SYMBIO
MEET YOUR SUSTAINABILITY TARGET

Anteja

vcg.ai
VALUE CHAIN GENERATOR

Driving SME Sustainability and Circular Innovation: Strategies, Tools, and Advocacy for a Resilient Future

2nd Workshop

02.04.2025

Funded by the European Union Grant Agreement No 101135166

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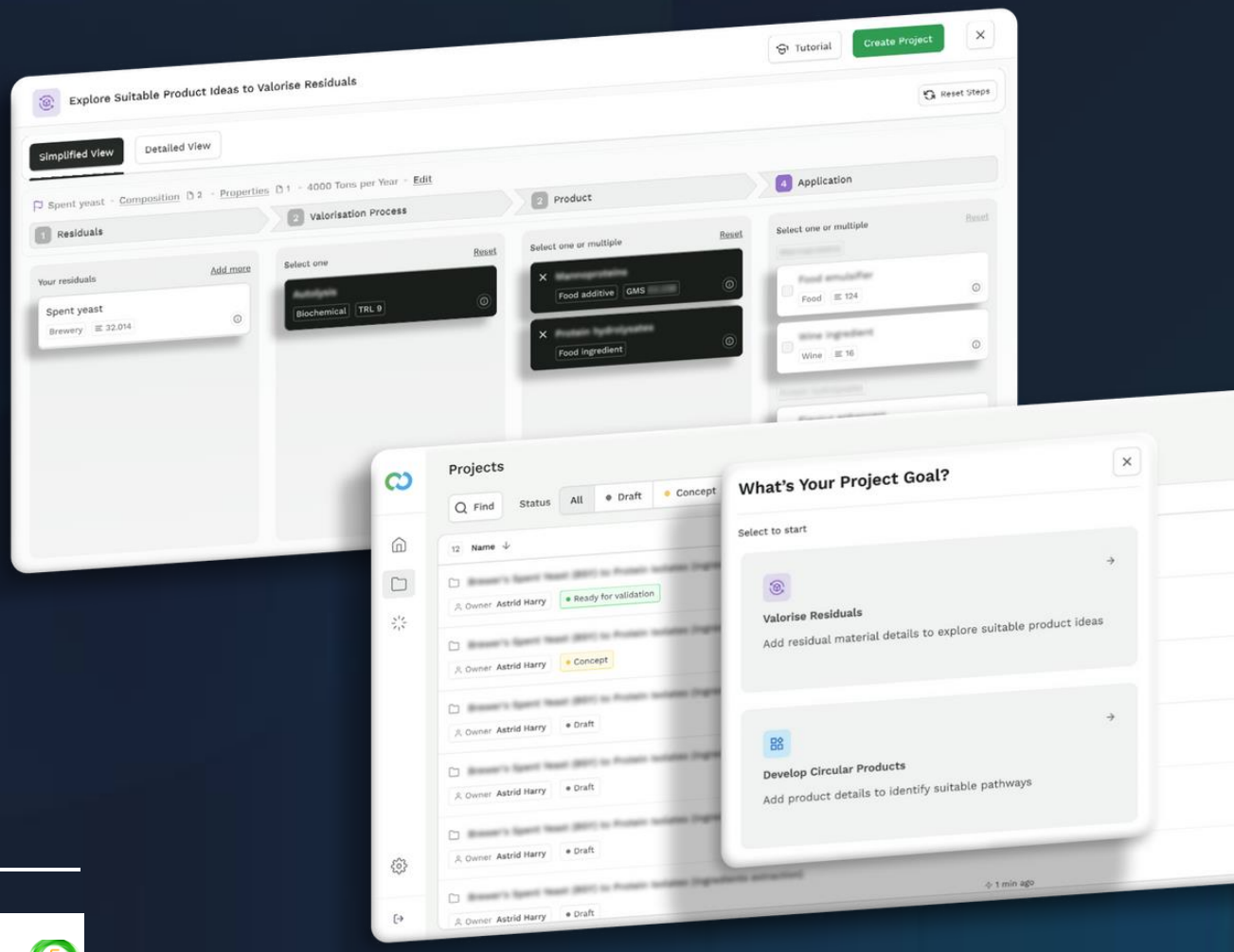
VALUE CHAIN GENERATOR

AI development of circular & biobased products and business models



EIC Accelerator

CYBER ONE
DER HIGHTECH AWARD BADEN-WÜRTTEMBERG

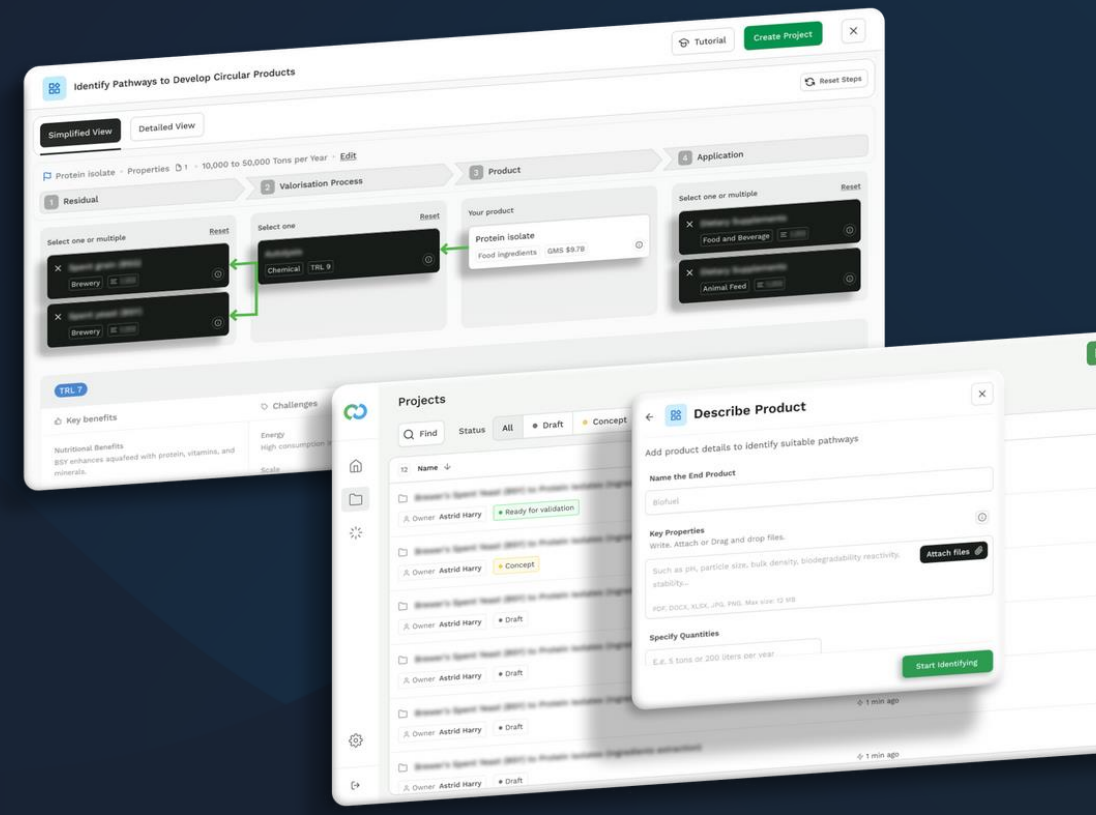
#FRAME OF HELP

CIRCULAR SPC

DEVELOP TECHNICALLY FEASIBLE & PROFITABLE CIRCULAR SOLUTIONS

vcg.ai
VALUE CHAIN GENERATOR

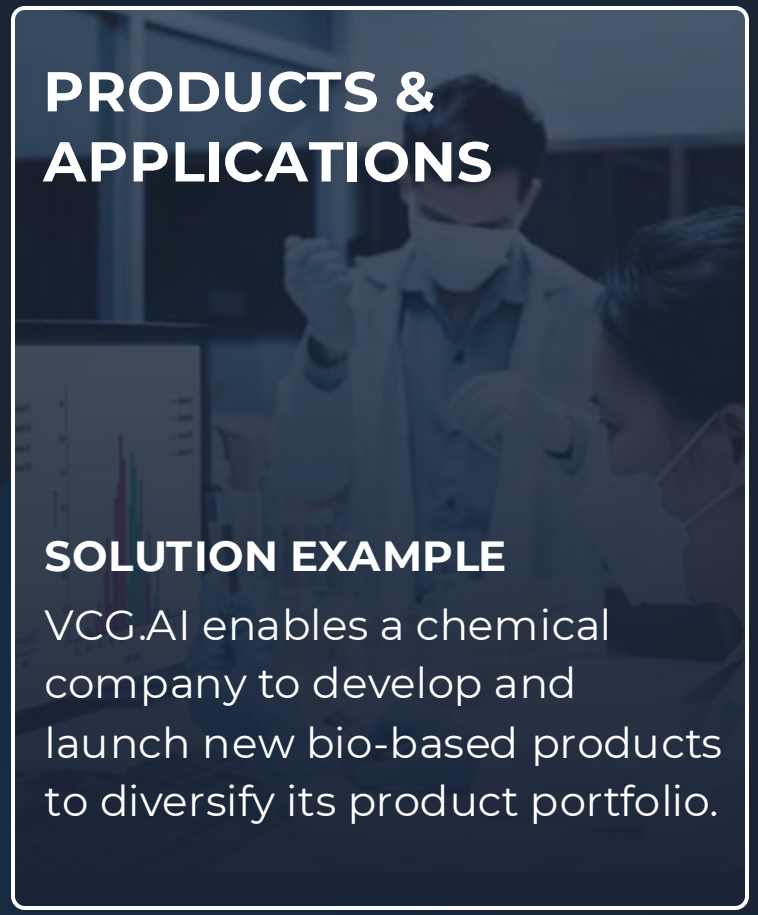
AI to develop circular solutions based on the latest technological and scientific advances combined with material, market, and feedstock availability intelligence.



A COMPETITIVE EDGE WITH SPECIALISED AI

With more than 5 million of the latest patents, technologies, scientific publications, market reports, LCAs, and other data sources, you can realise circularity with global intelligence at your fingertips.

VCG.AI
SCOPE OF OUR SOLUTIONS



PRODUCTS & APPLICATIONS

SOLUTION EXAMPLE

VCG.AI enables a chemical company to develop and launch new bio-based products to diversify its product portfolio.

TECH & MARKET MONITORING

SOLUTION EXAMPLE

VCG.AI monitors the tech landscape and market dynamics for a major recycling company in Scandinavia.

FEEDSTOCK SOURCING

SOLUTION EXAMPLE

VCG.AI supports project implementation by providing reliable feedstock sourcing, meeting quantity & quality requirements.

TECHNOLOGY LANDSCAPE ANALYSIS & MONITORING
TECH ADVANCEMENTS & MARKET OPPORTUNITES

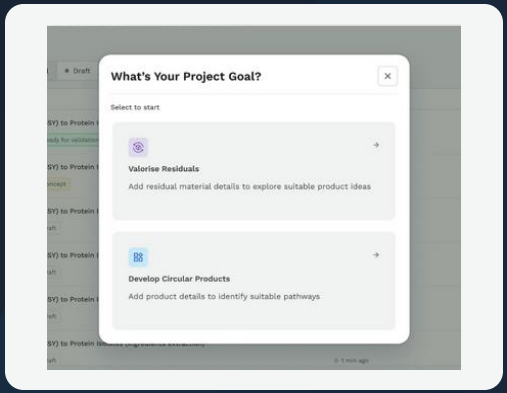
Analyse the current state of technology readiness & advancements across feedstocks, processes, products and applications for data-driven strategic development.

Monitor the IP landscape, technology developers, projects (pilot, demo, industrial scale), market dynamics and the latest scientific publications.

ACCELERATE PRODUCT DEVELOPMENT WITH AI

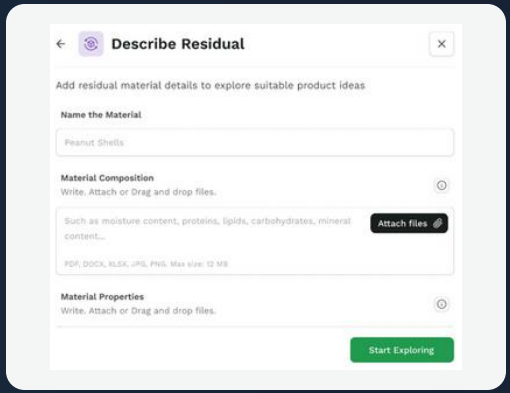
DEVELOP PATHWAYS TO YOUR TARGET PRODUCTS

Analyse all possible combinations of feedstocks, processes, products & applications based on the latest technological advancements and market trends.



