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Joint Strategy for Bio-Based Industry Cluster Policy

Cross-clustering partnership for boosting eco-innovation by developing a joint bio-based value-added network for the Danube Region

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Gerd Meier zu Köcker, Dominik Patzelt, Mateja Dermastia,
Darja Osvald, Gregor Švajger, Michael Keller

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LIST OF ABBREVIATIONS

ASP	Associated Strategic Partner
BSC	Balanced Scorecard System
BSO	Business Support Organization
DTP	Danube Transnational Programme
ERDF	European Regional Development Fund
EU	European Union
EUR	Euro
Fig.	Figure
FTE	full-time equivalent
GODC	Government Office for Development and European Cohesion Policy
i.e.	that is (Latin: id est)
IPA	Instrument for Pre-Accession
JBCS	Joint Bio-based Industry Cluster Policy Strategy
LP	Lead Partner
p.	page
PLA	Policy Learning Arena
PP	Project Partner
R&D	Research and Development
RIS3	Research and innovation smart specialisation strategy
SME	Small and Medium Enterprise
SRIP	Strategic Research and Innovation Platform
S3	Smart Specialisation Strategy

GLOSSARY

Bioeconomy	Bioeconomy is the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products and bioenergy. Its sectors and industries have strong innovation potential due to their use of a wide range of sciences, enabling and industrial technologies, along with local and tacit knowledge. *(Source: European Commission (2012). Innovating for Sustainable Growth: A Bioeconomy for Europe, p. 3)*
Cluster	Clusters are geographic concentration of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standards agencies, and trade associations) in particular fields that compete but also cooperate. *(Source: M. Porter (1998). On Competition, Updated and Expanded Edition. Harvard Business Review Book, p. 213)*
Cluster initiative	Cluster initiatives are organised effort to increase the growth and competitiveness of a cluster within a region, involving cluster firms, government and/or the research community. *(Source: Ö. Sölvell, G. Lindqvist and Ch. Ketels (2003). The Cluster Initiative Greenbook , p. 9)*
Cluster organisation	By a cluster organisation one should understand organised efforts to facilitate cluster development, which can take various forms, ranging from non-profit associations, through public agencies to companies. *(Source: PricewaterhouseCoopers (2011). Uncovering excellence in cluster management, p. 6)* Cluster management can be defined as the organisation and coordination of the activities of a cluster in accordance with certain strategy, in order to achieve clearly defined objectives. *(Source: PricewaterhouseCoopers (2011). Uncovering excellence in cluster management, p. 3)*
Cluster participants	Cluster participants are representative's industry, academia or other intermediaries, who are commonly engaged in a cluster initiative. Given the case a cluster initiative has a certain legal form, like association, cluster participants are often called cluster members.
Cluster Policy	Cluster policy is an expression of political commitment, composed of a set of specific government policy interventions that aim to strengthen existing clusters and/or facilitate the emergence of new ones. Cluster policy is to be seen as a framework policy that opens the way for the bottom-up dynamics seen in clusters and cluster initiatives. This differs from the approach taken by traditional industrial policies which try (and most often fail) to create or back winners. *(Source: European Commission (2016). Smart Guide to Cluster Policy, Guidebook Series: How to support SME Policy from Structural Funds, p. 11)*
Eco-innovation	Eco-innovation aiming at significant and demonstrable progress towards the goal of sustainable development. Eco-innovation projects will therefore aim to produce quality products with less environmental impact, whilst innovation can also include moving towards more environmentally friendly production processes and services. Ultimately, they will contribute towards the reduction of greenhouse gases or the more efficient use of various resources. *(Source: European Commission (2015). Eco-innovation, When business meets the environment. FAQ: What is Eco-Innovation? Online).*
Programme	Programmes are a vehicle to implement a policy, e. g. funding programme for R&D in environmental technology. In addition to programmes, policies are also implemented through regulation (= regulatory framework, e. g. law on consumer protection).
Smart Specialisation Strategies – S3	Smart Specialisation is a strategic approach to economic development through targeted support for research and innovation. It involves a process of developing a vision, identifying the place-based areas of greatest strategic potential, developing multi-stakeholder governance mechanisms, setting strategic priorities and using smart policies to maximise the knowledge-based development potential of a region, regardless of whether it is strong or weak, high-tech or low-tech. *(Source: Foray (2015). Smart Specialisation, Opportunities and Challenges for Regional Innovation Policy, Routledge.)*
Value Chain	The value chain describes the full range of activities that firms and workers do to bring a product from its conception to its end use and beyond. A value chain refers to the full lifecycle of a product or process, including material sourcing, production, consumption and disposal/recycling processes. This also includes activities such as design, production, marketing, distribution and support to the final consumer. *(Source: University of Cambridge (2017). What is a value chain? Definitions and characteristics. Online.)*

We will clearly distinguish between clusters, cluster initiatives and cluster organisations to make it easier to understand what is intended with the corresponding question.

