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Technology Collaboration Programme

Ecosystem of innovation in the region - Bio-based innovations from Central Germany

Case study report: Regional transitions in existing bioenergy
markets 2.0

IEA Bioenergy: Task 40

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Alliance region of BioZ with location of the participating institutions © German Biomass Research Center (DBFZ)



Ecosystem of innovation in the region - Bio-based innovations from Central Germany

Case study report: Regional transitions in existing bioenergy markets 2.0

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Summary

Central Germany's BioZ alliance (Zeitz region, Saxony-Anhalt) offers a concrete, real-world example of how a fossil-fuel-dependent industrial region — one shaped by decades of lignite mining — can transition toward a bio-based economy. BioZ brings together agricultural, food, and chemical industry stakeholders in an innovation platform that converts regional biomass (sugar, starch, wheat, sugar beet) and industrial by-products into high-value products such as biopolymers, specialty chemicals and functional proteins. The region benefits from an existing chemical industry cluster (the historic Leuna-Bitterfeld-Schkopau "chemical triangle"), large-scale agribusiness, and strong research infrastructure, as it established industrial infrastructure and large corporations, alongside innovative SMEs, positioning it as a promising hub for bioeconomy development. However, the case also illustrates that regional bio-based transitions face structural, regulatory, and market barriers that require policy support to overcome.

Key messages:

- Bio-based regional economies offer a viable alternative to fossil-dependent industry, particularly in regions undergoing structural change (e.g. regions phase-out coal). By using local biomass and industrial residues instead of fossil feedstocks, initiatives like BioZ reduce dependency on finite fossil resources, cut transport emissions, promote material circularity, and strengthen local economic resilience against global market fluctuations.
- Success depends on combining regional strengths — feedstock, infrastructure, and expertise. The BioZ region in Central Germany benefits from the coexistence of agribusiness, an established chemical industry, and research institutions.
- Regulatory and market conditions can pose a challenge to bio-based innovations. Approval procedures, high certification costs, and lack of harmonized sustainability standards can in particular create a burden for SMEs, while international commoditized markets compete on price and scale. Streamlined regulatory pathways and support for credible, affordable sustainability certification (e.g. shared tools and guidance) are needed to help regional innovators compete.
- BioZ case study demonstrates that integrating bio-based materials into the chemical industry helps reduce the environmental footprint of a historically fossil-fuel-dependent sector within the same region. This shift leverages existing industrial infrastructure to enable more sustainable practices.
- Social and institutional engagement is essential. Given the legacy of industrial transition in former mining regions, successful bioeconomy transformation requires proactive engagement of citizens, social organisations, and public institutions, alongside targeted investment mobilisation and marketing support, to secure public acceptance and long-term investments.

Overall, BioZ demonstrates that regionalization and integration into global (commoditized) markets are not mutually exclusive — regional specialization can itself become a competitive advantage. The BioZ project in Germany leverages regional strengths, such as agriculture and the chemical industry, to create a competitive advantage and foster a bio-based economy. Realizing this potential at scale, however, requires policy action on regulatory simplification, targeted investment incentives, support for SME sustainability certification, and sustained public engagement to accompany the shift away from fossil-based towards bio-based industry and economy.

Index

Index	2
1. Introduction	3
1.1 Background	3
1.2 Regional Transitions 2.0	3
2 Case study description	4
2.1 General Overview	4
2.2 Specifics of BioZ	6
2.3 Economic and ecological viability	7
3 Regional development/community building	8
4 Markets: opportunities and threats	10
4.1 Opportunities	10
4.2 Threats.....	11
5 Conclusions and Outlook.....	13
References	14

1. Introduction

1.1 BACKGROUND

The global energy transition towards carbon neutrality is complex and uncertain, but key trends are emerging. These include the increasing cost-effectiveness of solar and PV electricity, the electrification of road transport, and the future potential of a "green" hydrogen economy alongside a circular carbon economy. There is also a shift from centralized fossil-fuel-based energy supply to decentralized, distributed renewable energy systems. Recent conflicts and climate change-driven events have heightened the urgency of this transition, sparking interest in regionalizing energy supply for improved security of supply.

