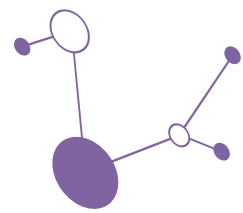


BOOK OF GOOD EXAMPLES: BIOCIRCULAR SOLUTIONS FOR SMEs

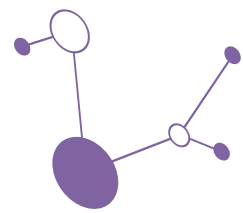
From By-products to New Business Opportunities





CONTENT

Introduction.....	2
Case studies	3
A.Hemp Stem Material into Biocomposites.....	4
B.From Vineyard to Value: A Circular Economy Case Study on Prosecco By-Products.....	5
C.Beyond the Core: Circular Economy Applications for Radicchio Leaves.....	6
D.Utilisation of Agricultural and Food Residues for Yellow Mealworm Farming and Processing.....	7
E.Agri-food Waste Bioconversion into Animal Feed, Fuel or Other Products.....	8
F.Upgrading a By-Product: Regional Collaboration for Food-Grade Pumpkin Seed Meal.....	9
G.Utilisation of Apple Residues for Pet Food Production.....	10
H.Apple Pomace for Pectin and Animal Feed Production.....	11
I.Corn Cobs into Granulates for Different Application.....	12
J.Integrating Regional Hemp into Circular Furniture and Textile Production.....	13
From by-products to business opportunities.....	14



INTRODUCTION

Biocircularity offers SMEs a practical way to turn underused biological resources into new products, savings and business opportunities. Instead of treating agricultural and food residues as waste, businesses can explore how they can be reused as inputs for new products, materials, feed, energy or other applications.

The TeBiCE project demonstrates this approach through pilot actions across European regions, involving agriculture, food processing, bio-based materials and other sectors. The examples show that biocircular innovation does not always require major investment: it can begin with better use of existing resources, adapted equipment, a new partnership or a small-scale pilot.

HOW TO USE THIS BOOK

This publication is designed as a practical source of **inspiration for SMEs**. Each case study highlights:

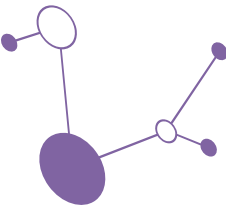
CHALLENGE	-	What	problem	or	unused	resource	was	identified?
SOLUTION	-	What		was	tested	or		implemented?
BENEFITS	-	What	value	or	improvement		was	achieved?
LESSONS	-	What		can	other	SMEs		learn?
SCALABILITY - Could the approach be adapted elsewhere?								

The examples are not solutions to copy directly. They are starting points for identifying ideas that can be adapted to your own resources, capabilities and market.

Start with what you have, connect with the right partners, test what works and build from there.



Hemp field from Rottal Hanf Ltd., Germany



CASE STUDIES

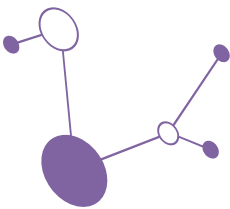
Showcasing Biocircular Innovation Across Regions

This chapter presents a curated collection of 10 pilot actions implemented across 8 TeBiCE regions from 6 countries (Austria, Germany, Italy, Poland, Slovakia, Slovenia), capturing real-world applications of biocircular principles in the agri-food and bioeconomy sectors.

Each **case study** fiche follows a standard template to ensure comparability and clarity. These fiches document not just **what was done**, but **why it mattered**—highlighting context-specific challenges, innovative solutions, measurable impacts, and key insights for future replication.