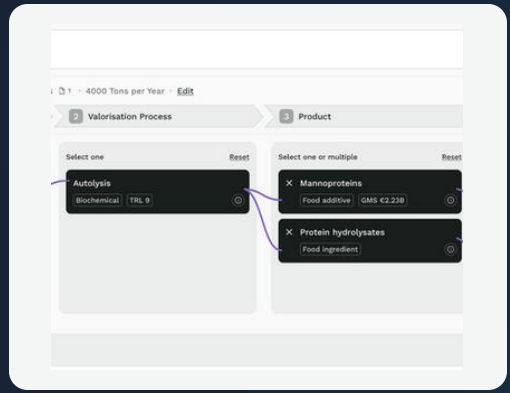
1. CHOOSE YOUR STARTING POINT

Start with the feedstock, target product, or market application, based on your challenges & goals.



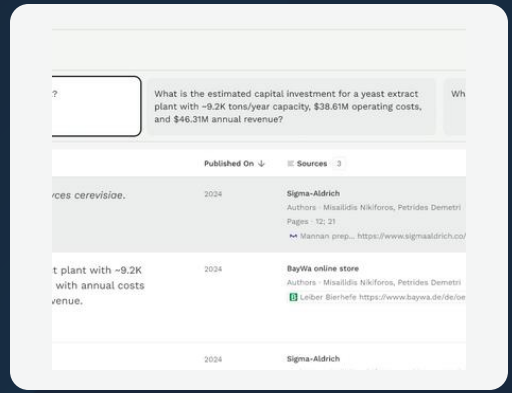
2. ADD SPECIFIC CRITERIA

Add key details, such as material properties and quantities, to refine solutions from the start.



3. DISCOVER POSSIBLE SOLUTIONS

Analyse feedstocks, processing technologies, and product applications based on the latest data.



4. CUSTOM ASSESSMENTS

Dive deep into key feedstock and process parameters, IP landscape, sustainability and more.

FEEDSTOCK SOURCING
BIO-BASED FEEDSTOCK PORTFOLIO ACROSS EUROPE

WE SOURCE THE OPTIMAL FEEDSTOCK FOR SUCCESSFUL PROCESSING

VCG.AI has a portfolio of verified bio-based feedstock suppliers across Europe, ensuring the right feedstock is sourced for your needs.

Additionally, VCG.AI uses data about 3.5 million companies and predictive models to comprehensively assess feedstock availability in any region, enabling optimal site and supplier selection.

+4.5 mio tonnes

annually of bio-based feedstock supply available in our portfolio today

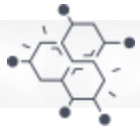
PARTNERS & CLIENTS
EUROPE AND BEYOND

F&B Company

Chemical Company

Retail Chain

Global Brewery



Fertilisers Producer

Chemie Cluster Bayern

Fraunhofer

SINTEF

15 countries

where VCG.AI is already deployed

+300,000 tonnes

of renewable feedstock sourced for projects already in development

vcg.ai®
VALUE CHAIN GENERATOR

Customised demo

VCG.AI’s overview of demo analysis done based on clients’s request.

DEMO SCOPE & OBJECTIVE
FERMENTATION OF ORGANIC WASTE FOR CHEMICALS

Data on the complete value chain

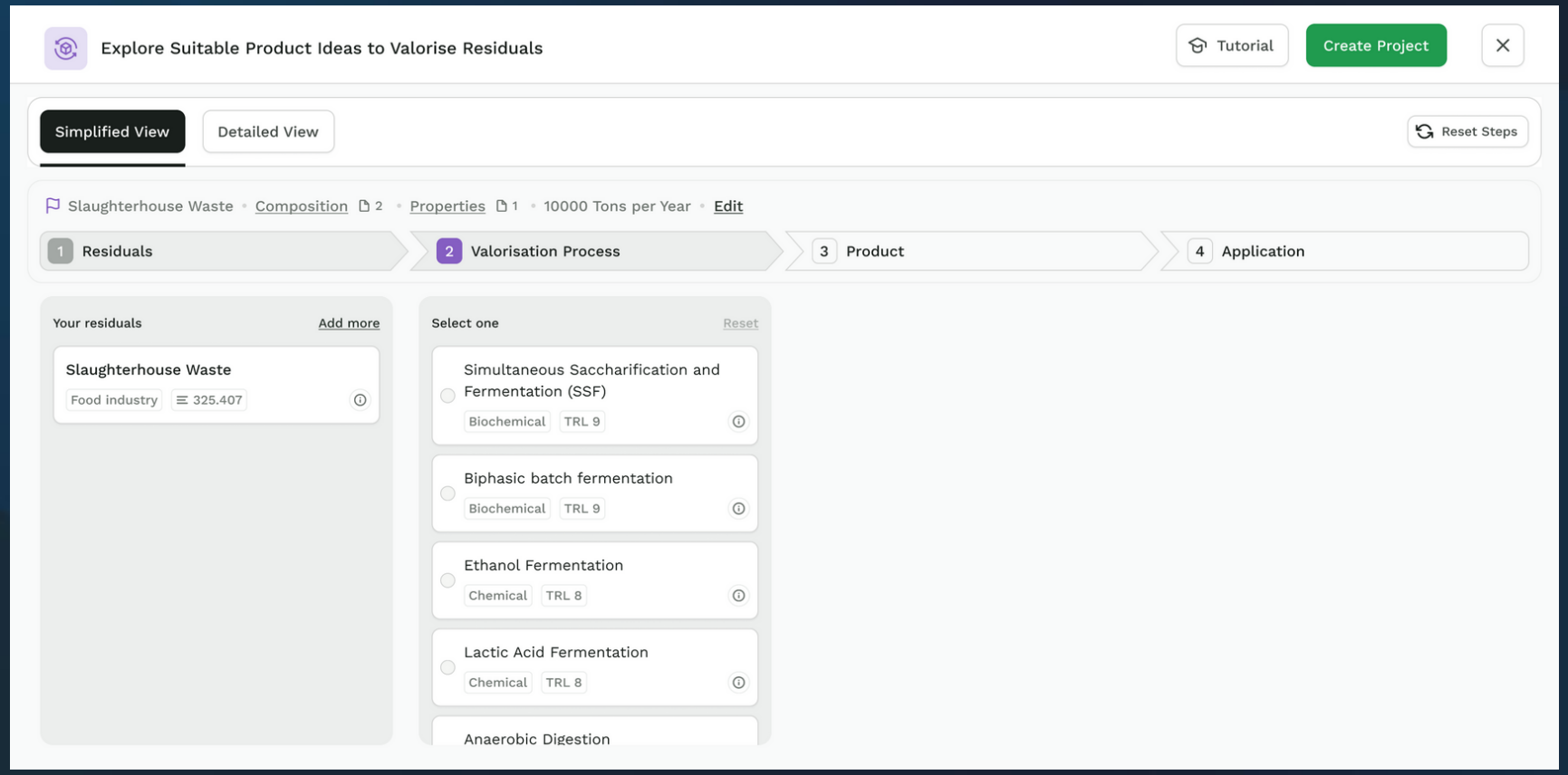
This demo is focused on: **Fermentation of organic waste to produce chemicals.**

This demo is focused on **Slaughterhouse Waste (SHW)**

The following **data were analysed**

- Technical value chain concepts
- Technology landscape and TRL analysis
- IP landscape
- Scientific publications landscape
- Start-ups and new technologies scenario
- Company reports
- EU project reports

TECHNICAL VALUE CHAIN SOLUTIONS
RESIDUALS / VALORISATION PROCESSES



5 types of Fermentation processes

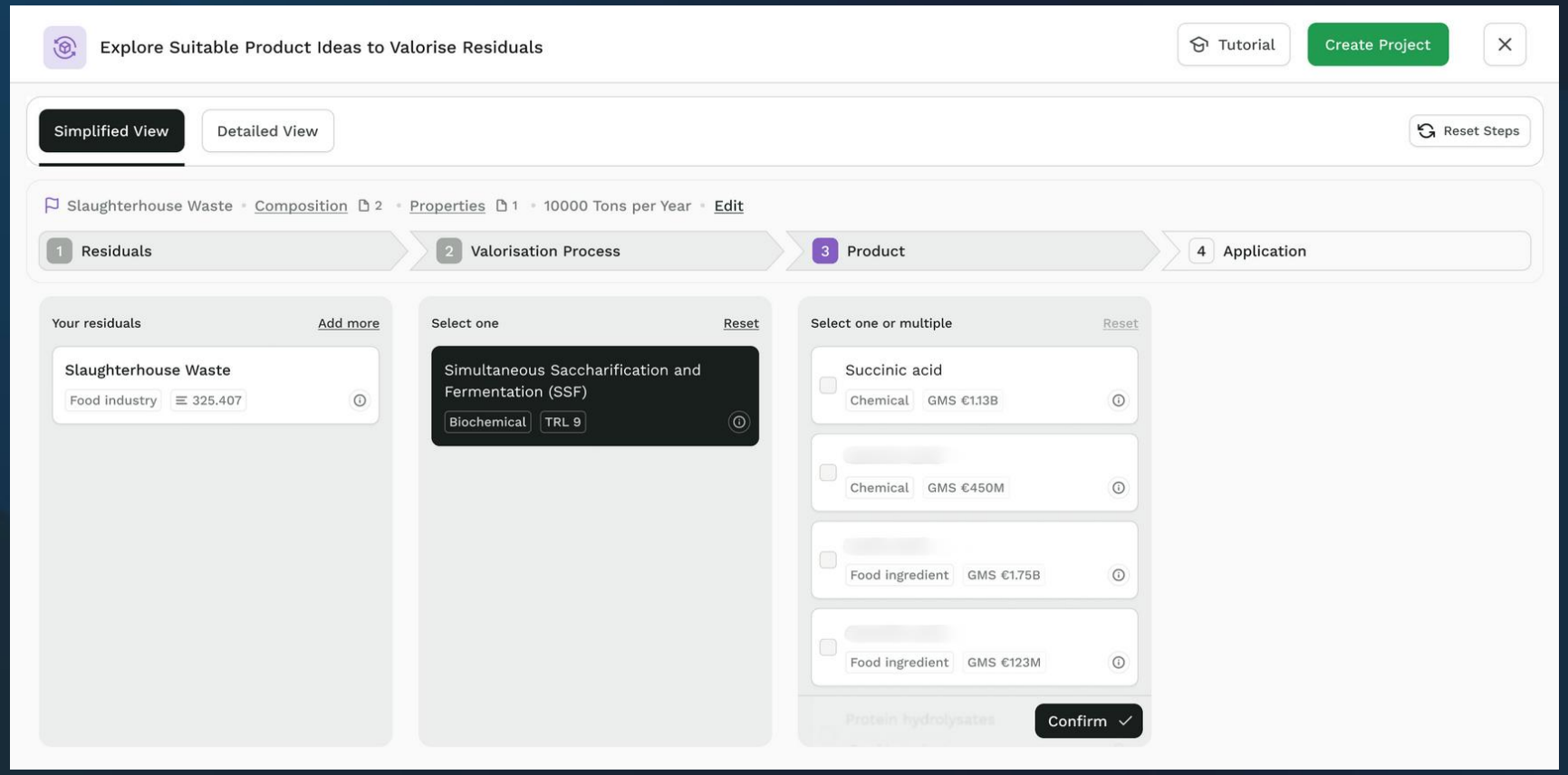
Technical details

Process:
Simultaneous Saccharification and Fermentation (SSF)

Pre-treatment:

1. Thermal/Thermochemical Methods
2. Chemical Methods
3. Biological Methods
4. Mechanical Methods
5. Combined/Hybrid Methods