Bioenergy, part of the larger bioeconomy, plays a significant role in this transition, with both regional and global supply chains contributing to sustainable energy. While international bioenergy trade has been crucial for the development of the bioenergy sector and deployment of renewable energy (Junginger et al. 2019), it also faces criticism from others for potentially hindering the move towards decentralized, renewable energy and for possibly lacking ecological sustainability (McGovern and Klenke 2016). IEA Bioenergy Task 40 supports the deployment of viable, efficient, and profitable biobased value chains, especially bioenergy, as part of a sustainable energy system and circular economy. Thus, regionalization of bioenergy supply chains is encouraged where it offers clear advantages.

1.2 REGIONAL TRANSITIONS 2.0

The future size and viability of the bioenergy sector, as part of biobased value chains, depends on both its adaptability to the dynamic context of the energy transition and on its role in securing a reliable and sustainable energy system. In the Regional Transitions 1.0 project, experts from IEA Bioenergy Task 40 explored possible strategies to develop sustainable feedstock supply chains in a regional dynamic market context to deliver biomass for different end-use markets (Hoefnagels et al. 2023). **The Regional Transitions 2.0 project aims to demonstrate that regionalization and commoditization strategies are not mutually exclusive to the energy transition.** Their common denominator is that the regional context is important for the sustainability performance of bioenergy supply chains (O’Keeffe et al. 2016). To this purpose, the Regional Transitions 2.0 project has evaluated five different case studies on both regionalization and commoditization strategies in Austria, Germany, Sweden, the US, and the North Sea region.

- Case study 1: An evaluation of integrating bioenergy communities for the production of renewable natural gas in Austria
- Case study 2: Ecosystem of innovation in the region: Bio-based Innovations from the region of Zeitz and Central Germany
- Case study 3: The role of sugar depots in enabling regionalized supply with commoditized intermediates for commercial-scale biorefineries in the US
- Case study 4: Cost-effective supply chain configurations for the production of bioelectro- and electrofuels in Sweden
- Case study 5: Hydrogen supply and biofuel production in the North Sea region.

This report presents the results of case study 2, on the pioneering bio-based innovation alliance in the region of Zeitz and Central Germany.

2 Case study description

2.1 GENERAL OVERVIEW

BioZ - biobased innovations from Zeitz and Central Germany¹ - is a pioneering innovation alliance funded by the German Federal Ministry for Agriculture and Food that brings together regional stakeholders from agricultural, food, and chemical industries. The project BioZ² started in 2022 and aims to foster biobased innovations along high-potential value chains, driving the transition to a bio-based economy characterized by reduced reliance on fossil resources and increased use of renewable carbon sources. The initial phase of BioZ was concluded in 2025. The project's second phase has already started in 2026 and will extend over the next two years, consolidating earlier achievements and driving forward the development of a sustainable, bio-based economy.

The focus of innovation generated in BioZ is to bring biogenic raw materials into use which can be produced in significant quantities in the region, such as sugar or starch, as well as by-products and residues from the agricultural, food processing, and biofuel industries. These biogenic feedstocks provide a stable supply chain for the development of new processing methods and offer opportunities for innovation in food, chemicals and materials.

BioZ has established an innovation platform that serves as an incubator for regional stakeholders, facilitating the development and implementation of bio-based innovations. Such innovations may be technological, organisational, or social in nature. To reinforce this platform, BioZ has established a comprehensive network comprising regional expertise from research, industry, and multipliers, not least to tie up loose ends in the regional bioeconomy. The practical aspects of networking and innovation development are facilitated within this network through regular alliance meetings, an environment conducive to encourage trust and effective communication and specifically designated "dialogue groups." The dialogue groups focus on specific topics related to biobased innovation, namely:

- **Functional Proteins:** Developing production routes for specially functionalized proteins for food and non-food applications (e.g. emulsifiers, texturizers, functional foods, adhesives) using industrial by-products from the food industry and biogenic raw materials (e.g. industrial residues from plant oil mills, legumes, mushrooms), taking into account the requirements of the food and non-food sectors in the production process
- **Lipids,** such as waxes, oils, fats or tensides: Development of processes for the extraction of biogenic lipids from renewable biogenic resources and residues (e.g. industrial residues from plant oil mills, insects, microalgae) as well as processes for the application-specific modification of these lipids (e.g. cosmetics, printing inks, materials)

