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Short Study on the current economic situation of the DANUBE REGION with focus on circular bioeconomy

Problems of SMEs and existing support schemes and mechanisms supporting value chain development

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Disclaimer

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Executive Summary

This study was produced within the framework of the development of flagship projects for the PA8 of the EUSDR.

With the Ukraine war, surging temperatures, fires and water shortages of the summer and autumn of 2022, the signs are clear that the world is becoming more dangerous and far less predictable. Regions are under increasing pressure. Local companies are losing access to inputs and markets, energy prices are skyrocketing, and inflation is returning. They seek approaches which combine supply chain resilience, resource utilization and circularity. The window to act is far shorter than was believed even just a few years ago. Regions are hoping to establish a competitive foothold in the climate technologies that will drive change and ensure a decrease of Greenhouse Gas Emission (GHGE) by 55% by 2030. The UNEP report (October 2022) calls for rapid and systemic transformation to avoid an accelerating climate disaster by 2030[1].

The main obstacles identified at SMEs level are on information asymmetry, technology access and access to finance (Chapter 3). The Danube Region, therefore, seeks both optimization and scalability of accumulated knowledge and available technologies, preferably through cross-regional cooperation. Knowledge and technology transfer strategies to compete in a global market was also proposed as response to the current situation. It is a striking finding that an important bottleneck to be further addressed is the elaboration of the assessments systems that can be used by regional planers, funding agencies and commercial banks / private investors. Such systems should link to different sustainable frameworks like Environmental, Social, and Governance (ESG) reporting standards, Sustainable Development Goals (SDG) or Life Cycle Assessments (LCA).

Research pointed towards the complexity of challenges. Only two regions (Baden-Württemberg and Bavaria) and Austria have a fully-fledged circular bioeconomy strategy in place, whilst the other Danube regions (and countries) do not have such strategies and related programs. This is reflected in the scattered and fragmented support for the region's circular bioeconomy, which cannot materialize in significant investments. Buyers, sellers of secondary materials, and byproducts produced by companies that can serve as input for other companies are not known to each other which prevents formation of new value chains and leads to high cost for companies for treatment and disposal of secondary materials.

Availability and access to commercial financing of green-oriented investments is limited and not recognized as vital for any green transition. Finally, several sustainability frameworks exist and are used by financial institutions, program owners and authorities. However, they do not address the new circular value chains. They are mainly based on past performance and not on the impacts of new circular value chains.

[1] United Nations, 2022, Emission Gap Report 2022, https://www.unep.org/resources/emissions-gap-report-2022

Cluster organizations play a role in supporting SMEs and contribute to regional development, but have limited impact. They are not (yet) specialized in targeted support of circular bioeconomy value chain incubation or development.

The extension of the current Danube Flagship Danube Alliance towards a macro-regional wide network that provide knowledge and tools for targeted circular bioeconomy value chain incubation or development was proposed by the majority of the interviewed experts and during an expert meeting in Zagreb on 4 November 2022.

1. INTRODUCTION

A circular bioeconomy is an economy powered by nature. It is a new economic model that emphasizes the use of renewable natural capital and focuses on minimizing waste, replacing the wide range of non-renewable, fossil-based products currently in use. The approach is different from current systems by design, with materials used for as long as possible and emissions-reducing practices put into place[2]. Land and marine ecosystems, production sectors like agriculture and forestry, and the industrial sector work in an intentionally crafted, circular manner, with scientific approaches and technological innovations employed to create more sustainable materials and spur regeneration[3].

The European Union Strategy for the Danube Region (EUSDR) intends to develop coordinated policies and actions, reinforcing the commitments of Europe 2020 strategy towards the smart, sustainable and inclusive growth based on four pillars and twelve priority areas. These shall tackle key issues as mobility, energy, biodiversity, socio-economic development and safety. In line with the goals of the territorial cooperation objective, the strategy focuses on enhancing closer cooperation within the concerned territory.

The circular bioeconomy's major focus is accelerating the transition from a fossil-based economy to a circular Bioeconomy economy. The Danube Region is well aligned with the objectives of EUSDR and plays an important part in the current Danube Region Programme (DRP) 2021-2027. Sustainable economic development and environment, energy and climate change are important pillars of the new DRP. Among others, the DRP shall support smart regions/cities solutions as well as advanced technologies regarding circular bioeconomy.

While the war in Ukraine has exposed Danube countries to new challenges, it has also provided a much-needed spark to move towards the circular bioeconomy model. The case has never been stronger for a more modern shock-resistant, resilient, sustainable model for value chains and partnerships within the Danube Region and across Europe.

The current study was focused on current economic situation of the Danube Region with the focus on circular bioeconomy and clusters. It builds on the findings of GoDanuBio and the study on the impact of the Ukraine war on selected value chains (focus on bioeconomy)[4]. The following analysis aims to update the recent ones, considering all the situations in the Danube Region, with a focus in the circular bioeconomy. Attention is also given on cluster initiatives in

[2] Center for International Forestry Research, 2021, The Circular Bioeconomy, Knowledge Guide, https://www.cifor.org/wp-content/uploads/2021/03/Flyer%20-%20Knowledge%20Guide_Circular%20Bioeconomy-v4.pdf

[3] Tan, E. and Lamers, P., 2021, Circular Bioeconomy Concepts – A Perspective, https://www.frontiersin.org/articles/10.3389/frsus.2021.701509/full

[4] Dermastia, M., McManus, Michael, 2022, Impacts and Potentials of the Ukraine Crisis on Supply Chains Development for the Danube Region, https://www.researchgate.net/publication/362175408_Impacts_and_Potentials_of_the_Ukraine_Crisis_on_Supply_Chains_Development_for_the_Danube_Region

the Danube Region due to the fact that a working group within the priority area 8 (PA 8) – Competitiveness of Enterprises - of the EUSDR also deals with cluster development.