TECHNICAL VALUE CHAIN SOLUTIONS
PRODUCTS



12 Different Chemical Products

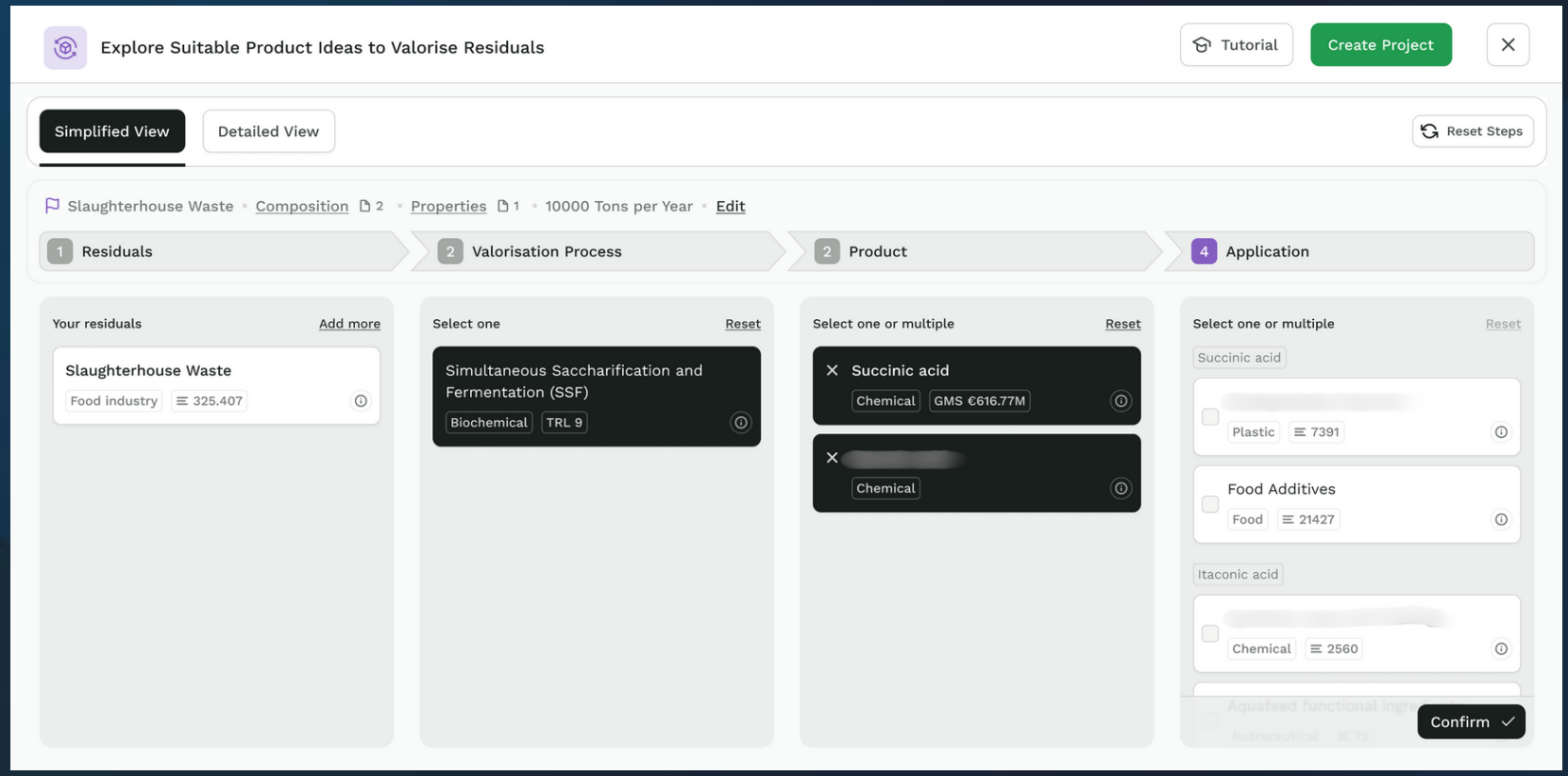
from Simultaneous Saccharification and Fermentation (SSF)

Product types include

- Sugar Alcohols (Polyols)
- Organic Acids
- Alcohols and Biofuels
- Amino Acids

The Global Market Size for these products ranges from $118.4 Bn to $144.7 Bn/year.

TECHNICAL VALUE CHAIN SOLUTIONS
APPLICATIONS

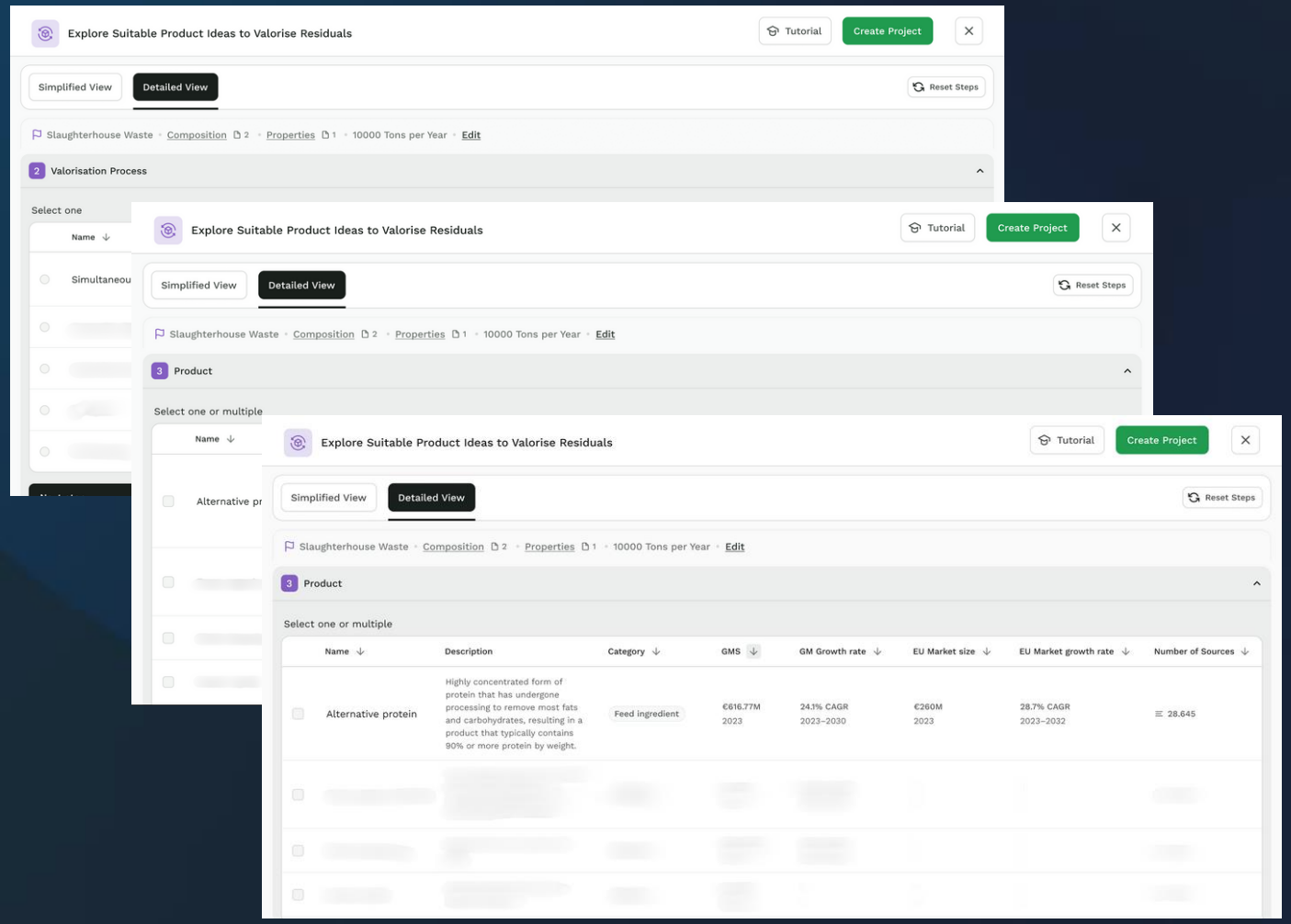


36 End-market Applications
in the following sectors

- Food & Beverage Industry
- Pharmaceutical & Healthcare Industry
- Personal Care & Cosmetics
- Cleaning & Household Products
- Industrial & Chemical Manufacturing
- Energy & Biofuels
- Animal Feed & Agriculture

Price point for the Applications ranges from €4,5-14/kg to €55-75/kg.

TECHNICAL VALUE CHAIN SOLUTIONS
DETAILED VIEW

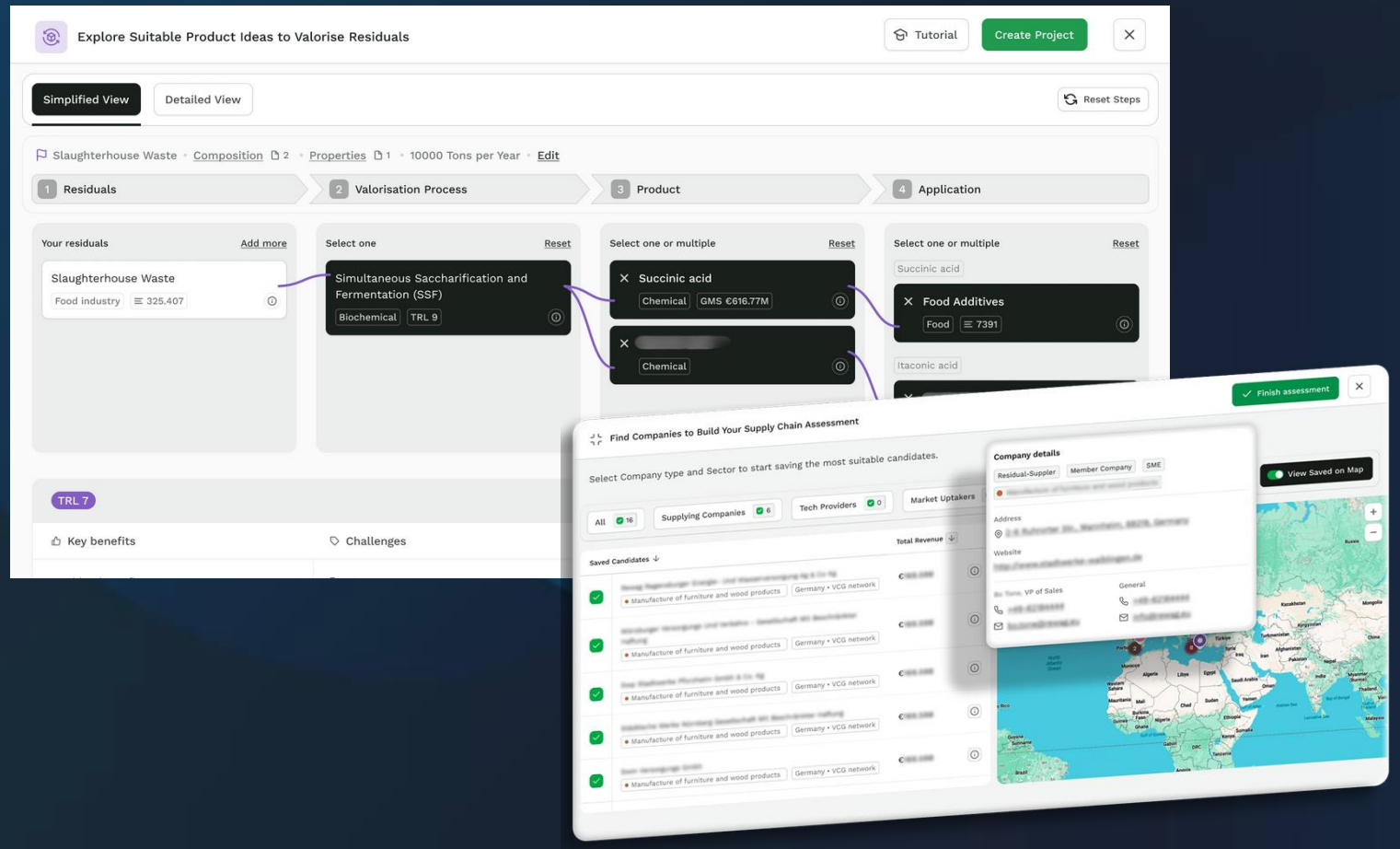


Detailed View

for in-depth information of each step in the value chain, with insights like:

- **Technology Readiness Level** (TRL)
- **Process yeilds & other parameters**
- **Material compositions**
- **Number of Data Sources**
- **Number of Patents**
- **Market Prices**: Provides estimated pricing for these products when derived from beer spent grain, measured in kg, liters, or any other relevant unit depending on the sector.
- **& more...**