¹ The notion of "Central Germany" lacks a precise spatial definition. According to Schönfelder (2021), it can refer to the spatial concentration encompassing Leipzig, Halle (Saale), and Jena, particularly highlighting the central German industrial region, which is predominantly characterized by its chemical industry. This definition extends to include adjacent rural areas as well as the administrative centers of Dresden, Magdeburg, and Erfurt. Consequently, the three German federal states of Saxony-Anhalt, Saxony, and Thuringia represent a pertinent area for investigation in this case study

² BioZ Project website: <https://www.bio-z.de/>

- **Fine and specialty chemicals:** Using biogenic resources (e.g. residues of dairy, insect or sugar production, sugar, starch) for the production of niche products, such as flavourings, colorants and fragrances and specifically address challenges associated with the use of bio-based raw materials, such as increased complexity and variability
- **Biopolymers & biomaterials:** Use of regional raw materials (e.g. residues of agriculture, forestry, residues of sugar production, chitin, natural fibres) to produce completely bio-based and/or biodegradable drop-in solutions and modifiers (such as plasticizers from vegetable oils, fillers from insect chitin or reinforcing materials from natural fibres), particularly for packaging, agricultural, furniture, medical applications or automotive industries.

These dialogue groups:

- Serve as a platform identify company needs and innovative products and processes and develop of joint research and development projects that lead to project outlines for the BioZ calls
- Are organized and moderated by scientific partners of the BioZ Alliance and form a protected space in which ideas can emerge and be further developed together
- Represent fields of work (defined subject areas as listed above) to drive the transition to a bio-based economy by making clever use of nature's synthesis, establishing new processes and production methods for handling raw materials of variable quality, establishing (regional) biogenic value chains and introduce new, particularly high-quality products
- Are linked to each other by focusing on the interconnections of value chains, same actors taking part in multiple dialogue groups and separate meetings of the dialogue group leaders
- Connect relevant expertise together.

The BioZ alliance aims to create a self-sustaining innovation ecosystem that fosters collaboration between stakeholders, including local businesses, research institutions and government agencies. This approach aims to promote economic development and improve the quality of life in the region, rather than focusing solely on commercialising existing innovations for external markets.

BioZ as a whole is also accompanied by overriding framework projects. This includes the “Life cycle assessment (LCA) and Sustainability Assessment & Innovation Ecosystem Case Study”, which focuses on the accompanying research in the field of sustainability assessment of these newly established bio-based value chains and addresses scientific questions. In the specific tasks of the framework project, the diversity of the alliance partners is used to answer these research questions and to validate the results.

The “Innovation Ecosystem Case Study” aims to continuously generate assessments and data on the developing innovation ecosystem to analyse its development process. The results are condensed into a regional case study focusing on the core region of the BioZ alliance - Central Germany. This also includes a monitoring of the regional bioeconomy.

Therefore, various dimensions of the development of a regional innovation ecosystem, both quantitatively and qualitatively, are examined. These analytical dimensions, which also represent regionally relevant development areas, are e.g. innovation and innovation capability, employment, economy and quality of life. Dimensions such as innovation and innovation capability, employment and economic power can be mapped using regional statistical data and further specified with regard to the actors involved through surveys and interviews. The quality

of life dimension, on the other hand, is largely subject to subjective assessments and evaluations, which requires qualitative approaches (e.g. surveys, interviews, focus group discussions). In order to capture the different dimensions of the development of the regional innovation ecosystem in an adequate and differentiated way, the methodology is based on an approach that combines quantitative and qualitative methods (mixed methods approach).

The case study of the BioZ innovation ecosystem will provide specific insights into the views of the involved actors as well as external stakeholders. Furthermore, strengths, weaknesses, opportunities and threats (SWOT analysis) of the regional innovation system will be pointed out and strategies for its further development will be developed. This overall assessment helps to derive lessons learned and describe success factors for pursuing the transition from a fossil based economy to a biobased economy in a certain region.

The 'Life Cycle Assessment/Sustainability Assessment' is an overarching and accompanying activity alongside the 'Innovation Ecosystem Case Study' to support regional actors on their way to sustainable production by providing them with appropriate methods and tools for sustainability assessment and other forms of support such as guidelines and workshops on frequently asked questions/problems. These tools ease the access to standardized environmental assessment frameworks which are generally only available to larger companies.