10 BIOCIRCULAR SOLUTIONS IN ACTION										
Turning agricultural and food by-products into value across Europe										
TeBiCE Territorial biorefineries for circular economy										
REGION	1 Hemp Stem Material into Biocomposites Slovakia	2 From Vineyard to Value: Prosecco By-products Italy (Valdobbiadene)	3 Radicchio By-products into Functional Ingredients Italy (Veneto)	4 Yellow Mealworm Farming and Processing Poland (Warmia and Mazury)	5 Agri-food Waste Bioconversion into Animal Feed, Fuel or Other Products Poland (Kujawsko-Pomorskie)	6 Upgrading a By-Product: Food-Grade Pumpkin Seed Meal Austria (Southeast Styria)	7 Apple Residues for Pet Food Production Italy (South Tyrol)	8 Apple Pomace for Pectin and Animal Feed Production Slovenia	9 Corn Cobs into Granulates for Different Applications Slovenia	10 Integrating Regional Hemp into Circular Furniture and Textile Production Austria & Germany
RESOURCE / BY-PRODUCT	Hemp stems (outer fibers, shives, hurd)	Grape pomace, stems, lees, tartaric residues	Radicchio leaves and processing residues	Agricultural and food residues (for insect feed)	Agricultural residues and biomass	Pumpkin seed press cake	Apple pomace and processing residues	Apple pomace (from juice production)	Corn cobs (after grain harvest)	Hemp fibers (from regional cultivation)
SOLUTION IMPLEMENTED	Mobile decortication and processing into fibers, shives and microparticles; production of biocomposite materials	Mapping and assessment; focus on lees for biostimulants and nutraceutical ingredients	Fractioning and extraction of bioactive compounds for food, pet food, cosmetics and nutraceuticals	Optimization of feed substrates, rearing and drying processes; use of scientific support	Mapping biomass availability and properties; identification of suitable technologies and applications	Regional cooperation and use of shared infrastructure for pressing, milling, sieving and packaging	Pre-treatment and conversion into functional ingredients for pet food	Drying for animal feed; extraction of pectin for food applications	Adapted harvesting, drying and granulation for feed, bedding, bioenergy and other uses	Partnership between hemp processor and sustainable manufacturer; material testing and product integration
KEY RESULTS & IMPACT	New materials for construction and furniture; value retained in the region; reduced waste	Up to 90 t/year of lees and 48 t/year of pomace/stems from the winery valorised; High-value applications identified	Low-value residues transformed into functional ingredients; new markets accessed	Higher productivity and efficiency; better use of local residues; new source of circular protein	Regional biomass atlas; identified opportunities for biogas, fertiliser, feed and other products	Press cake upgraded to food-grade meal; higher value and new food markets accessed	New pet food ingredients created; seasonal residues turned into stable and valuable materials	Two value pathways: accessible feed application and higher-value pectin production	Efficient collection and processing; new markets for granulates; better use of corn by-products	Regional hemp integrated into furniture and textile products; reduced reliance on imported materials
MAIN LESSON	Local processing and SME cooperation can turn an underused resource into higher-value materials.	Systematic mapping and testing reveal high-value potential in winery by-products.	Perishable residues can become valuable when matched with the right applications and partners.	Step-by-step optimization with technical and scientific support improves insect farming performance.	Reliable data and stakeholder cooperation are essential starting points for circular value chains.	Regional collaboration and shared facilities help SMEs access higher-value markets without high individual investment.	Cross-sector partnerships and proper processing unlock value from perishable residues.	Cascade use and cooperation increase the economic and environmental value of apple pomace.	Collecting and processing together makes a bulky by-product economically viable.	Partnerships and local materials strengthen circular supply chains and sustainability.
CROSS-CUTTING BENEFITS OF BIOCIRCULAR SOLUTIONS										
RESOURCE EFFICIENCY Better use of local biomass and by-products.		ECONOMIC VALUE New products, cost savings and additional income streams.		LOCAL DEVELOPMENT Stronger regional value chains and new jobs.		ENVIRONMENTAL IMPACT Less waste, lower emissions and reduced use of virgin resources.		COLLABORATION SMEs, researchers and partners innovate and succeed together.		
								RESILIENCE More resilient businesses and communities in the face of future challenges.		
Small steps. Local resources. Strong partnerships. Biocircularity turns challenges into opportunities.										

Use these case studies as a toolbox for practical innovation and a testament to how small steps, rooted in place-based action, can drive systemic change.