DanuBioValNet PROJECT

The DanuBioValNet project is aiming at establishing bio-based industry networks across the Danube Region. The emerging transnational cooperation of clusters will foster bio-economy and eco-innovations and lead to a strengthening of the regional economies. Consequently, with this project the partners pursue a strong strategic orientation beyond the immediate and medium-term economic objective of strengthening the regional economy. It is the strategic goal to establish cross-border strategic partnerships, particularly in developing regions, with the help of powerful cluster organisations. In this way, project results will be sustained beyond an immediate effect and the creation of strategic investments, especially in emerging industries such as the bio industry, will be enabled and facilitated. This will be achieved mainly by newly emerging or transforming value-added chains, which are increasingly being transnationally established and further developed as a result of the increasing internationalisation of value-added processes.

In this way, long-term economic effects are achieved, based on a network of agile clusters, which prepare the investment approaches in a targeted manner and implement them with high efficiency. One example of the present project is the establishment of bio-refineries in the regions, which can form a strategic technological backbone of a successful independent bio-industry.

The partners intend to develop and implement a long-term, industry-driven roadmap for such collaboration along the entire value chain based on cluster partnerships for these processes. With the project, a pilot function of the implementation is taken over and the prerequisite for creating a blueprint for similar and similar cross-national cooperation, also in other industries, is created.

For achieving these tasks, 17 project partners from 10 countries have joined forces. The project will pave the way from an economy based on fossil resources towards an economy using renewable resources. The striving of the partners to minimise greenhouse gases and resource-saving as well as resource-efficient utilisation of available biomass will result in synergistic effects. These effects will improve the sustainability, regional development through diversification of the local economy and will also positively affect the workforce. The development of new bio-based value chains from primary production to consumer markets needs to be done by connecting enterprises from different regions and industries. But due to a missing holistic transnational approach, Danube actors in bio-based industry still operate disconnected and cannot properly benefit from the potential. Therefore, the aim of this project is to develop new methods, strategies and tools to connect enterprises transnationally.

Clusters as the strong representatives of a group of industries that are closely linked by common products, markets, technologies and interests are chosen to organise and bear the industry cooperation and creation of new value chains, because they are performant and sustainable partners and guarantee the upgradeability in the dimension industry, sciences and also politics.

One of the planned outputs of this project will be the development of a Joint Bio-based Industry Cluster Policy Strategy (JBCS) to describe the procedure and to make it actionable and reusable. Furthermore, a bundle of new methods and tools to support clusters for transnational working will be developed and joint into a strategy. They will be tested in three pilot actions where it is planned to create new bio-based value chains in the Danube Region. The main target groups are on the one hand the policy – four Ministries are involved –, on the other hand clusters and their SMEs – nine cluster organisations are involved. The policy level will benefit from the JBCS, which can be used as a political framework.

The clusters and SMEs will benefit from the new innovative tools and methods developed for transnational cross-clustering. Successfully established new bio-based value chains in the pilot actions can motivate other clusters and SMEs to test this newly developed approach in the future.

The following partners commit to the implementation of the cluster partnership and transnational cooperation:

Role	Official Name in English	Acronym	Country
LP	BIOPRO Baden-Württemberg GmbH	BIOPRO	Germany
ERDF PP1	ClusterAgentur Baden-Württemberg	CABW	Germany
ERDF PP2	Anteja ECG	ANT	Slovenia
ERDF PP3	PROUNION	PU	Slovakia
ERDF PP4	Romanian Cluster Association	CLUSTERO	Romania
ERDF PP5	Association of Business Clusters	ABC	Bulgaria
ERDF PP6	National Cluster Association – CZ	NCA	Czech Republic
ERDF PP7	Business Upper Austria – OÖ Wirtschaftsagentur GmbH - Upper Austrian Food Cluster	UAFC	Austria
ERDF PP8	Ministry of Economy	ME	Romania
ERDF PP9	Ministry of Economy, Entrepreneurship and Crafts	MEEC	Croatia
ERDF PP10	Ministry of Education, Science and Sport	MIZS	Slovenia
ERDF PP11	Croatian Wood Cluster	CWC	Croatia
ERDF PP12	Institute for Economic Forecasting	IPE	Romania
ERDF PP13	Business Upper Austria – OÖ Wirtschaftsagentur GmbH – Cleantech-Cluster	BizUp	Austria
IPA PP1	Innovation Center of Faculty of Mechanical Engineering	ICME	Serbia
ASP1	Montenegro Vine Cluster	MVC	Montenegro
ASP2	Ministry of Economic Affairs, Labour and Housing Baden-Württemberg	WM	Germany