Regional producers aim for sustainable and local production to communicate this externally, for example through green claims and certificates. The companies are often small to medium-sized, often young and lack expertise in sustainability assessment and verification. However, there are two main hurdles: on the one hand, there is a jungle of possible sustainability assessment methods and certificates due to a lack of regulations; on the other hand, there are also methodological challenges in balancing the environmental impacts of new bio-based products and applications in the bio-economy. This work package is therefore primarily concerned with helping to overcome this hurdle by providing guidance.

2.2 SPECIFICS OF BIOZ

The BioZ project targets more the aspects of a regionalization strategy rather than commoditization. Regionalization refers to the process of developing a region's unique characteristics, strengths, and resources to create a competitive advantage in the global market. In contrast, commoditization involves standardizing products or services to make them more accessible and affordable, often at the expense of unique regional characteristics. BioZ focuses on promoting biobased economy as a distinct regional asset, leveraging the region's specific strengths, such as its agricultural resources, strong chemical industry, existing infrastructure like research institutions, and innovative companies.

BioZ intends a self-sustaining innovation ecosystem that fosters collaboration between stakeholders, driving economic development and improving the quality of life in the region. The aim is to make a significant contribution to the transition to a circular (biogenic carbon) economy.

The project's focus on innovation and economic development through the bio-based economy can lead to several positive outcomes. By encouraging stakeholders to think in closed-loop terms, BioZ contributes to a more circular economy. Innovation projects supported by BioZ rely on biogenic resources and therefore have the potential to reduce dependence on (finite) fossil resources. With the regional focus on local production and consumption patterns, and by utilising by-products and residues from the food processing, agricultural and biofuel industries, BioZ promotes the minimisation of waste, increase of resource efficiency and reduction of

transport emissions. The main region of BioZ is situated in Zeitz, a modest municipality located in the Burgenland district of Saxony-Anhalt. The region already boasts several prominent figures from the regional bioeconomy, including representatives from the sugar, starch and bioethanol industries. For example, Südzucker AG, Cropenergies Bioethanol GmbH and Interstarch GmbH use regional feedstocks like wheat and sugar beets from local farmers. Furthermore, other companies from the chemical industry are located in the Chemical and Industrial Park Zeitz, which is designed to attract investments in sustainable industries and green chemistry principles. Thus, their main products, residual and waste materials from Zeitz present a significant opportunity for the establishment of a sustainable value creation network for the regional bioeconomy. This may be exemplified by the use of sugar beet pulp for the production of dextrans for pharmaceutical products, the functionalisation of wheat silage into protein concentrates for vegan meat substitutes, and biodegradable materials derived from starch esters.

Through its innovation platform, BioZ incubates bio-based innovations that can lead to new products, processes or services that reduce environmental impact. This platform can support entrepreneurship and innovation in the transition to a circular economy, creating opportunities for local businesses, research institutions and government agencies to collaborate and drive sustainable growth.

2.3 ECONOMIC AND ECOLOGICAL VIABILITY

The legacy of lignite mining in Central Germany of the past has created a structural change that can be used to develop new industries and supply chains, particularly as the region transitions from the use of fossil fuels to a bioeconomy. Several region-specific factors - which have been described in detail within the project Bioeconomy model regions in the Central German and Lusatian mining areas (MoReBio)³ - contribute significantly to the economic and environmental viability of these supply chains (Brödner et al. (2023)).

The presence of large agribusinesses is a notable advantage. The regional agri-food industry produces and processes significant quantities of biogenic raw materials such as maize, sugar beet and wheat. These materials serve as reliable and cost-effective feedstocks for bio-based products. In addition, the food processing sector plays a crucial role by generating by-products and residues that can be valorised through bio-based innovation led by initiatives such as BioZ. The observed decline in meat consumption further increases the availability of feed raw materials, facilitating the establishment of new value chains.

In addition, the creation of these value chains will be supported by the adoption of sustainable and climate-resilient agricultural practices, including the cultivation of drought-resistant or protein-rich crops. Such developments present significant opportunities for regional industries to diversify their offerings and innovate in response to emerging market trends.