The study provides an overview of the situation of the existing bioeconomy value chains, considering the challenges and identifies the main enablers as well as limiting factors for the transition to new, more circular value chains and business models and provides common problems for SMEs in the region related to circular bioeconomy value chains.

The research was conducted through a review and analysis of information retrieved through review of existing most recent studies. However, to properly reflect the fast changing and highly unpredictable environment, the study mainly built on firsthand information gathered in direct consultations with stakeholders.

So far, the Danube Alliance has cooperated with more than 20 cluster initiatives and regional development actors and has integrated them into the analytical work of value chain development. The analysis was done through desktop research, expert interviews (cluster managers, regional developers, SME-leaders) and in the frame of selected events, which the project partners participated in. One of the events was a workshop conducted in Zagreb, where 20 cluster managers, business representatives and bioeconomy experts spent a day on brainstorming and preparatory sessions on further developments of circular bioeconomy value chains in the Danube Region. The Transnational Dialogue under GoDanuBio that took place on 16 October 2022 in Novi Sad (Serbia) also served as a good platform to gain updated information on current framework conditions. Important focus was on direct engagement with various SME users (as part of cluster initiatives) of the Value Chain Generator (VCG) as well as with stakeholders who are in the scope for using it in the future (other clusters and regional development agencies) and has used these connections to gather related information on the SME level. In total 14 interviews with cluster managers and industry experts were conducted in one-on-one format. In addition, the participants of the Zagreb workshop were also interviewed.

The questionnaire applied for the interview approach followed as semi-structured approach, which allowed for the change of sequence when asking the prepared questions and allowed for more general and open questions. There were also pre-coded questions in the online form. We guided the interviewee along the questions prepared in Google Form, of which some results are displayed in graphic tables.

The interviews were focused on activities in the clusters regarding the following topics: i) Most prominent circular value chains in their sector, ii) Feedstock, iii) Main by-products and wastes, iv) Technology Implementation, v) Future of their circular VCs and vi) Impact of environmental regulations. A mixture of quantitative and qualitative data was obtained from them to establish an intelligence picture of current situation related to circular bioeconomy across the Danube Region, identify barriers and enablers of circular economy that can be effectively tackled by the Danube Alliance approach.

2. The Current Economic Situation of the Danube Region with Focus on Circular Bioeconomy

2.1. Changes before and after the Ukraine war

The economies of the Danube Region continue to face a challenging environment, placing households, businesses and governments under pressure. The war in Ukraine increased energy prices and slowed down global growth. Higher energy and food prices have pushed inflation to levels unseen for many years.

Private consumption and investment were the key drivers of growth in many Danube Countries. Rising wages and remittances, together with increasing private credit, have supported private consumption. Investment was particularly strong in Serbia, and in Bosnia and Herzegovina, partially as countries accumulated inventories to avoid value chain bottlenecks and accelerated investment in the energy sector[5]. Sustained export growth has also acted as a key growth driver in many Danube Countries. New economic challenges, such as inflationary trends in raw materials, food, fuels, and energy prices, started confronting the region in the second half of 2021 and intensified after the beginning of the war in Ukraine and subsequent sanctions against Russia. Currently, the region's recovery seems at risk.

However, the economy in the Danube Region was already slowing before the outbreak of Ukraine war. After reaching an estimated 5.5% growth in 2021, global growth was expected to slow to 4.1% in 2022. The projected slowdown reflected intermittent COVID-19 flare-ups, the exhaustion of pent-up demand, reduced monetary and fiscal policy support, and lingering supply disruptions. Logistical bottlenecks, shortages of intermediate inputs, and sluggish supply of energy commodities had been driving inflationary pressures. Inflation had repeatedly surprised central banks and market participants on the upside. After declining to 1.2% in May 2020, inflation reached 6.5% in February 2022[6], mainly due to supply disruptions and rising food and energy prices. Inflation in the Danube Region is expected to peak in the second half of 2022 before declining through 2023, aided by well-anchored expectations in the majority of countries.

Table 1 reveals the development of the GDP in selected Danube Countries in 2021 and the predictions for 2022 (as of September 2022). It becomes obvious that GDP growth in 2022 is much lower than in 2021.

[5] The World Bank, 2022, Beyond the Crises – Western Balkan Regular Economic Report No. 22, https://openknowledge.worldbank.org/bitstream/handle/10986/38189/P17947818ec26c8c17fe014901194ac104a1b5d70a2a.pdf?sequence=1&isAllowed=y

[6] The World Bank, 2022, Implication of the war in Ukraine for Global Economy, https://thedocs.worldbank.org/en/doc/5d903e848db1d1b83e0ec8f744e55570-0350012021/related/Implications-of-the-War-in-Ukraine-for-the-Global-Economy.pdf

Country	GDP Growth in 2021 [%]	Projected GDP Growth for 2022 [%]	Source[7]
Austria	4.6	4.5	OECD
BiH	7.1	3.2	EBRD
Bulgaria	4.4	3.1	OECD
Croatia	10.2	8.9	EBRD
Germany	2.7	1.6	OECD
Hungary	7.1	5.0	OECD
Moldova	11.7	0	OECD
Romania	5.9	5.8	OECD
Serbia	7.5	2.0	OECD
Slovakia	5.0	1.9	OECD
Slovenia	8.2	6.9	EBRD

Table 1: Development of the GDP in selected Danube Countries in 2021 and the predictions for 2022 (as of September 2022)