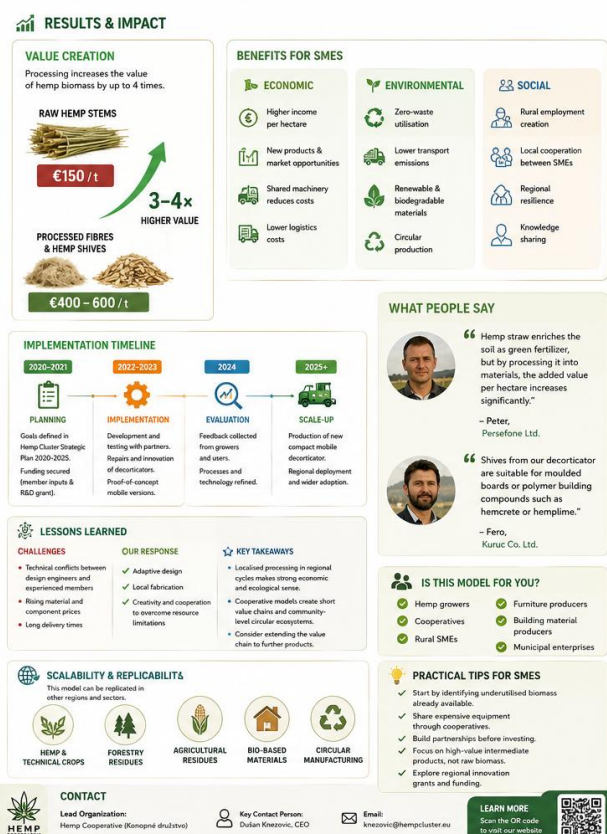


A. Hemp Stem Material into Biocomposites

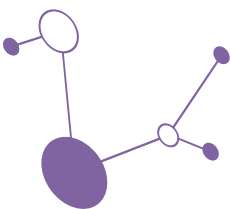
Industrial hemp is primarily cultivated for seed in southern Slovakia, while its stems remain an underused resource despite their potential for higher-value applications. The pilot explored how local processing and cooperation between growers and SMEs can transform hemp stems into fibres, shives and biocomposite materials for construction and furniture, creating a short regional value chain based on circular bioeconomy principles.



Refurbished Charlie & Co. decorticator



Local processing of hemp stems through cooperative SME networks can turn an underused agricultural resource into higher-value materials while keeping economic value within the region. Shared infrastructure and collaboration can make circular production more viable for smaller businesses.



B. From Vineyard to Value: A Circular Economy Case Study on Prosecco By-Products in Valdobbiadene

The Prosecco Superiore DOCG area around Valdobbiadene is a renowned wine-producing region where traditional production generates several organic by-products, including grape pomace, stems, lees and tartaric residues. The TeBiCE pilot with Adami S.r.l. explored how these streams—particularly fermentation lees—could be better understood and transformed into higher-value applications such as biostimulants and nutraceutical ingredients, combining production data, scientific assessment and stakeholder cooperation.



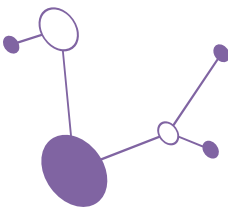
Winery by-products can offer untapped value beyond conventional disposal or low-value uses. For SMEs, systematic mapping of material flows, early testing and cooperation with technology, research and market partners can help identify viable high-value applications while building a more circular and resource-efficient wine value chain.

C. Beyond the Core: Circular Economy Applications for Radicchio Leaves

Radicchio Rosso di Treviso IGP is one of Veneto's distinctive horticultural products, but its processing generates significant quantities of leaf residues that are largely composted despite their valuable bioactive compounds. The pilot led by Veneto Agricoltura, together with Tera Bona S.C.A.R.L. and Vortex, explored how selected residues can be transformed into ingredients for food, pet food, cosmetic and nutraceutical applications.



Even highly perishable horticultural residues can become valuable resources when the right fractions are identified and matched with suitable markets. Collaboration between producers, processors and technology providers can help SMEs turn unavoidable by-products into new circular business opportunities.



D. Utilisation of Agricultural and Food Residues for Yellow Mealworm Farming and Processing

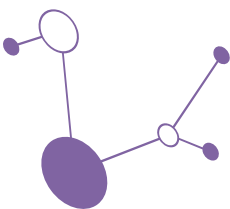
CIRWINS Insects is a Polish SME developing sustainable animal feed based on yellow mealworm larvae. The pilot explored how locally available agricultural and food residues can be used more efficiently as feed substrates while improving rearing and drying processes. The approach combines practical experimentation with scientific expertise to support the development and scaling of insect-based feed production.