Another important factor is that Central Germany's historic chemical triangle (Leuna-Bitterfeld-Schkopau) offers an established industrial infrastructure that facilitates efficient logistics and supply chain management - including e.g. chemical to pharmaceutical production and recycling as well as the energy and water supply. The landscape is characterised by industrial parks housing both large corporations and a diverse range of small and medium-sized enterprises

³ MoReBio project website: <https://www.dbfz.de/biooekonomieatlas/start>

(SMEs). Many SMEs specialise in niche technologies with a strong emphasis on research and development, requiring the adoption of cutting-edge solutions. As sustainability becomes increasingly important in the chemical sector, it is imperative for these SMEs - who are sought after by major players seeking to meet evolving regulatory requirements - to prioritise sustainable practices. By integrating bio-based materials and processes into their operations, SMEs can reduce their environmental footprint while increasing their competitive edge in dynamic markets. This dual advantage underlines the importance of sustainability in revitalising the value proposition of the chemicals sector.

In summary, Central Germany's unique combination of renewable resources, research expertise, established industrial infrastructure and commitment to sustainability positions it as a leading hub for bioeconomy innovation. Initiatives such as BioZ play a vital role in guiding the establishment of robust and sustainable supply chains that leverage these inherent strengths while addressing both the economic and environmental challenges facing the region.

3 Regional development/community building

BioZ aims to develop resilient and sustainable supply chains that build on the region's strengths while addressing its economic and environmental challenges. The legacy of lignite mining, coupled with large-scale agribusiness and the availability of biogenic feedstocks from the food processing industry (including valuable by-products), positions Central Germany uniquely for this transformation. In addition, the presence of research and knowledge centres enhances the region's capacity for innovation.

The region of BioZ alliance and its location in Germany are shown in Figure 1 and Figure 2.



Figure 1 The region of BioZ alliance (BioZ 2024)



Figure 2 Alliance region of BioZ with location of the participating institutions (created by DBFZ)

At the moment, BioZ plays a key role in fostering bio-based innovations by connecting regional stakeholders from research and business. Ongoing research and initial activities have made the short-term impact of BioZ visible. The innovation platform serves as an incubator for regional stakeholders, providing them with tools and support needed to develop and implement bio-based ideas into innovation projects. Stakeholders emphasize the positive and constructive nature of the communication fostered in BioZ.

The establishment of dialogue groups focused on specific technological topics, such as biobased plastics, proteins and lipids. These groups create a structured environment for stakeholders - including small and medium-sized enterprises (SMEs), research institutions, and larger regional companies - to discuss ideas and collaborate on projects. Initial projects include pilot studies or prototypes that demonstrate the feasibility of using local biogenic raw materials, laying the groundwork for future advancements.

As BioZ progresses into the mid-term phase, feasible changes could emerge with the establishment of a more and more self-sustaining innovation ecosystem. This ecosystem will encourage collaboration among local stakeholders (businesses, research institutions, and

potentially societal organisations and government agencies) leading to shared resources, knowledge exchange, and collective problem-solving. Furthermore, as stakeholders collaborate on shared goals related to sustainability and innovation, community identity can be strengthened as an important part of structural change in the region of Central Germany.

The overarching goal for the long term is to facilitate a transition from a fossil-based to a bio-based economy. Through its various initiatives, BioZ can play a pivotal role in reducing the region's environmental footprint while capitalizing on emerging market trends by promoting sustainable economic growth. Diversified economy based on local resources (like sugar, starch and biobased by-products) and biobased innovations enhances the region's resilience against global market fluctuations, decreasing dependency on fossil fuels and external supply chains. This transition not only demonstrates sustainable solutions but also has the potential to serve as a model region for supply chain transformation within the chemical sector. In this way, BioZ can inspire other regions and industries to adopt similar approaches, further amplifying its impact.

To ensure that this evolution occurs in the right direction, it is crucial to implement effective monitoring and feedback mechanisms. These systems will allow the network management and involved stakeholders to react promptly to any pathways that may not align with the goal of fostering a region-specific bio-based economy. Identifying risks and challenges is an essential part of this process. By recognizing potential obstacles early on, BioZ can strategically combine these insights with regional strengths and network-specific potentials. This proactive approach will help mitigate risks while leveraging local resources and expertise, ultimately enhancing the effectiveness of initiatives aimed at promoting sustainability.

And beyond that: Although there is no defined and standardised factor for the regionality of an economy, the positive effects of using regional raw materials, labour, infrastructure and decentralised local production can be shown in sustainability assessments. BioZ offers regional stakeholders the appropriate instruments and tools to present these positive effects for sustainability via green claims or certificates. Regionally produced products that have a green claim or certificate and have thus proven the quality of sustainability promote market opportunities and trust in the products and thus also contribute to the further development of the region.