TECHNICAL VALUE CHAIN SOLUTIONS
LINKED VALUE CHAIN

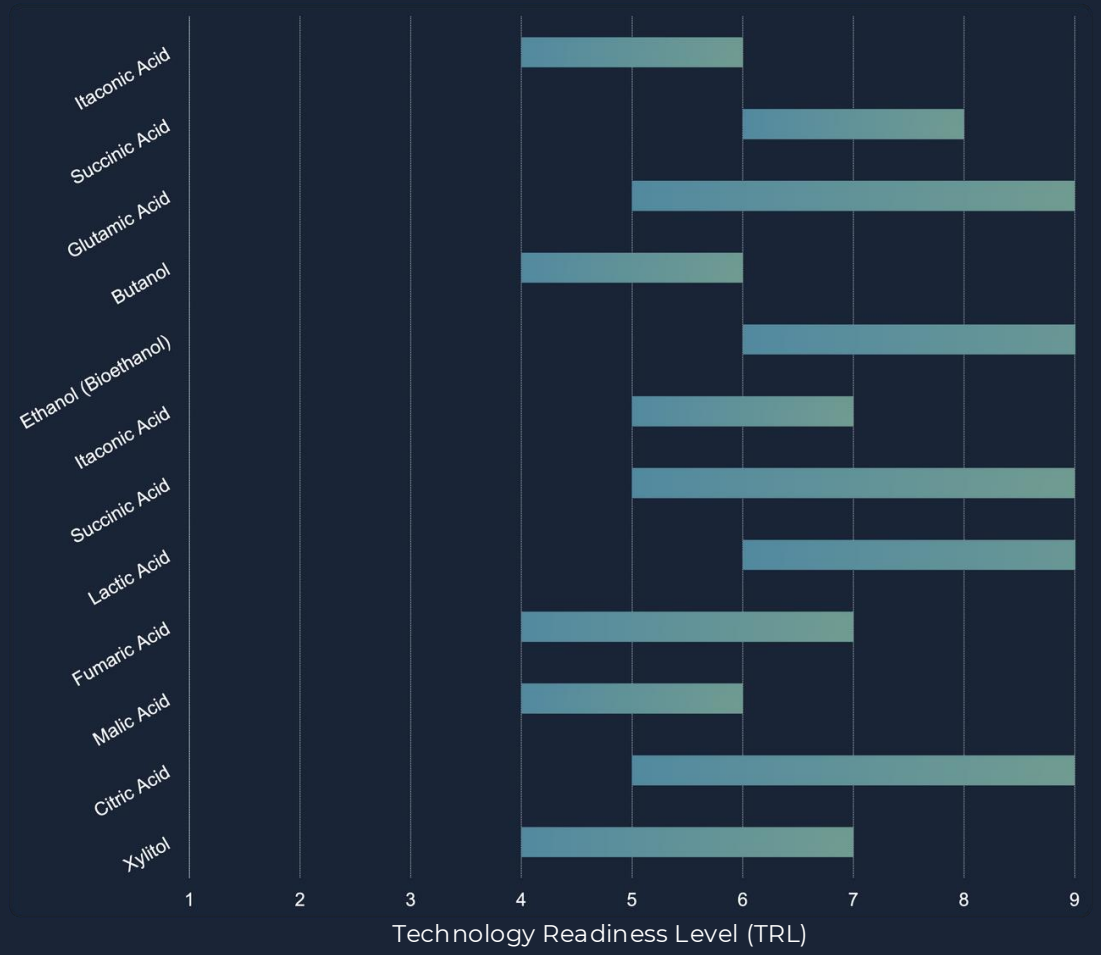


+220k companies

mapped across Europe in the relevant sectors

- Waste generators
- Processing companies
- Chemical producers
- Potential buyers of the products in each market application

TECHNOLOGY READINESS LANDSCAPE



Products range from TRL 4 to 9

They are used to develop a variety of Products

- Xylitol (**TRL 4 - 7**)
- Citric Acid (**TRL 5 - 9**)
- Malic Acid (**TRL 4 - 6**)
- Fumaric Acid (**TRL 4 - 7**)
- Lactic Acid (**TRL 6 - 9**)
- Succinic Acid (**TRL 5 - 8**)
- Itaconic Acid (**TRL 5 - 6**)
- Ethanol (Bioethanol) (**TRL 6 - 9**)
- Butanol (**TRL 4 - 6**)
- Glutamic Acid (**TRL 5 - 9**)
- Succinic Acid (**TRL 6 - 8**)
- Itaconic Acid (**TRL 4 - 7**)

HINTS FROM STARTUPS AND SCALEUPS SCENARIO

Startup major trends in SHW valorisation

- Organic Acids Production
- Collagen and Gelatin Extraction
- Biofertilizer Development
- Lipid Recovery and Biodiesel
- Protein Hydrolysates and Animal Feed
- Biogas Production

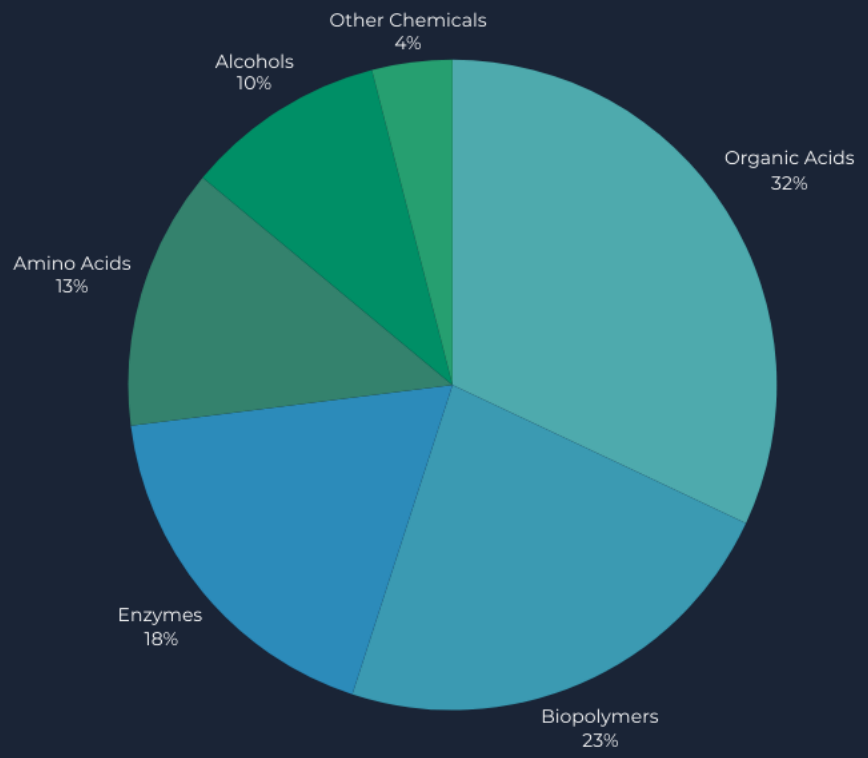
5 core technologies

- **Biotechnology & Enzymatic Processes** → Protein and Fibre Extraction
- **Fermentation & Microbial Solutions** → Production of Alternative Proteins
- **Food Ingredients from Upcycling** → High Protein Flours and Functional Additives
- **Sustainable Packaging** → Bioplastics and Biodegradable Materials
- **Circular Economy Solutions** → Soil improvers and organic fertilisers

Examples:

- ÄIO (Estonia): Converts SHW into sustainable fat substitutes for food and cosmetics through fermentation. Raised €1M.

PATENTS LANDSCAPE



3795 new PATENTS

regarding the technologies to **produce chemicals through the fermentation of SHW**.

6 different types of chemicals

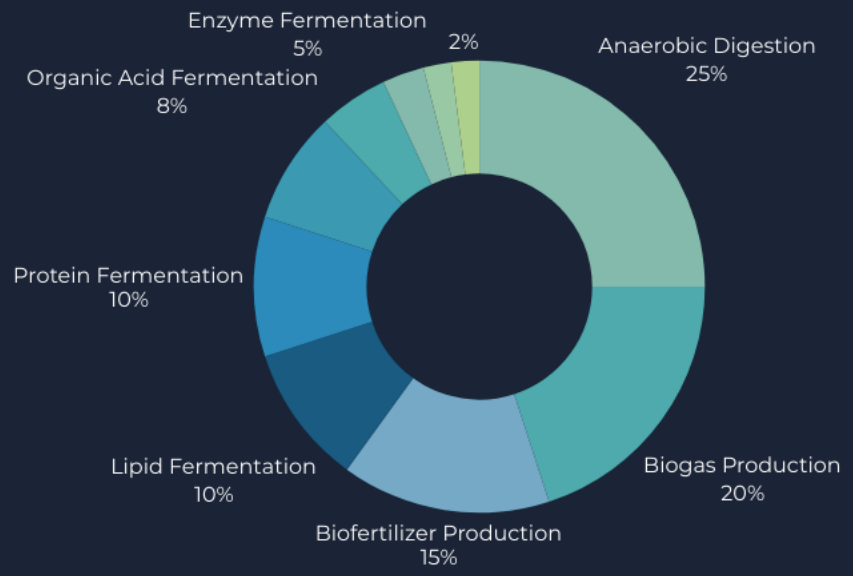
- Organic Acids
- Biopolymers
- Enzymes
- Amino Acids
- Alcohols
- Other Chemicals

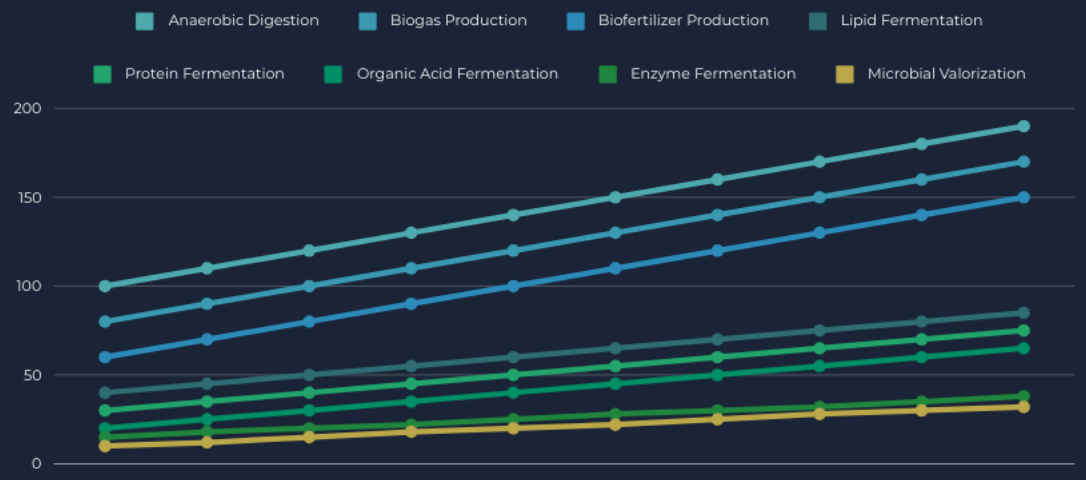
9 different trends

in the analysed patents, like:

- Specific Waste Stream Valorization
- Advanced Fermentation Technologies
- Integration with Other Technologies
- Bioproducts production
- Circular Economy implementation
- Enzymatic Fermentation development
- Microbial Fermentation Implementation.
- Advanced Pretreatment.
- Bioraffinery Concepts.