2.2. Current Status of Bioeconomy Cluster Development

The analysis on the current cluster landscape in the Danube Region revealed a positive trend in terms of numbers of cluster initiatives over the recent years. Despite the fact that many Danube countries still do not have a dedicated cluster policy and support programmes in place (e. g. BiH, Bulgaria, Croatia and Serbia) the number of Danube clusters has developed well over the recent years. Whereas a previous cluster study[8] identified 152 cluster in 2018, the European Cluster Collaboration Platform (ECCP) counts 287 cluster initiatives (plus 88% over the last four years) in October 2022. It is interesting to note that the number of bioeconomy clusters in the Danube Region increased much less by 16% (from 25 in 2018 to 29 in 2022). One reason might be that framework conditions for bioeconomy clusters are still challenging in the macro region. Bioeconomy is still a comparably new industry and the focus of global efforts are still more on R&D rather than on commercialization. Consequently, business opportunities are limited. However, the share of bioeconomy clusters in the entire Danube Region can be calculated by 10% (Figure 1)

[7] EBRD: European Bank for Reconstruction and Development; OECD: Organisation for Economic Co-operation and Development

[8] Meier zu Köcker, G, 2018, Current Status of Cluster Management Excellence in Bioeconomy with focus on the Danube Region, https://www.researchgate.net/publication/324804216_Current_Status_of_Cluster_Management_Excellence_in_Bioeconomy_with_focus_on_the_Danube_Region

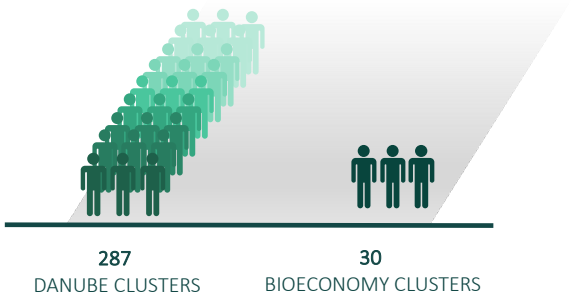

Figure 1: Share of Bioeconomy clusters in the Danube Region (Source: ECCP, own investigations, November 2022)

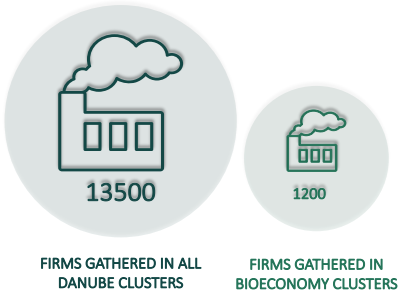

Figure 2: Companies gathered in Danube clusters (Source: ECCP, own investigations, November 2022)

On the firm level, the 287 Danube clusters gather around 13,500 companies[9], most of them SMEs, whereas the 30 bioeconomy clusters have around 1,200 industrial members (Figure 2). These data are backed by recent study from the Danube Alliance[10] that identified around 40 cluster and business support organizations. Geographical concentration of the bioeconomy clusters and business support organization is given in the northern part of the Danube Region.

Figure 3: Share of Bioeconomy clusters in the Danube Region[11]

In general, bioeconomy clusters gather around 40 companies per cluster, which is much less than the average of all clusters across industry in the EU27[12], which is around 75 companies per cluster.

[9] According to the European Cluster Collaboration Platform, as of October 2022

[10] Dermastia, M. and McManus, M, 2022, Impact and Potentials of the Ukraine Crisis on Supply Chains Development for the Danube Region, Danube Alliance, DOI: 10.13140/RG.2.2.17378.20161

[11] ibid

[12] Meier zu Köcker, G., 2018, StressTesting Regional Approach Conducive to Implement S3 through Clusters in the Danube Region, DanuBioValNet, https://www.researchgate.net/publication/330986898_StressTesting_Regional_Approaches_Conducive_to_Implement_S3_through_Clusters_in_Danube_Region

When taking a closer look, the analysis and interviews with cluster managers revealed that most of the Danube clusters operate within traditional and already well-established value chains or research and innovation. The war in Ukraine and the supply chain disruptions that followed showed that the companies were not adequately prepared for a large-scale market change. More companies and other stakeholders seek shifts toward solutions, which could enable the resilience of their supply chains. Since the start of the Ukraine war, there is a need to shift towards alternative options that the circular bioeconomy models propose. Consequently, the potential of circular bioeconomy in the Danube Region is ever more valued. Yet the companies, especially SMEs, seek immense support to keep on track with available and emerging options on the market.

Figure 5 displays two well-known cluster initiatives in the Danube Region, which have been very active in the field of bioeconomy for many years. The members of the Czech Hemp Cluster are dealing with new applications based on hemp material. Industrial hemp is a promising candidate for phytoremediation. Hemp has deep roots and is tolerant to the accumulation of different metals. Industrial hemp has the potential to impact the textile, construction, automotive, biofuel, cosmetics, oil, and pharmaceutical industries[13]. However, industrial applications made of hemp are still in an early stage, and the Czech Hemp Cluster is still comparably small. Nevertheless, when talking to Ukraine cluster managers during the Global Connect Fair (15 November 2022), there is a common belief that hemp can play an important role as sustainable eco-construction material for the rebuilding of Ukraine's regions.