Dried yellow mealworm larvae

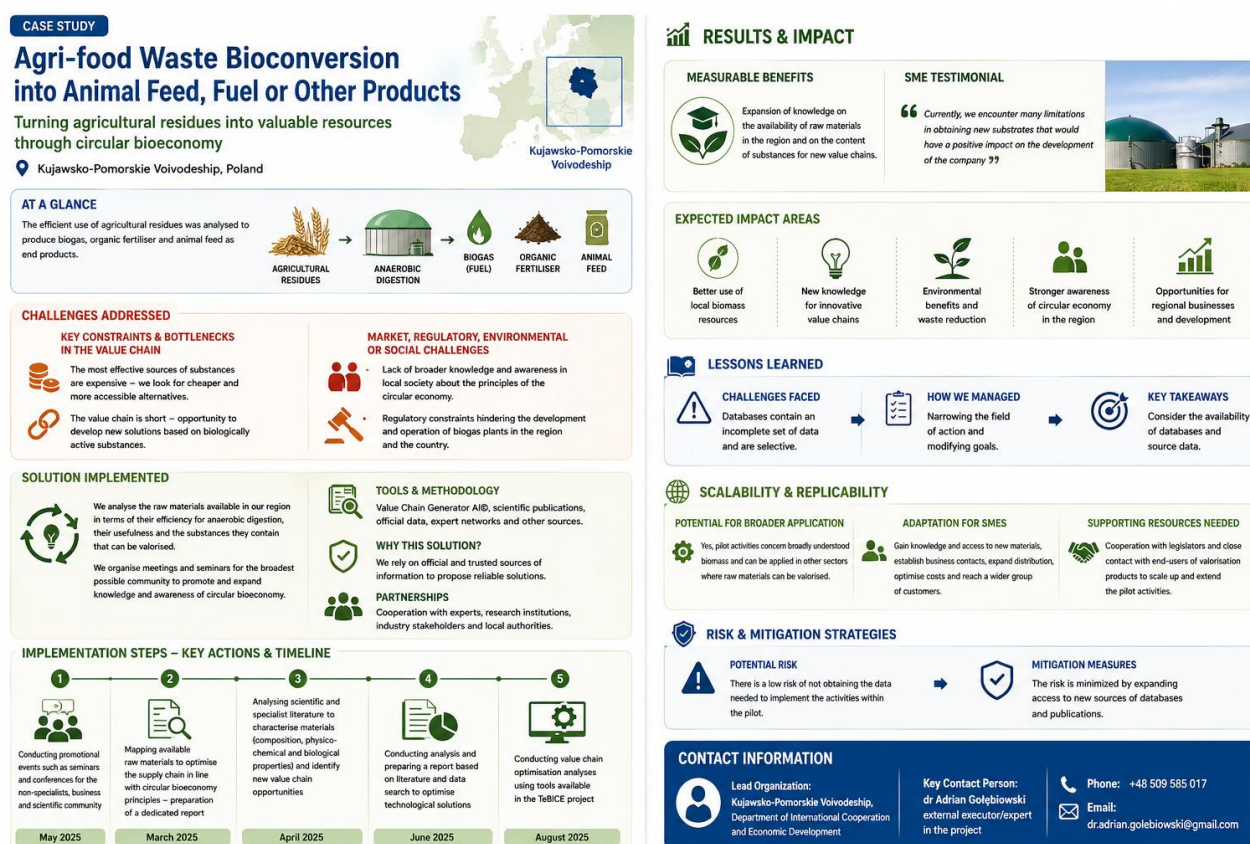


Better use of local residues, combined with targeted technical and scientific support, can significantly improve insect farming productivity and create new opportunities for circular protein production.

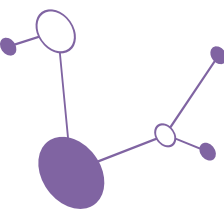


E. Agri-food Waste Bioconversion into Animal Feed, Fuel or Other Products

This case study explores how locally available agricultural residues can become resources for new circular value chains. By mapping biomass availability, analysing its properties and identifying suitable technologies and applications, the initiative aims to improve the use of regional resources for products such as biogas, organic fertiliser and animal feed.



Reliable information about available biomass is a crucial first step for SMEs seeking new circular business opportunities. Combining data, expert knowledge and stakeholder cooperation can help identify viable value chains while reducing dependence on costly raw materials.



F. Upgrading a By-Product: Regional Collaboration for Food-Grade Pumpkin Seed Meal

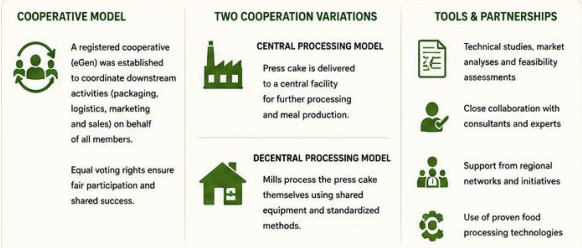
Pumpkin seed oil production is deeply rooted in Southeast Styria, where small oil mills generate pumpkin seed press cake as a valuable but traditionally underused by-product. The pilot explored how regional cooperation can enable these SMEs to upgrade press cake into food-grade pumpkin seed meal without requiring each mill to invest in complete processing infrastructure, opening access to higher-value food markets.