SCIENTIFIC PUBLICATION LANDSCAPE





+3.000 QUALITY PUBLICATIONS
on SHW VALORISATION **IN THE LAST DECADE**, WITH AN **ACCELERATING TREND**

8 major applICATION SECTORS

- Anaerobic Digestion
- Biogas Production
- Biofertilizer Production
- Lipid Fermentation
- Protein Fermentation
- Organic Acid Fermentation
- Enzyme Fermentation
- Microbial Valorization

8 DOMINANT TRENDS

- Anaerobic Digestion Optimization
- Biogas Upgrading
- Biofertilizer Formulation
- Lipid Fermentation for Biofuels
- Protein Hydrolysate Production
- Organic Acid Fermentation Optimization
- Enzyme-Assisted Waste Degradation
- Microbial Waste Transformation

SYMBIO
MEET YOUR SUSTAINABILITY TARGET

Circular Value Chains

Prepared exclusively for Andalusia under the framework of the SYMBIO project

Funded by the European Union Grant Agreement No 101135166

Introduction

SYMBIO OBJECTIVE: TO UNCOVER CIRCULAR VALUE CHAINS AND SUSTAINABLE SOLUTIONS FOR ANDALUSIA

- **Key Insight**: Andalusia has extensive feedstock streams, especially **wood and rice residues,** exceeding 3 million tonnes. Olive pomace exceeds 6 million tonnes.
- **Bioeconomy Companies**: SYMBIO identified 69 companies that can participate in circular value chains.
- **Focus**: Aligning these companies and their feedstock resources with **possible value chains**.

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Methodology for Evaluating Bioeconomy Value Chains

The Data Used

- Data on feedstock availability (SYMBIO)
- Database on viable technology routes (SYMBIO, VCG.AI)
- Technology availability (VCG.AI)
- Clear local market demand (SYMBIO, VCG.AI)
- Database of existing infrastructure in Andalusia (VCG.AI)

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VALUE CHAIN GENERATOR

Use of VCG artificial intelligence capabilities

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SYMBIO

Step 1.1: Finding feedstock availability from companies

Sector	# of Companies	Examples	Main Activities
Brewery industry	11	Heineken España, Cervezas San Miguel, Cervezas Alhambra	Large-scale beer production, craft brewing.
Biofuels	11	Ecocastulum, Lípidos Santiga BioOil, CEPSA bioenergía San Roque	Biodiesel and biomass production (solid biofuels, waste-to-energy), renewable energy plants.
Dairy industry	9	COVAP, Lactalis Puleva, Queso Payoyo	From large-scale dairy processing to artisanal cheese production and commercialisation
Rice Farms	5	Herba Ricemills, S.A., ARROZÚA, Arrocerías Pons, Arroces de Doñan	Rice cultivation, drying, storage, processing, and specialised biotech applications.
Vegetable Oils	4	DEOLEO, Sovena Group, ACESUR	Olive/vegetable oil production

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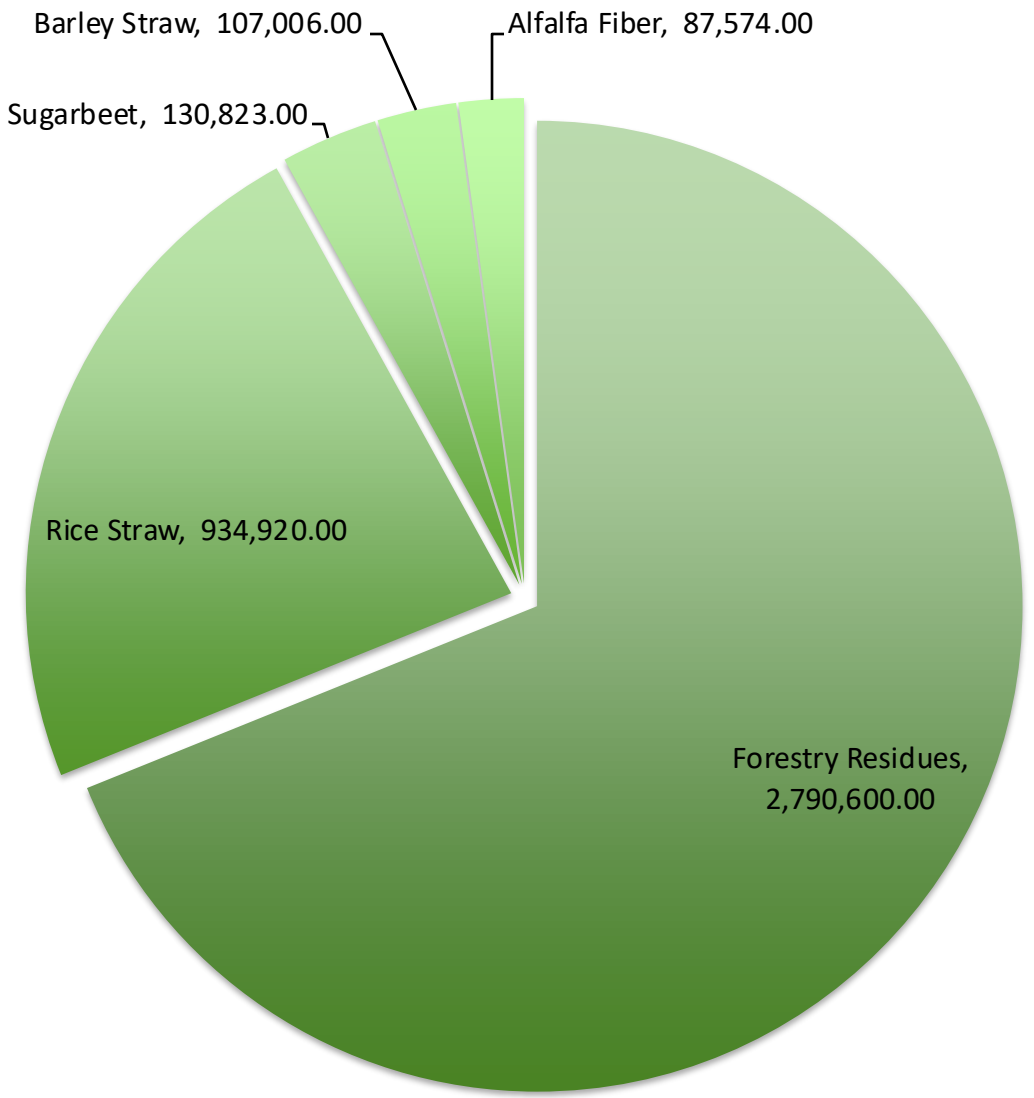
Step 1.2: Uncovering top Biomasses in Andalusia



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Step 2: Finding Viable Technology Routes

Olive and wood residues → Furfural: acid hydrolysis → dehydration

- Established technological readiness (TRL High)

Rice Straw → Sorbitol: Enzymatic hydrolysis → sugar fermentation

- TRL mid-to-high: commercially viable, with innovation potential

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Step 3: Filling in the tech gaps

Approach: Leverage VCG European technology providers database (450+) to fill local technology gaps

- Identify and engage companies in the EU specialised in:
  - Advanced fermentation technologies
  - Biochemical refining processes
- Identification of partnerships for tech transfer, licensing, or joint ventures

Benefits:

- Accelerates local bioeconomy development
- Lowers technological and financial risk
- Strengthens integration within European bioeconomy networks

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Step 4: Identifying clear local market demand

Identified through market analysis & existing industrial partnerships:

Finding companies in the region who have the capacities to offtake the products identified

Key local partners: Persan SA,

Sorbitol: Food industry mainly.

Local industrial partnerships: Ferrero, Mondelez International, Romero Alvarez, Servipan

Furfural: Specialty chemicals market (resins, adhesives, solvents).

Andalusian chemical & agribusiness companies: Persan SA, Andros Granada, Fapanys, Industrias Lacteas de Granada, Nuvaria Global

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Step 5: Existing Infrastructure & Overlap Analysis

Mapped from VCG database (>13,000 existing EU bioeconomy facilities):

- **Incineration plants**
- **Fermentation facilities**
- **Biodiesel producers**

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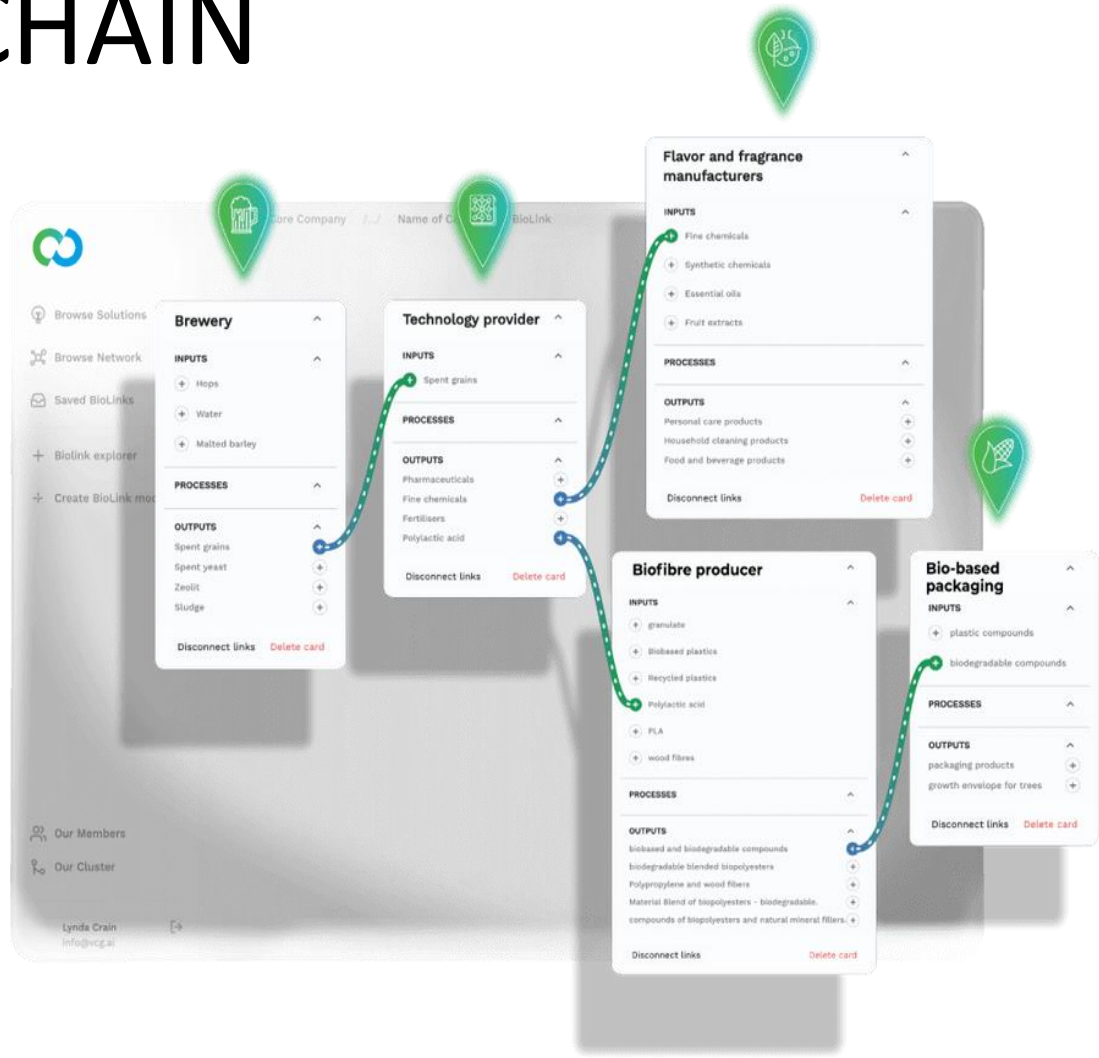
1st PRIORITISED VALUE CHAIN

OLIVE AND WOOD RESIDUES TO FURFURAL



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Furfural – product overview

What is it? An organic chemical derived from hemicellulose (mainly pentose sugars like xylose) present in agricultural and forestry residues.

Main applications: Production of resins, adhesives, solvents, lubricants, pharmaceuticals, agrochemicals, and bioplastics.

Circular potential: Platform chemical – acts as an intermediate building block for various specialty chemicals.

High market potential in diverse industries (chemical, pharmaceutical, food, agriculture).