4 Markets: opportunities and threats

4.1 OPPORTUNITIES

The BioZ initiative is situated within the regional context of Central Germany, capitalising on the area's historical strengths in industrial production and innovation. The region has a longstanding legacy in agriculture, research and development, chemical manufacturing and engineering, providing a robust foundation to integrate the bioeconomy. The collaboration of local universities, research institutions, SME and industry can draw upon existing expertise and resources, creating an environment conducive to innovation and sustainable structural change.

The BioZ initiative offers a promising opportunity for further economic development by establishing sustainable supply chains that connect local biomass producers with bio-based industries. This approach, which sources renewable raw materials and by-products from nearby farms and industry, enhances regional economic resilience while promoting sustainable practices. By supporting local farmers and businesses, this strategy also reduces transportation emissions associated with biomass procurement. In the BioFibreFilament project which is

funded as part of the BioZ framework, for example, flax and hemp from local farmers in the Leipzig region south of Saxony are being processed into textiles and turned into fibre composite tools for 3D printing and orthotic production that is also located in Saxony. The IMWS research institute, based in Halle (Saxony-Anhalt, next to Saxony), is scientifically monitoring the process to improve the material's properties.

BioZ projects showcase a diverse range of applications for utilising regional biomass feedstock. Examples include the development of biopolymer materials and additives, as well as novel products such as speciality chemicals, tensides, fragrances, and pharmaceuticals derived from sugar production residues. Additionally, the initiative explores new protein-based food products. In particular, notable examples of BioZ projects are Biocerine, Made for Fragrances, and SchlemPro. Biocerine focuses on replacing petrochemical plasticisers with bio-based alternatives made from glycerine, a residue from biodiesel production. Made for Fragrances exploits the potential of soldier fly maggots to produce fragrances, using organic residues from food and agricultural production as feedstock. SchlemPro develops novel food products rich in protein by utilising stillage proteins from bioethanol production.

Furthermore, innovative technologies in processing biomass can provide new work opportunities in the chemical and food industry. However, it is essential to scale up existing technologies and pilots in Central Germany (e.g. pilots at CPB Fraunhofer in Leuna⁴; oil and protein extraction pilots at PPM in Magdeburg⁵). A lighthouse project in terms of investment in the upscaling of a biorefinery concept is the UPM Biochemicals plant (under construction in Leuna, Saxony-Anhalt). The production of 220,000 tonnes of sustainable chemicals per year is planned, with a creation of up to 200 new jobs. This exemplifies an important opportunity promoting bioeconomy.

As mentioned above, proven green claims and sustainability certificates from reputable certification schemes can also help to build confidence in the sustainability of the product and thus increase market opportunities. The "Sustainability for Beginners" (Meisel et al. 2023a) guide developed in the LCA/Sustainability Assessment work package, with instructions on how to assess the life cycle of products, or the Zertifux tool (Meisel et al. 2023b) for finding the right certification system/certificate for the respective product/company, support regional stakeholders in developing green claims and in the certification process.

Moreover, the implementation of effective marketing and advocacy strategies will be crucial in attracting investment to BioZ's initiatives. By demonstrating the prospective economic benefits and environmental impacts of its projects, possibly by establishing living labs, BioZ can mobilise the resources necessary for scaling up operations, thereby creating deployment opportunities. This encompasses sustainable supply chains, workforce development programmes, community engagement initiatives and strategic marketing efforts, fostering collaboration and demonstrating innovative solutions.

4.2 THREATS

Although BioZ has successfully brought together innovative and dynamic small and medium-sized enterprises (SMEs), research institutions and some networks to create a well-structured

⁴ <https://www.cbp.fraunhofer.de/>

⁵ <https://ppm-magdeburg.de/>

innovation ecosystem, its impact on transforming the entire region into a best-practice example for the development of the bioeconomy may remain limited.

The restricted availability of biomass due to limited and declining cultivation area poses a significant challenge to regional bioeconomies (constrained by the hierarchy of biomass use prioritizing food safety before material and energetic use). This may lead to an enhanced dependency on imported biomass, which could potentially erode the regional benefits and give rise to new ecological issues. Given the constraints on biomass availability, it's unlikely that sustainably cultivated biomass can serve as a complete replacement for fossil resources, particularly in the context of rising demand. To guarantee sustainability, the integration of complementary technologies is crucial for diversifying the region's bioeconomic strategies (e.g. Carbon Capture and Utilisation (CCU), circularity).