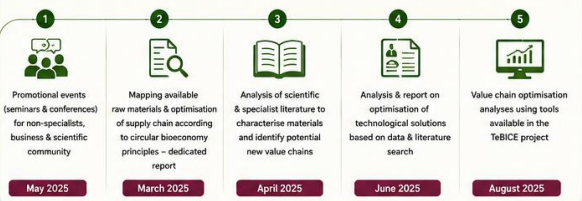
Source: www.kiendler.com



SOLUTION IMPLEMENTED



IMPLEMENTATION STEPS & TIMELINE



LESSONS LEARNED

- Incomplete and selective data in databases made analysis challenging.
- We focused our scope and adjusted goals to available data.
- For future projects: start with a clear view on data availability and source quality.

SCALABILITY & REPLICABILITY

- Broad potential: applicable to various biomass streams and other sectors.
- SMEs benefit from new material sources, partnerships, lower costs and wider markets.
- Scaling needs supportive regulations and strong links with product end-use markets.

RISK & MITIGATION

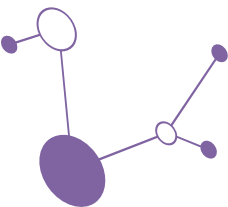
- Potential risk: Low risk of not obtaining the data needed for the pilot.
- Mitigation: Expanding access to additional databases and publications.

CONTACT INFORMATION

Lead Organization:
Kujawsko-Pomorskie Voivodeship,
Department of International Cooperation
and Economic Development

Key Contact Person:
dr Adrian Golebiowski
external executor / expert@project
+48 509 585 017
dr.adrian.golebiowski@gmail.com

Small SMEs do not always need to invest individually to enter higher-value markets. By pooling resources, coordinating processing and sharing marketing functions, regional cooperation can turn fragmented by-products into marketable food ingredients while reducing investment risks for individual businesses.



G. Utilisation of Apple Residues for Pet Food Production

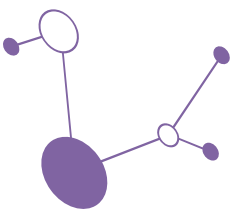
Apple processing generates substantial quantities of residues that can be further valorised instead of being treated as waste. The pilot explored the technical and economic potential of converting selected apple by-products into ingredients for pet food, combining processing expertise, laboratory analysis and cooperation across the apple value chain.



pet food (kibble) produced by Andriani SPA



Pre-treating and converting apple residues into functional ingredients can create new value for both producers and pet-food manufacturers. Cross-sector collaboration is key to turning a seasonal by-product into a reliable circular raw material.