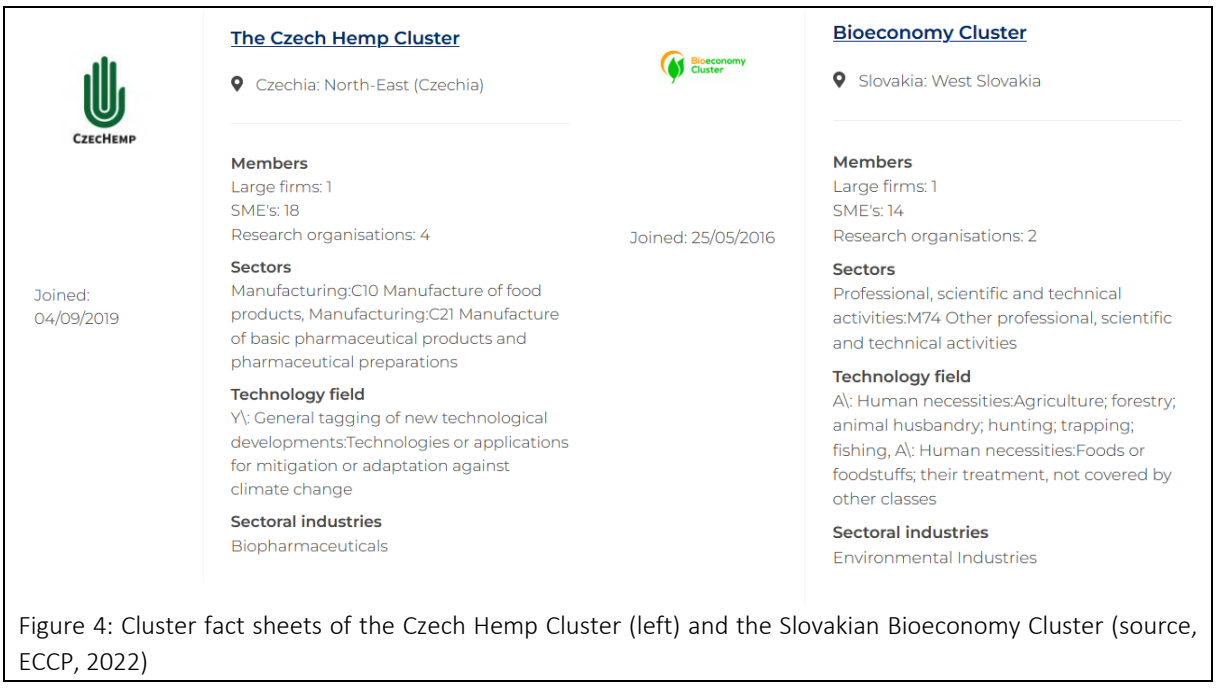

Figure 4: Cluster fact sheets of the Czech Hemp Cluster (left) and the Slovakian Bioeconomy Cluster (source, ECCP, 2022)

[13] Anastasija V., 2021, Development of Hemp Industry in the European Union and Latvia, 14(3) Reg'l Formation and Dev. Stud. 199, 200 (2021)

Another small, but well matured cluster initiative is the Bioeconomy Cluster from Slovakia. The Bioeconomy Cluster was established in 2015 with the aim to promote cooperation, networking, innovation and mutual exchange of information between cluster members and other stakeholders in agri-food and bio-based sectors. The members and partners of Bioeconomy Cluster are research centers, agricultural university and SMEs operating in the sector of agriculture, food, forestry and other areas representing wide bioeconomy spectrum. Established a while ago, the cluster management and members are challenged with unfavorable bioeconomy related framework conditions

Clusters are recognized as close support towards the transition. The majority generally focus more on innovation projects, engage in high-level road maps, and far less on the commercialization and business development for their members which is needed. SMEs who want to develop circular bioeconomy value chains are usually incentivized due to the opportunity of competitive advantage building, through niche strategies. To scale good practices, or develop new circular or bio-based value chains they need direct specific information about the products of suppliers they work with (e.g., quantity, quality, certifications, storage capacities), needed by the buyers. Such information is hard to obtain and many bioeconomy cluster managers are struggling to collect related data.

There are also issues existing, which can be underwood from a macro-perspective. There are some common waste market risks such as supply chain vulnerability for waste and by-products regarding proximity and logistics (lack of internal and external infrastructure). The desegregated waste policy framework also hinders their transition vastly, as there are problems with EU policy adaptation on a national and local level, a lack of internal investments, and the bureaucratic complexity for adaptation.

As from speaking with cluster managers, many companies are still reluctant to engage in cluster activities, due to adaptation resistance, trust-building process longevity (mistrust), and lack of internal human resource capacity to engage. More on the challenges will be discussed in the following sections.

2.3. Prevailing Circular Bioeconomy Value Chains

The Ukraine crisis has pushed a rather promising opportunity for producers in the Danube Region to fill a part of the gap created by Ukrainian shortages and disruptions. From the research conducted, there were three products identified that Danube Region producers and related clusters could best provide alternative supplies to Ukrainian equivalents. Connected to this are new market opportunities, mainly the EU27. These are apples, wood and sunflower seeds/oil. Discussions with clusters managers conducted in October – November 2022 showed some additional bioeconomy related value chains, which became more and more relevant since the Ukraine war started, that can be broadly divide in three main categories:

Figure 5: Value chain with raising reliance for firms and clusters in the Danube Region (Source: own investigations)

Serbia, Slovakia, Croatia, and Romanian cluster managers pointed out the importance of agriculture and forestry-based value chains like wine, apples, hemp, wood and also pointed out the export potential of biomass. Germany, Slovenian, Hungarian clusters pointed more to the high value addition value chains products such as use of lignin for adhesives, additives, wax and packaging solutions. Some specific high value addition applications include additives for pharma, use of waste for cosmetics industry ingredients and fertilizers production and use. Further discussions on optional value chains put attention to some additional high potentials

1. Sustainable textiles: Taking into account results of the SMART SMEs project[14] the fibers are one of the key drivers of green textile in Europe. This includes short and more localized supply chains (resilience).
2. Biologicals: Using biologicals (biofertilizer or biopesticides) for more green and sustainable agriculture.
3. Alternative plastics: Plastics substitutes to departure from recycling concept.