The competitive pressure from international markets represents another significant threat for the development and commercialisation of biobased innovations. A comparatively strict regulatory framework in the European Union and Germany, including generally lengthy approval procedures, acts as a significant barrier to the entry of innovative products and processes into (inter)national markets. Furthermore, as global supply chains become increasingly commoditised, local bio-based products may encounter challenges in competing on price and scale with established players in larger markets. This competition can impede the growth of regional SMEs that are still in the early stages of developing their innovations. Consequently, there is a risk of marginalisation for local efforts, as these SMEs may encounter difficulties in securing market share against more established companies that benefit from economies of scale.

It is also difficult for smaller and new companies to provide transparent sustainability information alongside their core business, to make green claims or to go through a costly certification process. While larger, centralised companies have dedicated departments for such things, smaller companies run the risk of choosing less reputable but cheaper certification schemes and of greenwashing in the jungle and complexity of sustainability assessment.

Moreover, the transition from a coal-dependent economy to a post-industrial society in Central Germany has had a profound impact on regional identity, community cohesion, and economic development. (The decline of the coal industry after 1990 resulted in significant structural changes, leading to a loss of purpose for many individuals. A similar transformation is currently underway with the German coal phase-out, which may exacerbate existing social and economic challenges.) Taking into account these complexities, it is essential that BioZ adopts a holistic approach to innovation that encompasses both technological advancements and critical non-technological factors. This includes the engagement of e.g. social organisations, citizen groups, political institutions and the public sector, in order to foster an environment conducive to innovation. It is not sufficient for BioZ to merely avoid replicating existing solutions, it must also provide meaningful alternatives that align with the needs and aspirations of local communities.

On the other hand, securing investments is crucial for the practical implementation of innovations. Effective marketing, advocacy, and communication strategies are essential for attracting investor interest and promoting bioeconomy initiatives. However, without effective public engagement or the adaptation of policy frameworks to support the transition to a bio-based economy, the mobilisation of essential resources may prove challenging. This challenge is further exacerbated by limited private investment, stringent regulations, and lengthy authorisation processes, which can hinder the realisation of innovative ideas.

While BioZ has provides a sufficient framework for fostering innovation projects in the regional bioeconomy, it still faces significant threats from standardised international markets that call its viability into question. To mitigate these risks, BioZ must broaden its scope by stronger

incorporating non-technological factors into its strategy, increasing its marketing efforts to effectively mobilise public stakeholders, and advocating for regulatory reforms within political framework to facilitate innovation. Only through such comprehensive approaches, BioZ can manage the complexity of global market dynamics while making a meaningful contribution to regional economic development.

5 Conclusions and Outlook

The innovation alliance BioZ connects the agricultural, food, and chemical industries to transition from fossil-based resources to sustainable, bio-based value chains. It supports the region's unique characteristics, strengths, and resources. The project shows that regionalization and commoditization strategies are not mutually exclusive, but that regionalization helps to create a competitive advantage in the global market. BioZ's main tools are specialized "dialogue groups", a collaborative incubator platform and the development of novel supply chains of high-value biogenic products from regional raw materials and biomass residues.

Central Germany's unique potential for a regional bio-based transition stems from its industrial lignite mining heritage, the presence of large-scale agribusiness and chemical industries. This transition is further accelerated by a network of research and knowledge centers in the region that bridge the gap between regional resources and advanced industrial innovation. Together, these actors can develop new regional supply chains that transform regional biomass into high-value products like biopolymers, specialty chemicals, and functional proteins. Additionally, by providing SMEs with specialized tools for sustainability certification and life-cycle assessment, the alliance bridges the gap between raw innovation and market readiness.

However, the project faces critical challenges, including limited biomass availability, international competition on commodity markets, and a complex regulatory landscape that can hinder smaller innovators within the bio-based transition. BioZ's success depends on widening its technological focus to promote social acceptance for bioeconomy in the region and advocate for policy reforms that support regional structural change. Ultimately, the transition aims to replace fossil dependencies with a resilient, self-sustaining ecosystem that boosts local employment and quality of life in the region.

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