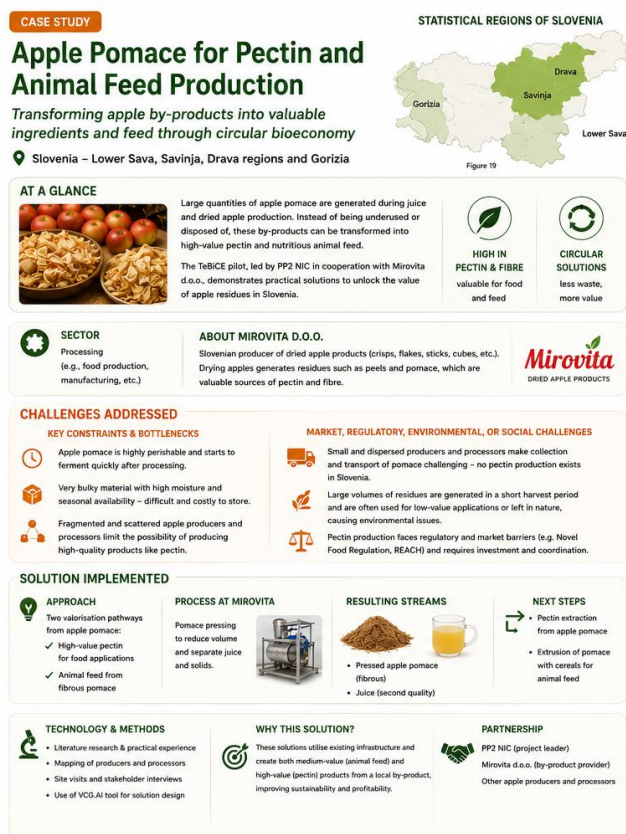


H. Apple Pomace for Pectin and Animal Feed Production

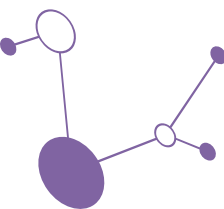
Apple processing in Slovenia generates significant quantities of perishable pomace, creating both storage challenges and an opportunity for valorisation. The TeBiCE pilot with Mirovita explored two complementary pathways: using apple pomace for animal feed as a more accessible option for SMEs and developing pectin production as a higher-value opportunity requiring broader regional cooperation and investment.



Dried apple products from the company Mirovita d.o.o.



Apple pomace can support different levels of value creation, from accessible feed applications to higher-value pectin production. For SMEs, regional cooperation, shared processing capacity and a cascade approach can make advanced valorisation more economically viable.



I. Corn Cobs into Granulates for Different Application

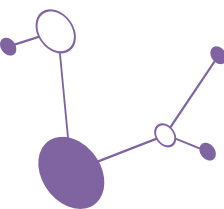
Corn cobs are an underused agricultural by-product that can provide additional value when collected and processed efficiently. The Žipo Lenart pilot explored how adapted harvesting equipment and existing drying and processing infrastructure can enable simultaneous collection of corn grain and cobs, creating new opportunities for granules used in animal feed, bedding, bioenergy and other applications.



Cattle breeding at Žipo Lenart d.o.o.



Efficient collection is the key to unlocking the value of corn cobs. Integrating cob collection into grain harvesting and using existing processing infrastructure can reduce handling costs and create new value from agricultural residues.



J. Integrating Regional Hemp into Circular Furniture and Textile Production

The partnership between Grüne Erde in Austria and Rottal Hanf in Germany demonstrates how regional cooperation can help introduce locally sourced hemp into sustainable furniture and textile production. Facilitated by Chemie-Cluster Bayern, the pilot connected hemp processing expertise with an established sustainable manufacturer and explored the technical suitability of hemp fibres as an alternative to imported materials.



Handmade mattresses from Grüne Erde Ltd., Austria

CASE STUDY

Integrating Regional Hemp into Circular Furniture and Textile Production

Building a sustainable value chain through collaboration, innovation and circularity

Austria (Grüne Erde, Scharnstein) & Germany (Rottal Hanf, Ering)

AUSTRIAN AND GERMAN REGION



Figure 27

AT A GLANCE

This pilot partnership integrates locally sourced hemp into sustainable furniture and textile production, demonstrating circular economy practices and regional value chain innovation. Chemie-Cluster Bayern facilitated the initial matchmaking and guided subsequent steps between Grüne Erde and Rottal Hanf to consolidate the partnership.



SECTOR

Mixed
(Combination of
production and
processing)

WHAT WE DO TOGETHER



CHALLENGES ADDRESSED

- KEY CONSTRAINTS & BOTTLENECKS**
- Limited availability of regional, plant-based materials for sustainable mattresses
- Lack of established processing methods for hemp fibres in mainstream production
- Need for circularity and eco-friendly alternatives to imported materials (e.g. coco-latex)
- Actors often unaware of each other – matchmaking and cooperation are challenging

- MARKET, REGULATORY, ENVIRONMENTAL, OR SOCIAL CHALLENGES**
- SMEs face challenges integrating new raw materials into established production lines
- Regional supply chains for hemp are underdeveloped
- Ensuring product quality and comfort while maintaining sustainability standards

SOLUTION IMPLEMENTED

- OUR APPROACH**
- Integrate regional hemp fibres into Grüne Erde's product line (mattresses, upholstery, textiles) – aligning ecological responsibility with circular economy principles.
- TECHNOLOGY & PARTNERSHIPS**
- Exchange of material samples
- Mutual site visits and technical discussions
- Knowledge sharing via Chemie-Cluster Bayern events
- WHY THIS SOLUTION?**
- Hemp is renewable, hypoallergenic, naturally antimicrobial, breathable and durable. Combining Grüne Erde's product expertise with Rottal Hanf's processing capabilities reduces reliance on imported materials and supports a circular, regional value chain.
- KEY OUTPUTS**
- Regional hemp fibres integrated into products
- Reduced environmental footprint
- Strengthened cross-sector collaboration and knowledge transfer