2.4. Prevailing Circular Bioeconomy Value Chain Challenges

Analysis showed there are many directions available for further material valorization and production optimization. Yet, companies face challenges from a macro perspective as described here:

- Difficulty to adapt internal processes: Even if the solutions exist, the adaptation requires either restructuring of certain production processes, investments in new technologies.
- Feedstock availability: Data on availability, seasonality and quantities is not there in order to predict and create more stable business models.
- Internal human resource capacities: It is difficult to arrange human resource management inside of the organization, as the circular value chains require strategic thinking and it involves engagement on many company levels. The capacity of companies' HR is often not there to put effort into development. The shift on the management level is required.

[14] https://www.alpine-region.eu/publications/smart-sme%E2%80%99s-collection-good-practices-and-existing-tools

- Trust-building between new partners: Clusters and regional development agencies put their efforts into the networking events and workshops, yet the role of time for trust building is still a big barrier.
- Governmental funding: As will be further discussed, this is the key missing factor when it comes to the implementation of circular value chains on a larger scale.
- Governmental policies and missing legislation: Policies on secondary raw material use for example are not so clear on the national or local level. It also applies to other new EU taxonomy regulations.
- Energy efficiency: In material valorization value chains and technologies involved, the processes are not necessarily energy efficient or even sustainable (transporting, low energy efficiency of some technologies, etc.).

The answers to sub-questions in our interviews conducted were somewhat generalized, as each cluster manager would approach the identification of value chains differently. Some of them would focus on specific supply chains with direct examples of companies with success stories and the others were speaking rather generally and focused more on the overall situation of the specific region. The AgroTransilvania Food Cluster from Romania is an interesting example of how wide their range of activities is in terms of innovation projects and on the other hand there is rather low engagement on a company level. They have commented: “Having 86 members and aggregating solutions for each is almost a mission impossible, as they all might have different needs.” However, clusters from Hungary have described the implementation of circular value chains or practices on direct case examples (meat production, dairy, fish farming, etc.). Interestingly clusters were sometimes unsure of answering questions such as resilience to supply chain disruptions and feedstock availability or the importance of a particular feedstock. This is a great point to think further about concerning how clusters could bring more value to their members or where they consider their presence to be irrelevant.

Challenge 1: Resilience of existing value chains

Throughout the interview, the respondents were primarily focused on the already existing circular bio-value chains, which can explain the average and (at least in some locations) higher resilience to supply chain disruptions and self-sufficiency. However, the position on resilience heavily depends on the location and cluster activities. The Hungarian Omnipack cluster commented: "It depends on self-sufficiency in materials such as fruits residuals we are rather resilient for now; however, we cannot claim for the impacts of climate change in the upcoming years and the impact this would cause on the harvest." On the other hand, they have expressed the fact that they import a lot of paperboard material from Finland for the initial beginning part of the production of packaging products in the value chain. Imports of paperboard also explain a certain level of wood import dependency, which for example, is not the case for Croatia (Croatian Wood cluster exposed that their exports in the wood sector are one of the peak performances in the last decades). There are feedstock availability discrepancies even between the neighboring countries. AgroTransilvania cluster has emphasized that the last events such as the war in Ukraine and Covid-19 pandemic have significantly changed their understanding

of Romanian resilience to supply chain disruptions. Now they asses their resilience as “mostly not resilient”.

Challenge 2: Most technologies implemented in the processes are low-tech

The level of technology sophistication used in the circular bio-based value chains was evaluated. As will be seen in the following results on the feedstock and secondary raw materials use, there are a few influencing factors that determine the level of sophistication of technologies in existing circular value chains. Since the majority of value chains are using agricultural and wood biomass (lignocellulose), there are mostly prevailing down-cycling value chain models for either use of the feedstock or utilization of residuals. By the principles of a bio-based economy, ideally the production should strive towards higher utilization of materials (upcycling). However, we evaluate that the circular transition (especially in rural areas and the sources of the main feedstock) as moving rather slowly due to the lower economic and social opportunities in the countries.

Challenge 3: SMEs have difficulties in the identification of relevant technologies

The technical knowledge of the technologies needed for the implementation would usually not cause a big problem if the company decided on such utilization. The knowledge of the technicalities of development was not identified as the biggest reason for companies' reluctance towards the establishment of circular value chains. SMEs struggle to adapt their production towards more circular approaches as the bio-tech initiatives usually respond to macro-regional or global market demands and not as many modular technologies are identified or even exist.

Challenge 4: Lacking internal human resources

The lack of internal human resources was emphasized in every interview conducted. It was discussed that clusters sometimes struggle with low participation rates at their events, as the topics they present must be extremely relevant to the SMEs for them to show interest, attend and actively participate. Companies have started to shift towards a mindset of proposing circular initiatives, yet they struggle a lot with assigning tasks among the existing staff as the circular economy is very conceptual, and there is still a lack of holistic understanding.

Larger firms are appointing specialists for sustainable development and a deeper look revealed that the majority are still assigned to reporting and compliance with new EU regulations. The second new profiles are employed as supply chain managers which try to improve transparency and traceability of existing supply chains. Active engagement of companies and SMEs might be observed in sectors that are hit by the Ukraine war, rather than due to access to raw materials, or end markets, or energy prices among them: agriculture, wood, food, beverages, textile, chemicals that all can present a cornerstone of Danube circular bioeconomy.

