilia-Romagna:
ART-ER (Attractiveness Research Territory
CAMPAIGNS
Italy:
beIT nation branding campaign
TRADE FAIRS
Lombardy:
Bioeconomy Trade Fair
Emilia-Romagna:
ECOMONDO - THE GREEN TECHNOLOGY EXPO (emilia romagna);
IFIB – INTERNATIONAL FORUM ON INDUSTRIAL BIOTECHNOLOGY AND BIOECONOMY
Trade Missions:
ITA italian trade agency
Awards:
Bio-based Industries Joint Technology Initiative (BBI JU)
Bio-based Innovation Student Challenge Europe (BISC-E)
CLUSTERS
Italy:
Consorzio Italbiotec
SPRING italian circular bioeconomy cluster
Terra Next, the Italian accelerator of the CDP National Network
CLAN Bioeconomy Cluster
Friuli-Venezia Giulia:
Cluster COMET (Cluster of Metalworking Industry and Advanced Technologies)
Italy:
Ministry of Ecological Transition (Ministero della Transizione Ecologica
Ministry of Agricultural, Food, and Forestry Policies (Ministero delle Politiche Agricole Alimentari e Forestali - MIPAAF
Ministry for research and universities (Ministero dell'univeristà e della ricerca)
Ministry of Foreign Affairs and International Cooperation (Ministero degli affari esteri e della cooperazione internazionale)
ISPRA superior institute for environmental research and protection
CNR national research center
National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA)
Assobiotec – National Association for Development of Biotechnology (Federchimica)
Lombardy:
FEDERATED INNOVATION (@mind district Lombardy)
Innovhub SSI Stazioni sperimentali per l'industria (lombardy)
SpeedMiUp (Business Incubator of Bocconi University and the Milan Chamber of Commerce)
Piedmont:
I3P (technoligy incubator)
2i3T (business incubator)
EU Programmes:
LIFE programme
Interreg
European Social Fund Plus (ESF+)
Horizon Europe programme
Cascade Funding
Cohesion Fund (CF)
InvestEU programme
National Recovery and Resilience Plan / Piano Nazionale di Ripresa e Resilienza (PNRR)
Just Transition Fund (JTF)
NextGenerationEU programme
PRINN Programme (Institution: MIUR - Ministry of Education and Merit)
European Agricultural Fund for Rural Development (FEASR)
Innovation Fund
Accordi per l'innovazione (Institution: MISE - Ministry of Business and Made in Italy)
RePowerEU funds - Transition Plan 5.0
Interregional Innovation Investments (I3)
European Regional Development Fund (ERDF) [Fondo europeo di sviluppo regionale (FERS)]
Regional Funding:
Lombardy PR FESR 2021-2027
Piedmont PR FESR 2021-2027
Emilia Romagna PR FESR 2021-2027
Friuli Venezia Giulia PR FESR 2021-2027
Finlombarda
Finpiemonte
IMPLEMENTATION ACTION PLAN (2020-2025) FOR THE ITALIAN BIOECONOMY STRATEGY BIT II
The Italian Bioeconomy Strategy is part of the implementation process of the National Smart Specialization Strategy (SNSI)
The BIO-SES framework, which aligns the bioeconomy with the SDGs
EDUCATION
RESEARCH
USER
FUNDING
BIOBASED INNOVATION ECOSYSTEM
SUPPORT
POLICY
PROMOTION
DELIVERY ACTORS

# Identifying Barriers & Enablers of Italian's Ecosystem

**Q1:** How well does the Italian ecosystem currently support implementation of bio-based value chains? (1 = not at all / 5 = very well)

**Q2:** Looking again at the ecosystem map - are there any systemic bottlenecks for the implemenation of biobased value chains in North Italy?