LP = Lead Partner, PP = Project Partner, IPA = Instrument for Pre-Accession, ASP = Associated Strategic Partner, ERDF = European Regional Development Fund

JOINT BIO-BASED INDUSTRY CLUSTER POLICY STRATEGY FOR THE DANUBE REGION

INTRODUCTION

The bioeconomy[1], or bio-based economy, is the production of renewable biological resources and the conversion of these resources and waste streams into value added products. This can be further elaborated, as a new model for industry and the economy. It involves the sustainable use of renewable biological resources (including crops, micro-algae and plant species that are barely used nowadays, among others) for producing food, energy and industrial goods. It also exploits the untapped potential within millions of tons of biological waste and residual materials as well as production side streams. The transition from a fossil-based to a bio-based economy is expected to reduce society's dependency on fossil fuels, increase sustainability and contribute to climate and environmental protection.

The bioeconomy goes far beyond value creation chains and seeks to interconnect all economic sectors. The Bioeconomic Distributed Manufacturing Environments (BDME) is a good example for the interconnectivity with many sector[2]. The BDME approach focuses on distributed manufacturing to achieve local manufacturing scenarios that use the amounts of locally available renewable raw and residual materials for conversion to deliver locally demanded materials. The Danube is an excellent region to turn this approach into industrial practice.

1) Source: European Commission (2012). Innovating for Sustainable Growth: A Bioeconomy for Europe, p. 3
2) Päivi Luoma, Juha Vanhanan and Paula Tommila (2011). Distributed Bio-Based Economy – Driving Sustainable Growth, Sitra (Helsinki), ISBN 978-951-563-790-1.

Therefore, the bioeconomy concept must be understood as an interdisciplinary and multifaceted system in which many subsystems and processes are interlinked. Nowadays, bio-based materials can be used for a very broad range of applications. Many industries are already involved in the bioeconomy, such as the automotive, building, plastics, plant manufacturing, mechanical engineering, chemical and associated industries. The concept is gaining in importance worldwide. Several countries have already launched bioeconomy strategies, and many more are working towards this. The European Union promotes the bioeconomy in a variety of ways; national and European governments have established many programmes in recent years aimed at fostering the bio-based economy.

What sound easy in theory turns out to be quite complex in practice. The development of new bio-based value chains from primary production to consumer markets is the key of success and needs to be done by connecting enterprises from different regions and industries. However, due to a missing holistic transnational approach, the Danube actors in the current bio-based industry still operate disconnected and cannot properly benefit from their potential. Therefore, the aim of this project is to develop new methods, strategies and tools to connect enterprises transnationally. Clusters represent groups of industries that are closely linked by common products, markets, technologies and interests. They are chosen to organize and carry forward the needed industry cooperation for the creation of new value chains. Properly performing clusters can help to upgrade industrial practices, generate new knowledge and contribute to regional policymaking.

Eleven Danube regions, led by Baden-Württemberg and Slovenia, decided in 2015 to spend higher efforts to develop the idea of bioeconomy and the connection of actors along the bioeconomy-related value chains further. The joint undertaken resulted in the so called DanuBioValNet project[3], one of the frontrunner initiatives to bring bioeconomy in the Danube Region further. Over the course of the DanuBioValNet, phytopharma, eco-construction and bioplastic/advanced packing (bio-based packaging) was identified as sector having a high economic relevance as well as high potential for improvement of their respective value chains. Furthermore, hemp was considered as a raw material suitable for all the three value chains.

The Joint Bio-Based Industry Cluster Policy Strategy (JBCS) presented here paves the way to turn Danube region into a bio-based economy. It puts dedicated attention to a better and more aligned use of cluster-based regional innovation strategies. It therefore briefly summarizes the existing potential of the Danube Regions, as documented in the different project outputs and highlights the availability of biomass, the presence of existing clusters, related policies (with a focus regional innovation and cluster policies), and bio-based industrial value chains. The DanuBioValNet project identified three value chains, for which the region has specific advantages and belongs, partly, already to the European front-runners: phytopharma, eco-construction, and bio-based packaging.