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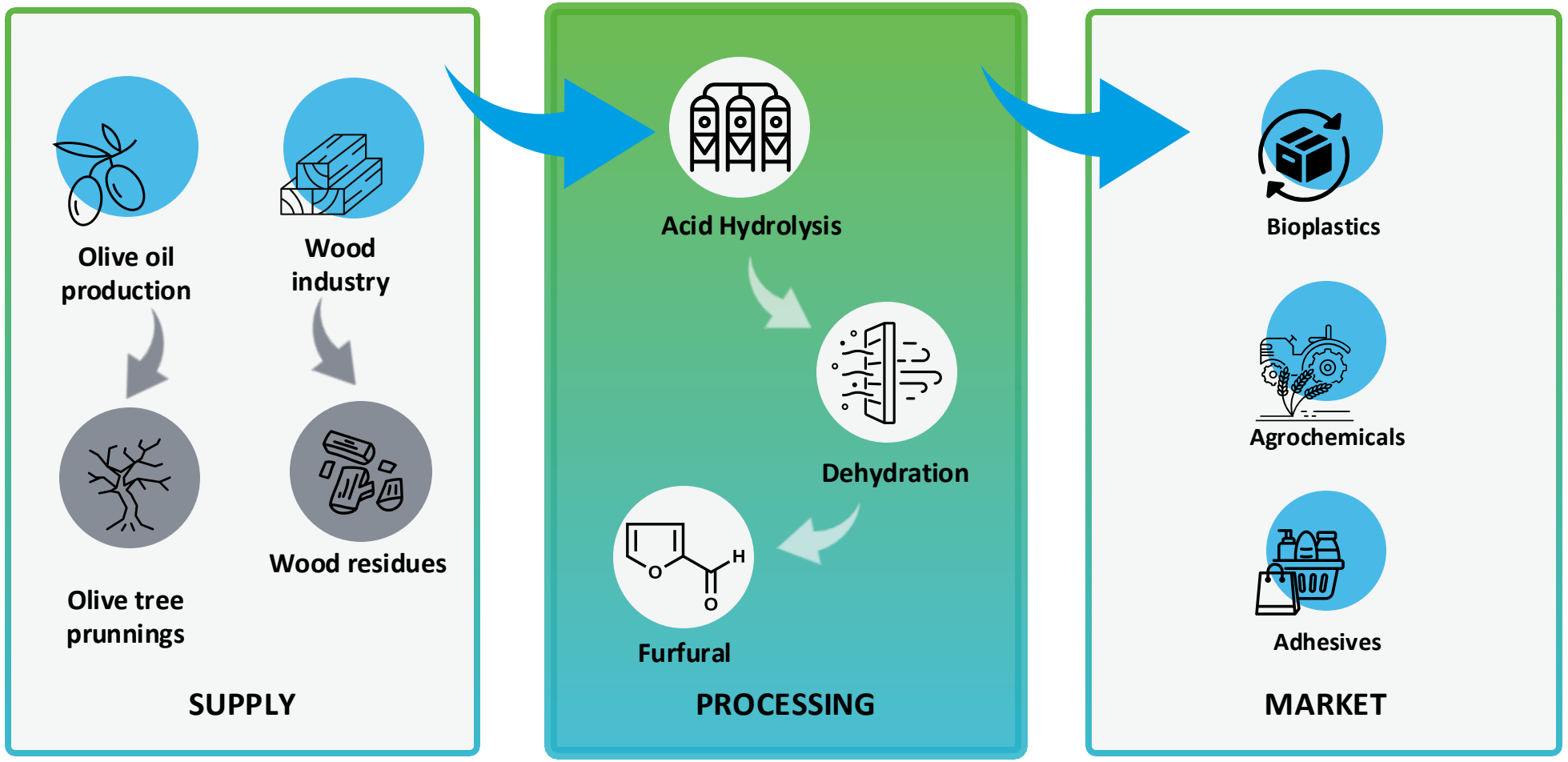
Bio-based Furfural Value Chain In Andalusia



100+ Olive and wood industry

0 Technology Provider

10+ Market Application Companies

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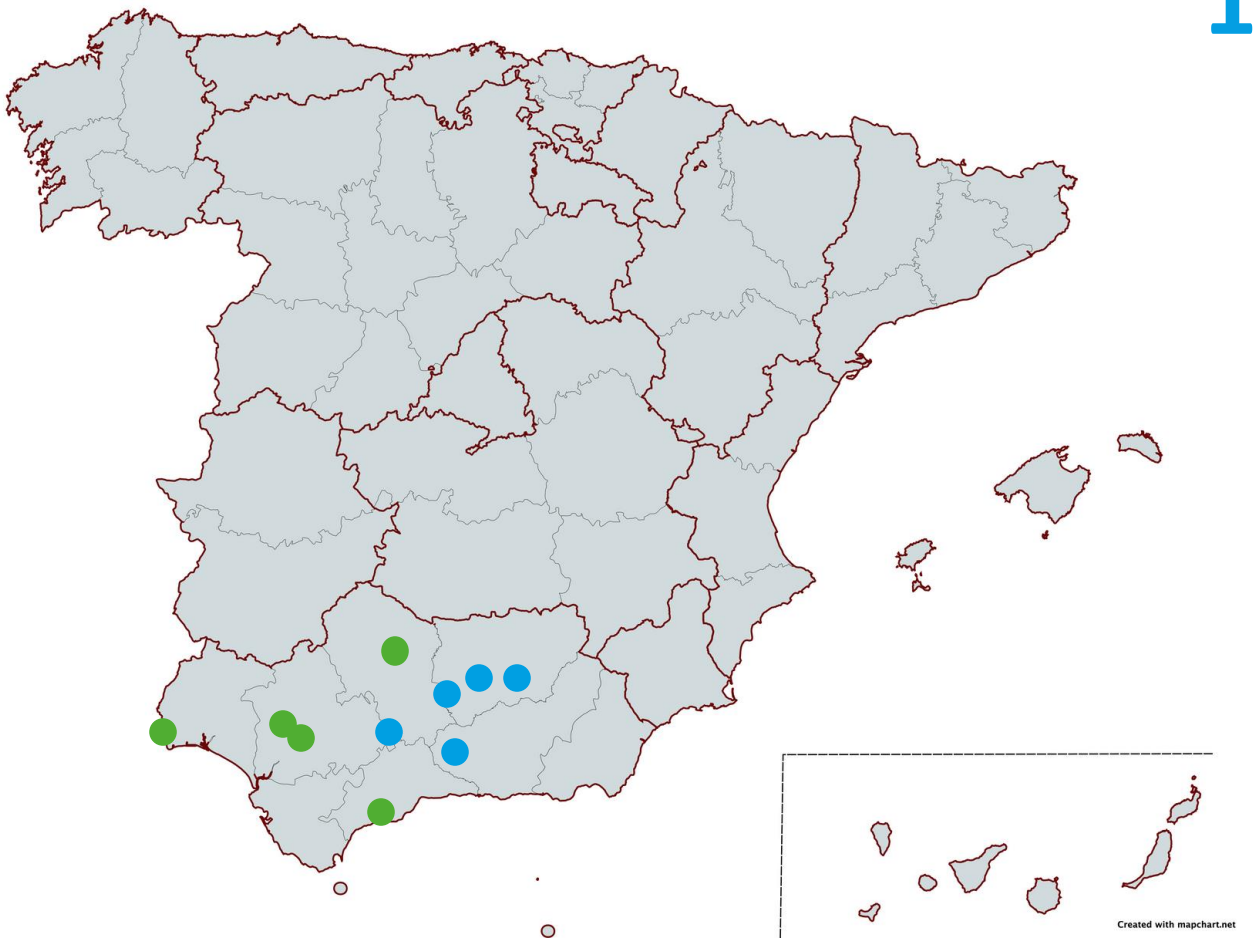
Regional partnerships – Feedstock and market demand



100+ **Biomass Producers**

Iberia Bioenergy, Castillo de Canena, Almazaras de la Subbética, Mueloliva, SGTRES, Ingeoliva, Grupo De Prado

0 **Technology Providers**

10+ **Market Application Companies**

Moeve, Chemical Park of Huelva, Química Futura, S.L., We Think Resin, Persan S.A., Condaplast S.A., Fertinagro Sur S.L., Sophim Iberia

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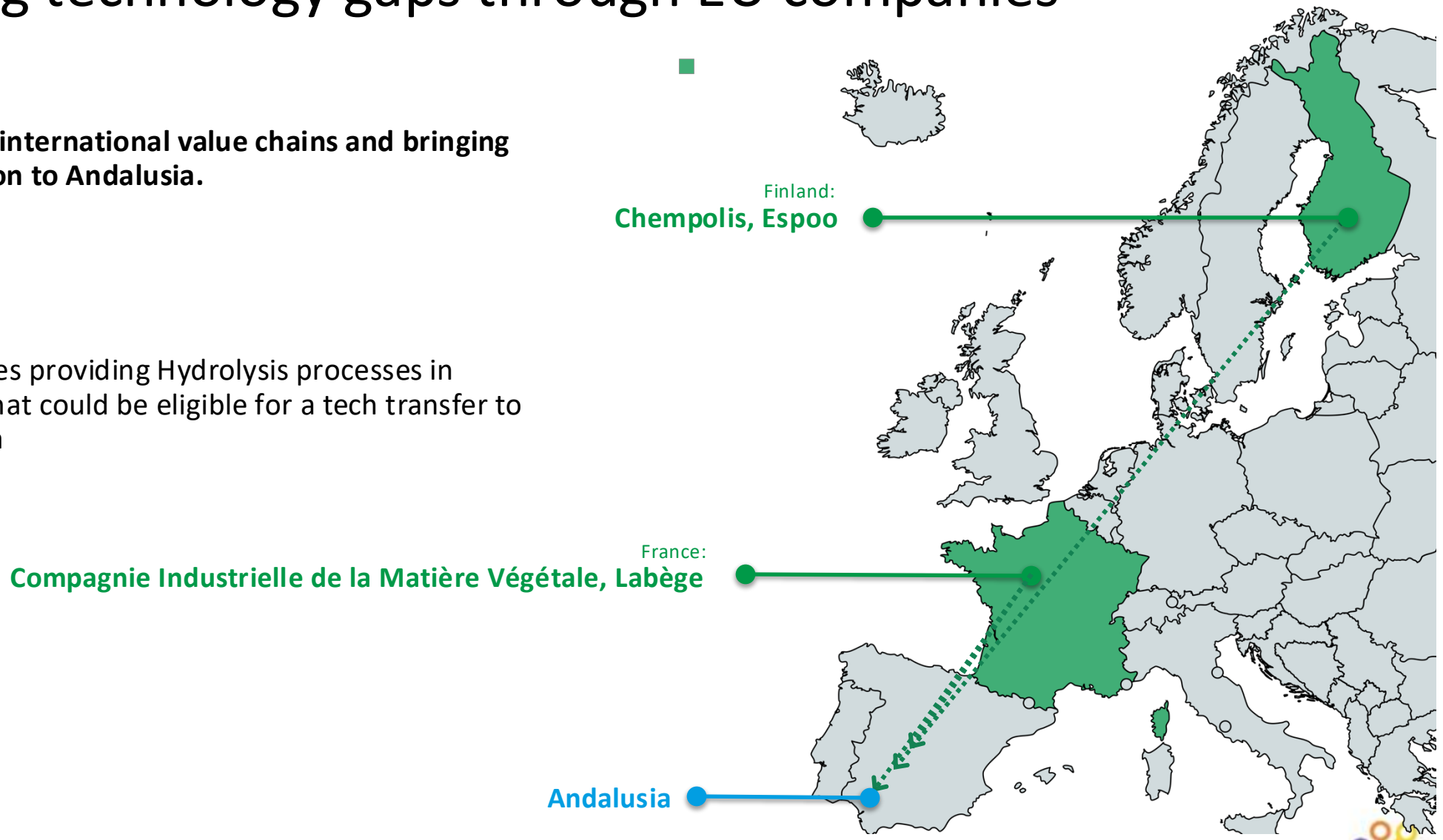
Filling technology gaps through EU companies

Creating international value chains and bringing innovation to Andalusia.

Companies providing Hydrolysis processes in Europe that could be eligible for a tech transfer to Andalusia



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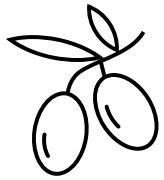
Biomass Availability Andalusia Region

2,5 million tonnes
of olive tree prunings in Andalusia



These prunings typically consist of thin branches (50% by weight), leaves (25%), and thicker branches or wood (25%).

Source: scaleup-bioeconomy.eu

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Viable Technology Routes

Furfural Production

- **Technology:** Acid hydrolysis, catalytic systems, solvent-thermal conversion (commercially mature)
- **Established industrial processes:** widely used in specialty chemical manufacturing globally (resins, adhesives, solvents).

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Existing Infrastructure Overlaps

Moderate to high competition: The competition for biomass in Andalusia is relatively strong, particularly from the bioenergy industry. Bioenergy plants are well-established and generally offer attractive pricing for farmers, leading to stable supply chains.