IMPLEMENTATION STEPS

PLANNING PHASE	IMPLEMENTATION	EVALUATION
- Sept 2023 Grüne Erde presents its circular economy vision at a Chemie-Cluster Bayern event. 2024 Rottal Hanf joins Chemie-Cluster Bayern network; collaboration concept initiated.	- End 2024 Online meeting facilitated by CCB to discuss material needs and collaboration. - Early 2025 Exchange of product/material samples; site visit to Grüne Erde HQ, Austria. - Mid 2025 Site visit to Rottal Hanf, Germany; evaluation of hemp material tests.	Following site visits and sample exchanges, both companies assessed material test results, discussed material supply collaboration potential, and refined approaches for integrating hemp fibres into Grüne Erde products.

RESULTS & IMPACT

MEASURABLE BENEFITS	KEY PERFORMANCE INDICATORS (KPIs)	KEY TESTIMONIAL
- Integration of regional, sustainable hemp fibres into furniture and textile production - Reduced environmental footprint by substituting imported materials - Enhanced cross-sector collaboration and knowledge transfer in the Alpine region - Industry clusters serve as catalysts, reducing risks and accelerating cooperation.	- Share of regional hemp fibres used - Substitution rate of imported materials % of sustainable, animal-free products - Reduction in water use & carbon footprint - Number of knowledge exchange events and stakeholder engagements - Number of material tests and product applications	"The collaboration serves as a promising example of using regional materials and cross-sector partnerships to advance circular economy practices, providing insights for integrating hemp fibres while maintaining product quality and performance."

LESSONS LEARNED

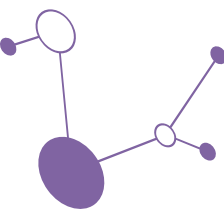
HOW WE MANAGED THEM	KEY TAKEAWAYS	SCALABILITY & REPLICABILITY
- Adjusting product specifications to accommodate new materials. - Limited availability of processed hemp fibres at scale. - Building acquaintance and trust between the actors was essential.	- Regional partnerships can replace imported materials. - Early facilitation and matchmaking are critical for SME collaboration. - Circular economy principles require both technical and relational alignment. - Industry clusters play an essential role as trusted intermediaries.	- Applicable to other regional SMEs and furniture/textile producers seeking circular solutions. - Cluster-facilitated introductions and guided cooperation can be transferred to other bioeconomy value chains. - Adaptable for SMEs at all stages (startups, growing, established).

RISK AND MITIGATION STRATEGIES

RISK CATEGORY	POTENTIAL RISKS	MITIGATION STRATEGIES
Financial Risks	Investment in new materials and R&D	Leverage public-private partnerships and EU funding
Market Risks	Acceptance of hemp-based products	Consumer education and regional branding initiatives
Regulatory Risks	Compliance with EU and regional standards	Adhere to relevant regulations and certification schemes
Operational & Technological Risks	Integration into existing production; processing challenges for hemp fibres	Phased implementation, iterative testing, collaboration with specialized suppliers
Environmental Risks	Sustainable cultivation and resource use	Monitor agricultural practices and maintain eco-certifications
Stakeholder Risks	Resistance to new materials or processes	Early engagement of employees, partners, local communities
Scalability & Replicability Risks	Limited hemp supply or processing infrastructure	Develop modular sourcing frameworks and local supplier networks

CONTACT INFORMATION
Lead Organization Chemie-Cluster Bayern GmbH
Key Contact Persons Emilija Kohls, Georg Weig
Email kohls@chemiecluster-bayern.de weig@chemiecluster-bayern.de

Regional matchmaking can help SMEs overcome the barriers to adopting new sustainable materials. Combining complementary expertise, iterative testing and trusted intermediary support can strengthen local supply chains while reducing dependence on imported materials.