Despite of the high potential to turn existing Danube Region economies in bio-economies, there are still significant challenges ahead. Biobased industries are partly lagging behind in bio-based industries, business conditions in the Danube Region vary significantly and the cluster landscape is not fully developed. Since cluster do play an important role in regional development, the JBCS spins around the idea of making better use of the interplay between existing bio-economy potential and clusters in the Danube region. Clusters can be seen as key driver for innovation, competitiveness and regional development. But only, if they are enables to turn existing assets into practice. This can be reached best by excellent cluster and related managements.

Since Danube Regions tend to operate isolated and not aligned in the field of bioeconomy, the JBCS puts common vision for a bio-economy in the centre as guiding principle for future actions.

3) http://www.interreg-danube.eu/approved-projects/danubiovalnet

OVERVIEW

THE BIO-ECONOMY POTENTIAL – BIOMASS, CLUSTERS AND REGIONAL INNOVATION STRATEGIES

The regions of the DanuBioValNet project, combine assets that can contribute to the realization of this vision, in terms of available biomass, existing clusters, specific value chains and regional policies already supporting the transmission towards a front-runner bio-economy region. These assets are documented in the different outputs of the project[4], in dedicated country reports and cluster mapping reports for Austria, Baden-Württemberg, Bulgaria, Croatia, Czech Republic, Montenegro, Romania, Serbia, Slovakia and Slovenia. The assets for specific value chains are documented in roadmap reports for bio-based packaging, eco-construction and phytopharma. A catalogue of "TOP bio-based products in the Danube Region"[5] showcases the region's specialisation in these sectors of bio-economy by presenting the availability of unique bio-based products. The following sections summarize the key elements reflecting the potential of the Danube region to become a front-runner for the bio-based economy.

BIOMASS

DanuBioValNet regions/countries have good opportunities for production of biomass due to the large amount of available forest and agricultural land. The agricultural land and forest area remain relatively constant in all regions/countries. Wood and agricultural biomass, bio-waste, landfill gas and biogas, and alcohol fuels (like Ethanol or Biodiesel) are the main types of biomass, but their uses in industry vary from region to region. Mostly, the biomass is used as primary energy for power and heating plants, for domestic use as a combustion source, and to produce biofuels and biogas. The forests prevail in most of the landscape of the Danube countries like Montenegro 70%, Slovenia 63,3%, Croatia 47%, Austria and Slovakia 42%[6]. It is worth mentioning that Romania has the largest surface of virgin forests in Europe. Almost half of the territory of the participating countries/regions (49,4%) consists of agricultural land. This includes arable land, permanent crops and agricultural grasslands as well as horticultural land. This is well above EU-27 which is, on average, 40% of the total area in 2014 was agricultural land (Eurostat, latest public data, June 2016 - Croatia is not included). Most of the land is used for cereal crop production (wheat, barley, rye, oats, maize, millet, sorghum). Romania and Serbia rank among first 5 maize producers in Europe, oilseeds (particularly rape, soy and sunflower), vineyards and orchards, wild and cultivated medicinal plants, grass, clover, or alfalfa.

The **Bioeconomic Distributed Manufacturing Environments (BDME)**[7] approach focuses on distributed manufacturing to achieve local manufacturing scenarios that use the amounts of locally available renewable raw and residual materials for conversion to deliver locally demanded materials. The current ideas to develop a bioeconomy focus on the introduction of renewable resources and their conversion products as intermediates in existing value chains. In some more complex scenarios, value chains are interconnected to value networks, so that more sophisticated products can be achieved. In this way, regionally available renewable resource materials can by synergistically and fully used. The idea of distributed manufacturing, to set up a local manufacturing network and have it interconnected with a regional producer network of renewable materials, will lead to a bioeconomic distributed manufacturing environment, that is in a position to independently produce raw materials, convert it into intermediate products and formulate components or materials out of that. Examples could be a fully integrated bioplastics production of locally demanded eco-construction components or the usage of locally available lignocellulosic raw or residual materials to get pulp for paperboard production or paper moulding and lignin based, glue type resins for smart fruit or vegetable packaging solutions.

4) The documents can be downloaded from the DanuBioValNet Library: http://www.interreg-danube.eu/approved-projects/danubiovalnet/outputs
5) Available in the DanuBioValNet Library: http://www.interreg-danube.eu/approved-projects/danubiovalnet/outputs
6) DanuBioValNet (2017). Report: The BioBased Status in the Danube Region. Web source: http://www.interreg-danube.eu/approved-projects/danubiovalnet/outputs
7) Päivi Luoma, Juha Vanhanan and Paula Tommila (2011). Distributed Bio-Based Economy – Driving Sustainable Growth, Sitra (Helsinki), ISBN 978-951-563-790-1,