Recommended actions: The sheer volume (approximately **2.5 million tonnes/year**) of olive tree prunings produced in Andalusia implies substantial surplus capacity, especially in rural or isolated areas that might not currently be fully exploited.

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Conclusion

Value Chain	Feedstock Availability	Tech Maturity	Market Integration	Infrastructure Overlap
Furfural	Very High	High	High	Moderate to High

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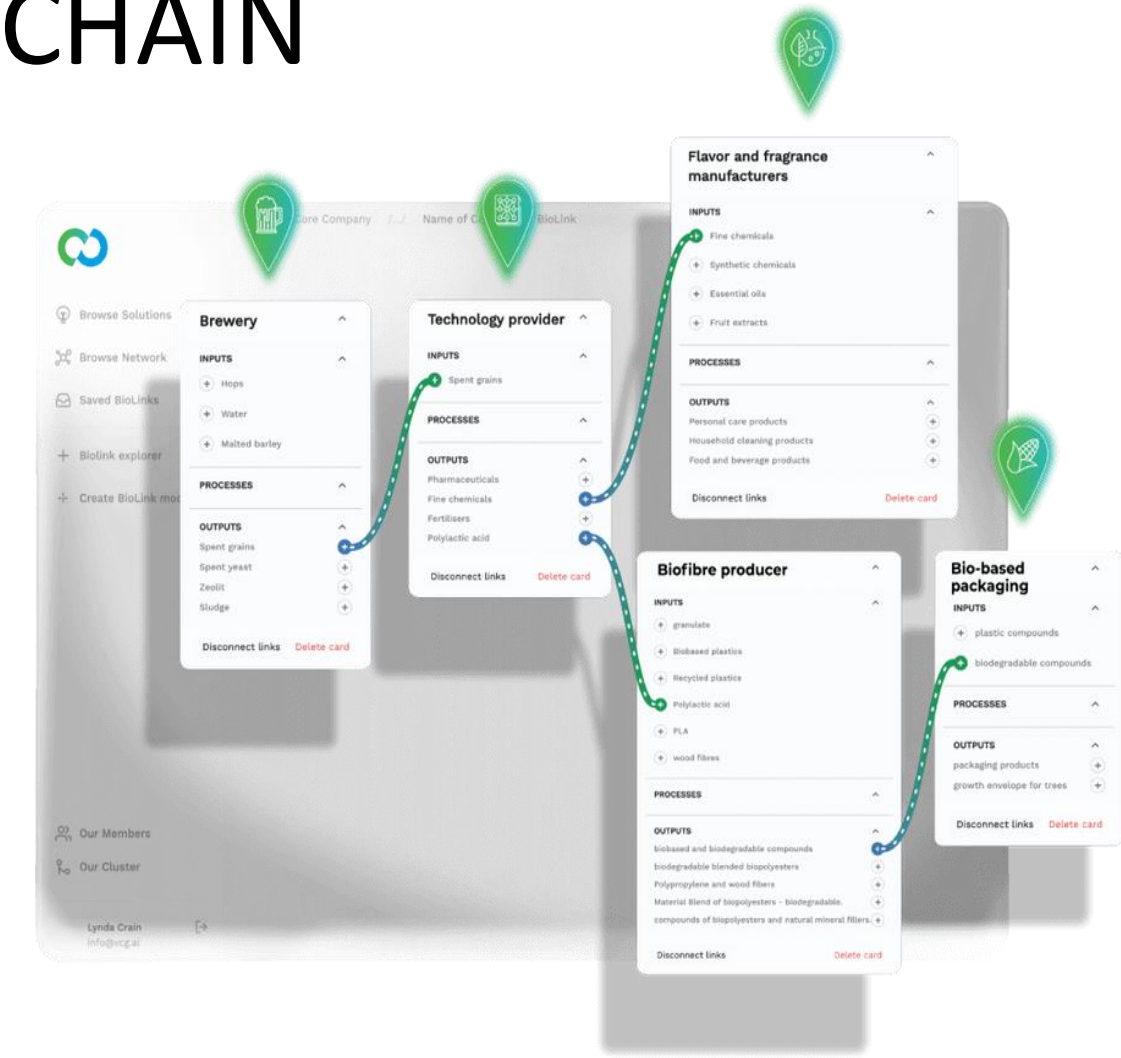
2nd PRIORITISED VALUE CHAIN

RICE STRAW TO SORBITOL



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Sorbitol – product overview

What is it? A sugar alcohol (polyol) derived from glucose often sold as a colourless, odourless liquid syrup or as white crystalline powder.

Main applications: Humectant, sweetener, bulking agent and stabiliser, texturiser and emulsifier.

High market potential in diverse industries (Food & Beverage, Pharma, Personal Care).

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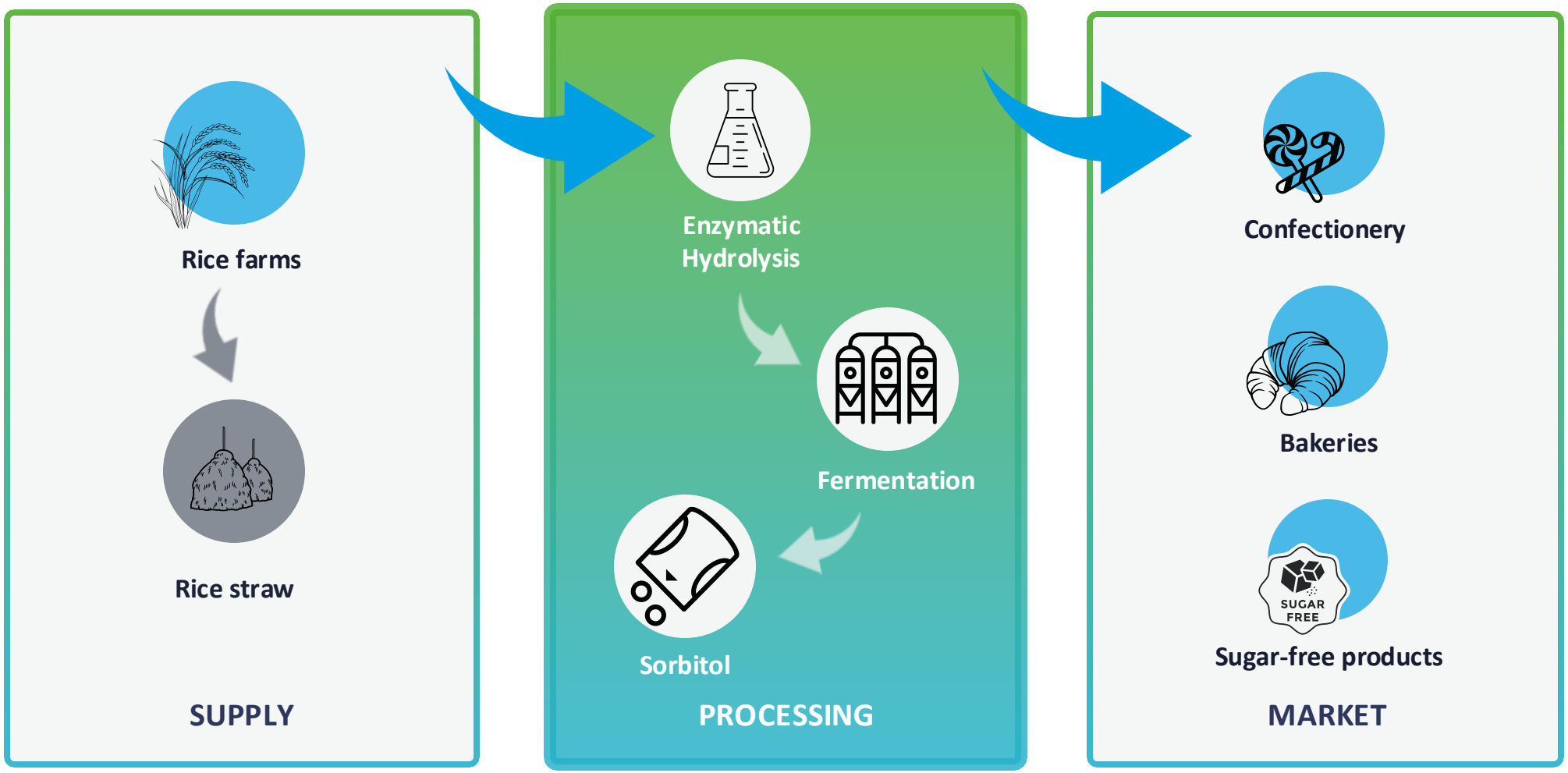
BIO-BASED SORBITOL VALUE CHAIN IN ANDALUSIA



10+ Rice production

2 Technology Providers

6 Market Application Companies

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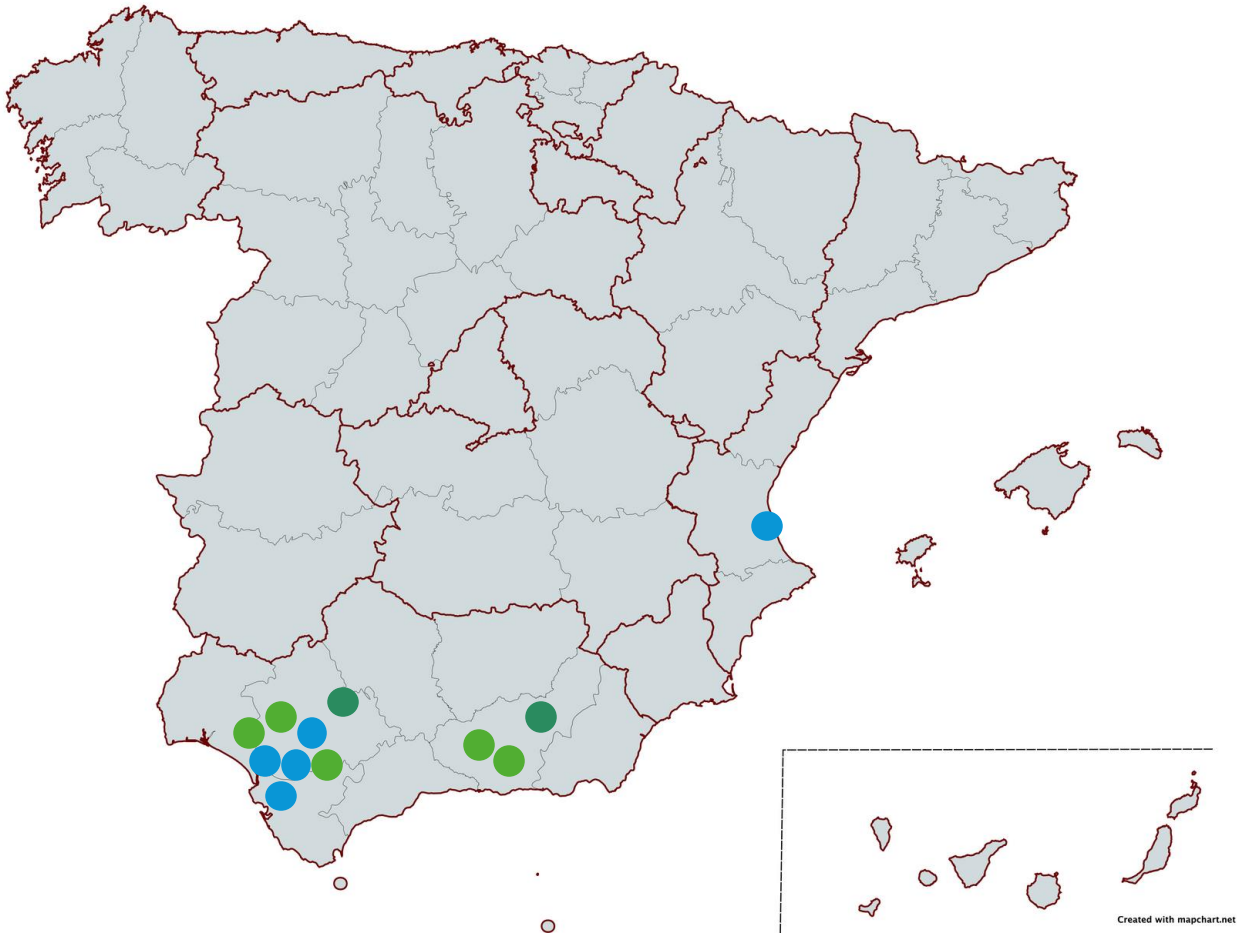
Regional partnerships – Feedstock and market demand