3. Problems of SMEs in the Danube Region

The further investigation pointed out the obstacles to implement or scale-up circular bioeconomy value chains in the region. The interviews and the workshop in Zagreb provided further insights into the dedicated problems of SMEs in the EUSDR with a focus on circular bioeconomy. They are presented in the Figure 6.

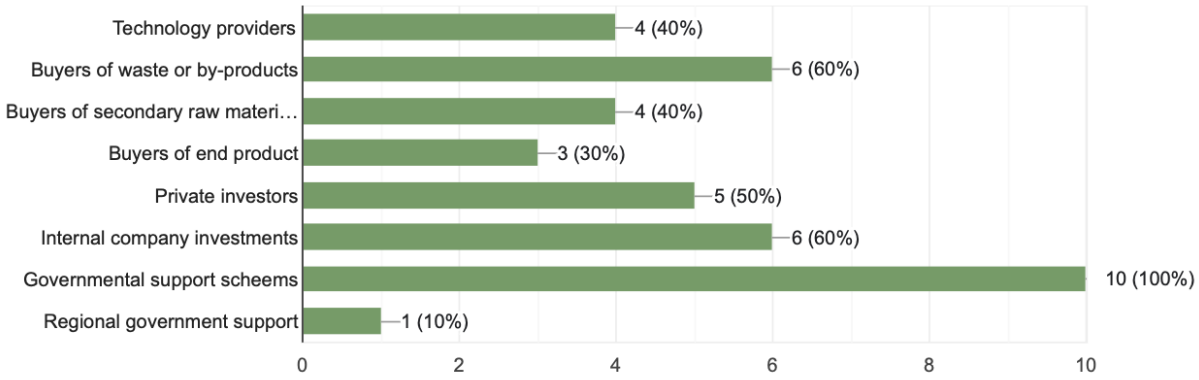

Figure 6: Prevailing obstacles to commercialise or scale-up circular bioeconomy products or services

3.1. High Level Concept and Invisibility of Actors

- High level concept of circular bioeconomy. Companies from the Danube clusters are having a hard time assessing or adapting to the unidentified frames. Bioeconomy is a very broad concept and there are some circular practices used in agriculture or feed production that are rather conventional but are now marketed as a bioeconomy practice. This can create misunderstandings and a fear of the possibility of the appearance of greenwashing. Governance structures should give more support to the definitions, goals, and assessments of circular value chains. It is essential to point out that in some countries (Serbia, Federation of Bosnia & Herzegovina, Romania and Croatia), the definition of bioeconomy is relatively unknown and reluctantly applied by the ministerial entities.

- Low commercialization activities. Many projects, mostly funded by the EU funds are innovation related, yet very few are linked to commercializing and scaling on the market. EU funded R&D activities in the field of circular bioeconomy are dominated by academia, companies are often in as “alibi” partners. Many such projects finish on the prototype level without further development and scaling. Funding and partners to further commercialize activities are missing. Companies, which could invest in commercialization and scale-up, do not have information and access to technologies that have been developed in different European projects. There is an information gap between availability of technologies and those who can commercialize and use in their processes.

- Invisibility of key value chain actors. Buyers and sellers do not identify themselves as potential partners. There is great need for the identification of use cases, good practices

and directly feasible models, which could be replicated on a larger scale, to create inter-industrial cooperation, tech-transfer and serve as a replicable model for similar industries.

- Missing private investors. Several reasons are a lack of tailored financial instructions on green investments, unclear risk assessments and general invisibility of technologies and companies, as the market is still emerging.

3.2. Clusters and Technology Divide

The case of cluster readiness to support acceleration of the circular bioeconomy in Danube and digital is divided between the West and East Danube, and this was also discussed at the Ulm Danube Conference in July 2022. Economic policy impulses from EU Strategy for the Danube Region should try to close this gap. However, the analysis pointed out:

- Data on the availability of bio-feedstock, residuals and by-products practically does not exist. Either the unavailability or even non-existence of data on waste amounts, their properties, and their availability is causing problems in managing and utilizing it.

- Clusters usually do not have trade related data about members' products and there is an absence of cross regional and regional networks with relevant information at the firm level. For example, in Slovakia, there are initiatives on the municipality level for the establishment of these databases and getting the data on agricultural waste to achieve at least some utilization (even if by downcycling) methods, yet it is a step forward towards circularity scale-up. In cases like these, clusters need even more support from the regional government-level institutions and from the municipal level.

- Digitalization and digital inclusion. Particularly the market penetration for the materials was expressed by the representatives from Serbian and Romanian cluster initiatives. They said that apart from the general lower market penetration of secondary raw materials to fossil fuel-based materials, the issue of digital inclusion and digitalization lagging behind is critical and gap is increasing.

3.3. Access to Finance and Information Asymmetry

Access to finance and information asymmetry are the initial reasons that majority of the SMEs and companies in the Danube Region do not even search for further utilizations of materials and circular, innovative solutions. There are things that all contribute to this systemic problem, and they cannot be simply characterized as "we can not only talk about finance". The Danube, in terms of the time required, needs much more investment in order to reach targets by 2030 and provide a good environment for the current and future citizens of the Region. The problem of information and financing is systemic and is most likely beyond the Danube's borders. A review of current finance options of selected regions shows that EU funds are playing the critical role. Interesting only Bosnia and Hercegovina has some private investments in place.

There are three things to be summarized here. Firstly, the majority of European/governmental support programs are focusing on research and innovation and not on commercialization and viable circular bioeconomy value chains. Secondly, the majority of solutions have been developing in the western part of the Danube Region and many results of innovation projects are not effectively disseminated. Established networks are not functional after the projects end and private initiatives are not encouraged. Third, engagement of private investors and banks in the circular bioeconomy across the Danube Region is rather anecdotal or linked to large scale “biorefineries - green infrastructure projects” that are out of the scope of SMEs and clusters.