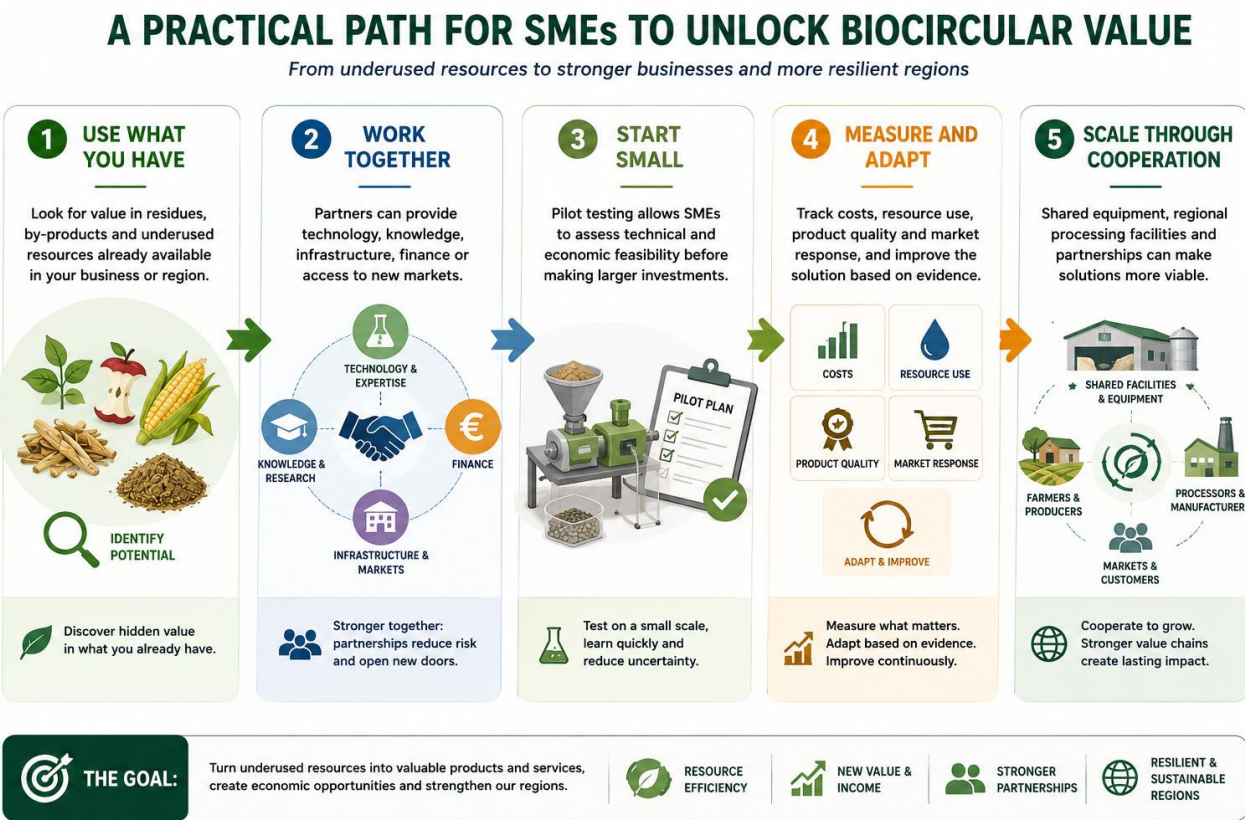


FROM BY-PRODUCTS TO BUSINESS

OPPORTUNITIES

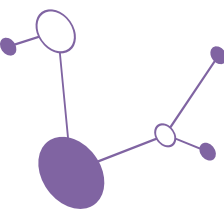
The TeBiCE cases demonstrate that biocircularity can help SMEs **use resources more efficiently, create new products, reduce selected costs, access new markets and strengthen regional value chains.**

The most practical lessons are clear:



A SIMPLE NEXT STEP

Ask three questions:



What are we currently underusing?
Who could help us create value from it?
Can we test the idea on a small scale?

A biocircular business journey can start with one resource, one partner and one pilot.



TAKE THE FIRST STEP TODAY



Small actions today. Big impact for your business, your community and our planet.



REDUCE RESOURCE LOSSES

Turn by-products and residues into valuable resources instead of waste.





CREATE NEW PRODUCTS AND MARKETS

Innovate with bio-based solutions that meet growing demand and open new opportunities.





STRENGTHEN LOCAL VALUE CHAINS

Work together with local partners to create value, jobs and prosperity in your region.





REDUCE DEPENDENCE ON EXTERNAL INPUTS

Use local, renewable resources to decrease reliance on imported materials and price volatility.





BUILD A MORE RESILIENT BUSINESS

Improve efficiency, diversify your offer and strengthen your business against future challenges.





**START SMALL.
THINK CIRCULAR.
GROW TOGETHER.**



Every step you take today builds a more sustainable tomorrow.

*Your business.
Our resources.
A better future.*