10+

Biomass Producers

Herba Ricemills, S.A., ARROZÚA, Arrocerías Pons, Arroces del Guadalquivir (various producers), Arroces de Doñan

2

Technology Providers

Pevesa Biotech, Biomasa del Guadalquivir

6

Market Application Companies

Fapanys, Andros Granada, La Estepeña, Dulces Olmedo, Laboratorios Rovi, Laboratorios VIR

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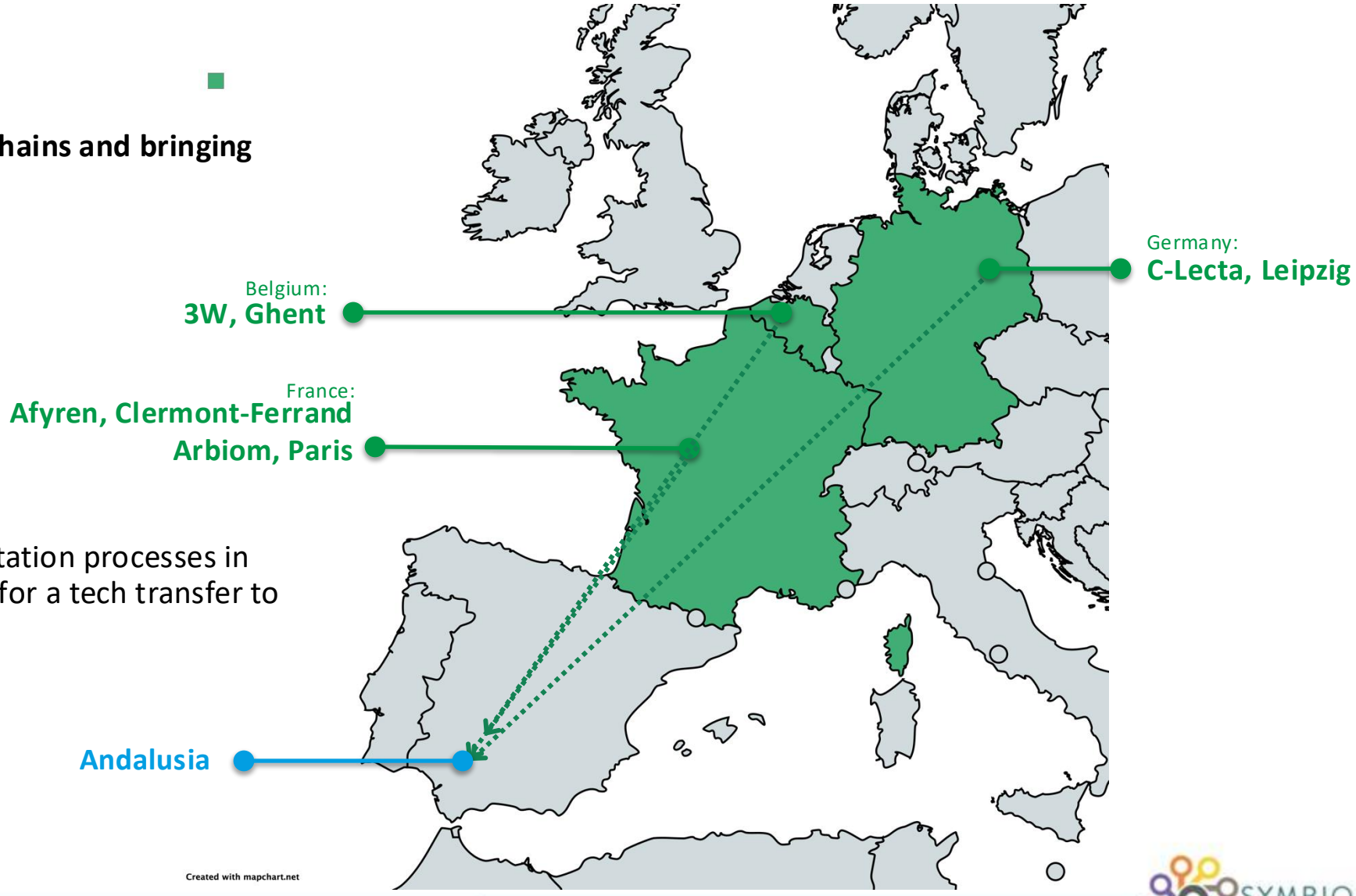
Filling technology gaps through EU companies

Creating international value chains and bringing innovation to Andalusia.

Companies providing fermentation processes in Europe that could be eligible for a tech transfer to Andalusia



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Biomass Availability Andalusia Region

935.000 tonnes
of rice straw in Andalusia per year

A multi-feedstock approach can reduce **seasonality** risks – if rice straw is only available after harvest, you could switch to **corn stover** or **sugar beet pulp** at different times of the year.

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Agreement No. 101135656

Viable Technology Routes

Pre-Treatment

- **Physical/Chemical** (e.g., steam explosion, mild acid) to break down lignocellulose.
- Increases accessibility of **cellulose** to enzymes.

Enzymatic Hydrolysis

- **Cellulases** convert cellulose → glucose.
- Key to **high sugar yield** for sorbitol production.

Catalytic Hydrogenation: Glucose + hydrogen → sorbitol, using metal catalysts (Ni, Ru)

- **Fermentation** (alternative route): Microbes convert sugars → sorbitol, then purification.

Downstream Processing

- **Purification & Concentration** of sorbitol solution.
- Potential to produce **liquid** or **crystalline** sorbitol forms.

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Existing Infrastructure Overlaps

No overlap: The VCG database does not show any significant competition for rice straw, however a portion of it needs to stay on fields for soil fertility.

Recommended actions: to secure large volumes for a bio-based process of sorbitol production, projects usually need to offer an inventive to ensure farmers can preserve soil fertility and still se an economic gain in removing the residue.

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Conclusion

Value Chain	Feedstock Availability	Tech Maturity	Market Integration	Infrastructure Overlap
Sorbitol	Very High	Very High	High	Low

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How can we implement circular value chains: a case of whey to proteins

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Whey-2-value

Greenfield investment into upcycling of the dairy industry’s by-products into high-value ingredients for the global market

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WHEY & DAIRY PERMEATES
UNDER-UTILISED, OFTEN WASTED

Sweet whey & permeates

Major by-products of dairy processing, generated during cheese and yogurt production.

Lower value products

Released in the environment

Used as feedstock for biogas production

INNOVATIVE CIRCULAR SOLUTIONS

DAIRY BY-PRODUCTS INTO HIGHER VALUE PRODUCTS

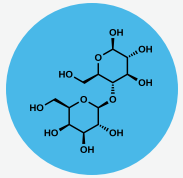
FEEDSTOCK

Sweet & sour whey

PROCESSING

Physicochemical process
Membrane separation, Ultrafiltration

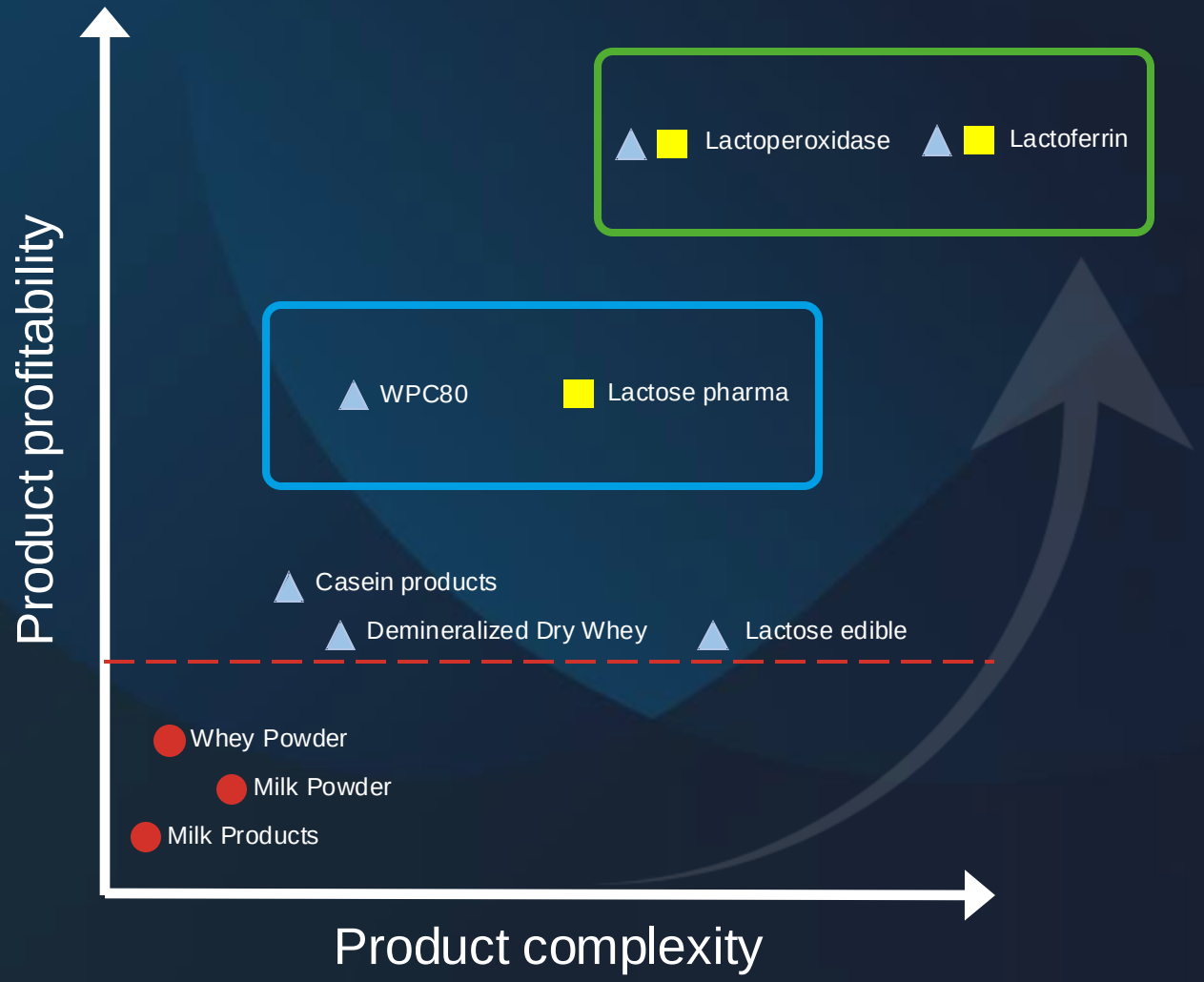
MARKET



Pharma-grade lactose

Protein concentrate (WPC)

AIMING FOR HIGH VALUE-ADDED MARKETS



The process allows for technological upgrades and adaptation to produce highest value products.

Extraction of WPC80 and pharmaceutical grade lactose is a proven process, that allows a profitable valorisation of dairy industry by-products at industrial scale.

- Products for the food industry
- Products for the pharmaceutical industry
- Traditional dairy products

MARKETS AND INDUSTRY APPLICATIONS

WPC80

Market price: 11.000 - 14.000 €/MT

Market CAGR: 10,5% (2022-2030)

“Pharma-grade” lactose

Market price: 2.000 - 2.500 €/MT

Market CAGR: 5,2% (2024-2032)

Confectionary

Nutrition

Pharmaceutical

F&B

Cosmetics

EXAMPLE FROM THE INDUSTRY

SERUM ITALIA - PRODUCTION OF PROTEINS (NO LACTOSE)

Year 2021	
Revenues	**52,5 mio. €**
Net Income	**6,2 mio. €**

EBITDA % = 15.1%

ROA* = 24.2%

ENVIRONMENTAL SUSTAINABILITY
IMPACT ON MULTIPLE LAYERS

Reduced costs, logistics and CO2 emissions

Local processing instead of transport abroad, 9,000+ tonnes less CO2 emissions/year

Sustainable source of protein and lactose

40 times less CO2 emissions/kg protein compared to beef

Development and long-term competitiveness

Higher added value for by-products of the dairy industry in the region

vcg.ai®

VALUE CHAIN GENERATOR

Let’s accelerate the development of the circular economy together!

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