4. Existing Support Schemes and Mechanisms Supporting Circular Bioeconomy Value Chain Development

As outlined in the previous chapter, access to finance and funding was identified as one of the prevailing challenges (Figure 6). Consequently, the analysis included an update of funding opportunities for circular bioeconomy inventions or for investments. For example Baden-Württemberg have a fully-fledged circular bioeconomy strategy in place, whilst the other Danube regions and countries do not have any such strategies and related programs[15]. Baden-Württemberg invests around €35 million in R&D, innovation and industrial ramp-up in the field of circular bioeconomy. In addition, the national Bioeconomy Strategy of Germany also provides funding opportunities. Figure 7 displays a funding landscape for companies, and academia from Baden-Württemberg having access to regional and national funding programs. Support schemes are ranking from applied R&D to industrial ramp-up investments.

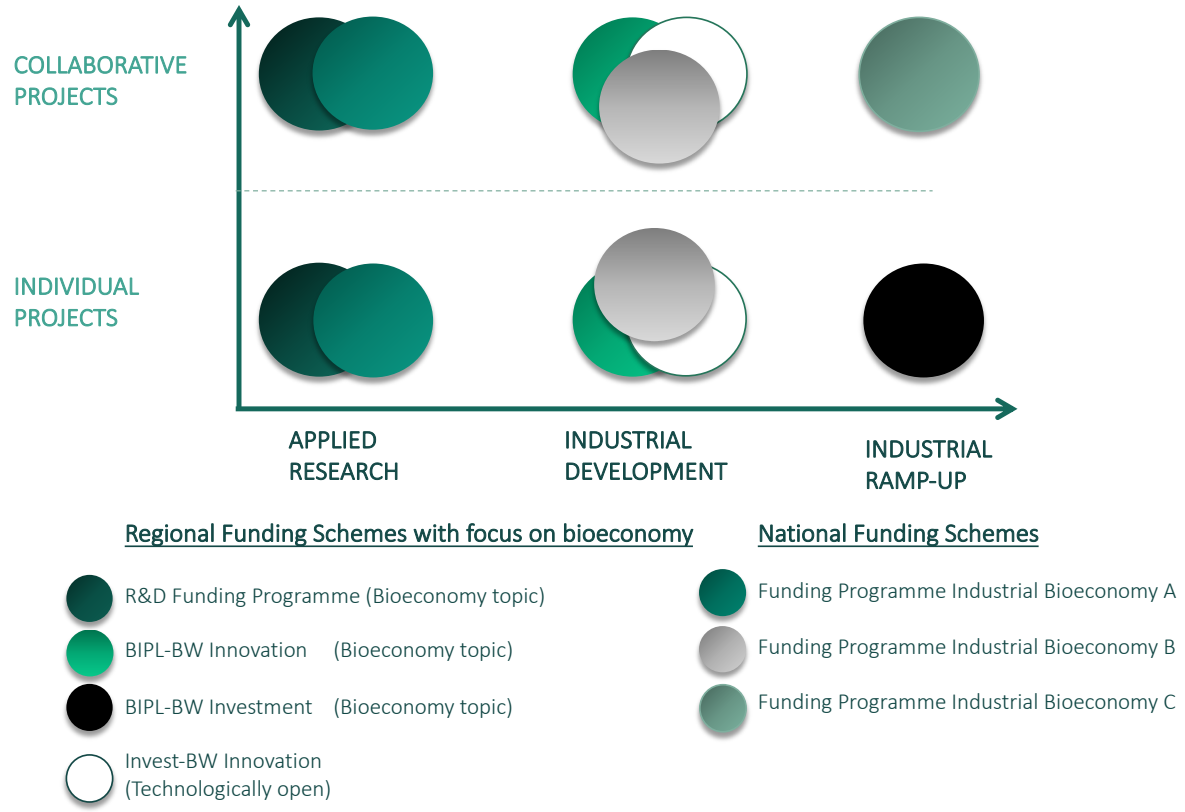

Figure 7: Bioeconomy funding landscape in Baden-Württemberg and Germany (source: VDI/VDE-IT)

Austria's Council of Ministers passed the "Bioeconomy – A Strategy for Austria" in March 2019[16]. This lays out Federal Government goals to decarbonize and encourage sustainability whilst preserving economic growth. In addition, Austria published a national "Sustainable

[15] It shall be noted that Germany and Austria do have a national Circular Bioeconomy strategy in place.

[16] https://www.bmbwf.gv.at/en/Topics/Research/Research-in-Austria/Strategic-focus-and-advisory-bodies/Strategies/Bioeconomy-Strategy.html

Circular Economy" Strategy in 2022[17]. It goes in line with first funding schemes implemented in 2021 and 2022, worth €10 million for funding. In addition, some federal states, like Upper Austria, embedded circular Bioeconomy in their regional the economic and research strategy #upperVISION2030.

Most other Danube regions do not have circular Bioeconomy strategies in place as given in Table 2.

Country/Region	Circular (bio)economy strategy/policy currently in place	Circular (bio)economy strategy/policy currently in planning stages	No Circular (bio)economy strategy/policy but topic-related policies
Baden-Württemberg (DE)	√		
Bavaria (DE)	√		
Bosnia Herzegovina			√
Bulgaria		√	
Burgenland (AT)			√
Carinthia (AT)			√
Croatia			√
Czech Republic			√
Hungary			√
Lower Austria (AT)			√
Moldova			√
Montenegro			√
Romania			√
Salzburg (AT)			√
Serbia		√	
Slovakia			√
Slovenia		√	
Styria (AT)			√
Tyrol (AT)			√
Ukraine			√
Upper Austria (AT)	√		
Vienna (AT)			√

Table 2: Regions/Countries with a circular (bio)economy strategy or similar policies in place (as of beginning 2022), source: GoDanuBio and updates done by the authors

It is hard to understand how on the macro-regional level circular bioeconomy can seriously be promoted if the participating regions do not have any strategies of this nature. If the core idea of a macro-regional approach is to facilitate cross-regional cooperation and bundling of critical mass in certain areas, this will struggle to succeed if parts of the macro-regional strategies are disconnected from what the partner regions focus on. This causes a lack of cross-sectoral cooperation possibilities due to missing regional strategies and related programs in the field of

[17] Federal Ministry Republic of Austria Climate Action, Environment, Energy, Mobility, Innovation and Technology, 2022, https://www.bmk.gv.at/themen/klima_umwelt/abfall/Kreislaufwirtschaft/strategie.html

the circular bioeconomy. It also leads to a gap between policy makers, civil society, and economic actors. In order to better align regional strategies among the Danube partner regions and the Danube Region Programme (DRP) there is a need for several key reforms.

There appears to be a sharp divide in the field of circular bioeconomy policies and programs between the EUSDR approach and the regions. The EUSDR intends to develop coordinated policies and actions in the area of the river basin, reinforcing the commitments of Europe 2020 strategy towards the smart, sustainable and inclusive growth based on four pillars and twelve priority areas. These shall tackle key issues as mobility, energy, biodiversity, socio-economic development, and safety. In line with the goals of the territorial cooperation objective, the strategy focuses on enhancing closer cooperation within the concerned territory. A key element of the strategy is coordination, by encouraging the increase in the level and quality of network activities, strengthening the existing regional and interregional cooperation but also fostering new cooperation.

While the EUSDR is ambitious in terms of sustainability, circular economy and the circular bioeconomy, only some Danube regions / countries have a fully-fledged circular (bio)economy strategy in place (Table 2). If this divide is not addressed, any strategy developed under the DRP will not and cannot be implemented in practice. Thus, it is no surprise why most respondents expressed their concerns about missing governmental support, especially for circular bioeconomy related innovation and industrial ramp-up.

When taking a closer look during the current analysis some technical support schemes and mechanisms for value chain development were identified. There are initiatives and events, directly and indirectly, connected to circular bioeconomy development. Most of them did not including monetary funding schemes, including working groups on value chain development on a firm level. Furthermore, bioeconomy clusters (Chapter 2.1.1), supported their companies in ways such as:

- Organizing networking events
- Innovation development and dissemination
- Trust building
- Attracting new firms and actors into the region
- Supporting the relationships after networking events
- Extension of individual firm-level networks
- Developing working groups on value chain development on a cross-company level
- Diffusing knowledge and technologies within the cluster

Companies can expect support from cluster organizations, but not usually on the individual level approach, especially in bigger clusters. Therefore, not all the members happen to be highly engaged or engaged at all in the processes and implementation of existing innovations on the market for the establishment of circular bio-based value chains.

Cluster managers interviewed confirmed previous studies that they do not feel prepared to support their members in dedicated value chain development topics, neither in circular Bioeconomy nor in traditional industries. Despite the fact that the cluster managers offer a wide spectrum of support services, none of them are targeting specific value chain development activities. That is why most of them were already in contact with the Danube Alliance[18] and expressed their interest in becoming more engaged.

[18] for further information: https://competitiveness.danube-region.eu/danube-alliance/

5. Conclusions and Way Forward

The work conducted under Task 1 provides a critical bottom up view of cluster managers and SMEs view on the current situation of the circular bioeconomy value chains in Danube Region. This study identified three main areas of circular bioeconomy viable value chains in the region: 1) agriculture and forestry biomass 2) Applications in pharma and cosmetics and 3) define textile, agriculture biologicals and plastics substitutes / alternatives as high potential areas (Figure 5). The current Ukraine war and disrupted supply chains put circular bioeconomy in the public eye more than ever before. Decentralized bioenergy provision or using natural building material for eco-construction when re-building post-war Ukraine are just two examples for many circular Bioeconomy opportunities.

The main obstacles defined at the SMEs level is on information asymmetry, technology access and access to finance (Chapter 3). The Danube Region therefore seeks both optimization and scalability of accumulated knowledge and available technologies, preferably through cross-regional cooperation. Knowledge and technology transfer strategies to compete in global markets was proposed as a response to the current situation. Yet it is a striking finding that an important bottleneck to be further addressed is the elaboration of the assessments systems that can be used by regional planers, funding agencies and commercial banks / private investors. Such systems should link to different sustainable frameworks like Environmental, social, and governance (ESG) reporting standards, Sustainable Development Goals (SDG) or Life Cycle Assessments (LCA).

Most respondents appreciated the work of the Danube Alliance so far. However, they also called for further actions and for an extension of the work of the Danube Alliance to assure further outreach. By now, the Danube Alliance is very much driven by the Government of Baden-Württemberg, whereas a more macro-regional approach is needed. Therefore, an extension of the Danube Alliance towards a macro-regional wide Danube Alliance Network could help to intensify the network by inclusion of more clusters, regional authorities, funding agencies, commercial banks and private investors for targeted circular bioeconomy value chain development. The future work should emphasize the importance of closing the digital and technology gaps between western and eastern Danube as well. The embedding of infrastructural elements, like the Value Chain Generator or VC Simulator can effectively promote circular bioeconomy models, technologies and enable cluster managers to identify opportunities for new value chains