CLUSTERS

In addition to available biomass, key assets of the Danube region include existing **clusters[8] and cluster initiatives[9]**, uniting, in a formally organized way or not, geographic concentrations of enterprises, knowledge institutions and R&D activities relevant for the bio-based economy. Nevertheless, a significant variance can be observed between the regions participating in the project. While BW and Upper Austria regroup all mentioned key assets in their clusters, the remaining regions derive their strengths almost exclusively from the presence of SMEs. Dedicated bio-economy clusters, if existing, are in all regions in initial stage, but there are traditional industry clusters dealing with the bio-based industries in all regions. More on the profile of the regions in terms of existing clusters can be found in Synthesis Report on Bio-based Value Chains Roadmapping in Danube region with Action Lines for The Danube Bio-Based Strategy[10] and related reports.

The presence of cluster initiatives, the organised effort to increase the growth and competitiveness of a cluster within a region, varies from region to region. The strengths of existing cluster initiatives in the regions participating in the DanuBioValNet project are reflected in a "Cluster Toolbox"[11], presenting available cluster services to support SMEs in bio-based industries with a focus on innovation, internal networking, external networking, business and commercial activities, entrepreneurship and cluster policy.

REGIONAL INNOVATION STRATEGIES

National and regional governments have established many policies in recent years aimed at fostering the bio-based economy. Surprisingly, only Baden-Württemberg and Austria have recently developed dedicated bioeconomy strategies with focus on regional bio-based industry development.[12] At the European level, the European Union also promotes the bio-economy in a variety of ways, but in most cases not well connected with regional development.
Undoubtable, regional innovation strategies are an important tool to strengthening innovation and competitiveness on regional level. There are many different approaches in place. Currently, the most important one is the so call Smart Specialisation Strategy approach (S3). The challenge at the heart of the Smart Specialisation Strategies (S3) approach is the need for regions to use their limited resources effectively to become and remain competitive in the global economy. Regions need to achieve differentiation by specialising on a limited number of prioritised economic activities to take advantage of knowledge spillovers and economies of scale and scope. Successful differentiation is contingent on exploiting existing related variety.[13]

One key challenge is to **implement S3 through clusters** in order to gain sustainable and inclusive growth while generating critical mass of economically viable activities[14]. Applied to the bio-economy in the Danube region this means that the clusters of the Danube region, become the levers to organise and bear the industry cooperation and creation of new bio-based value chains, because they are performant and sustainable partners and guarantee the upgradeability in the dimension industry, sciences and also politics. As a common policy framework, available in all regions of the Danube, regional innovation strategies offer an innovative approach to improve innovation and value chain development in the Danube region, for fields related to the bio-economy.

8) Clusters are geographic concentration of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standards agencies, and trade associations) fields that compete but also cooperate. (Source: M. Porter (1998). On Competition, Updated and Expanded Edition. Harvard Business Review Book, p. 213)
9) Cluster initiatives are organized efforts aiming at fostering the development of a given cluster either by strengthening the potential of cluster actors or shaping relationships between them. They often have a character like a regional network. Cluster initiatives are usually managed by cluster organizations.
10) Source: DanuBioValNet (2018). Synthesis Report on Bio-based Value Chains Roadmapping in Danube region with Action Lines for The Danube Bio-Based Strategy.
11) DanuBioValNet (2018). Cluster Tool Box „New Cluster Services to support SMEs in bio-based industries".
12) Bioeconomy - A Strategy for Austria, March 2019. Available online: https://www.bmnt.gv.at/umwelt/klimaschutz/biooekonomie/Bio%C3%B6konomie-Strategie-f%C3%BCr-%C3%96sterreich.html; Landesstrategie Nachhaltige Bioökonomie Baden-Württemberg, June 2019. Available online: https://stm.baden-wuerttemberg.de/fileadmin/redaktion/m-mlr/intern/dateien/PDFs/Bio%C3%B6konomie/Landesstrategie_Nachhaltige_Bio%C3%B6konomie.pdf
13) Foray, D., Goddard, J., Goenaga, X., Landabaso, M., McCann, P., Morgan, K., Nauwelaers, C. and Ortega-Argiléset, R. (2012). Guide on Research and Innovation Strategies for Smart Specialisation. European Commission, Regional Policy.
14) Keller, M., Reingruber, I., Dermastia, M., Bersier, J. and Meier zu Köcker, G. (2018). Smart Specialization Strategies (S3) and Clusters – An Innovation Model for Transformative Activities. Working Paper HES-SO//FR HEIA FR / Business Upper Austria / Anteja / ClusterAgentur Baden-Württemberg. Download: https://hesso.tind.io//record/2860/.

VALUE CHAINS OF PARTICULAR INTEREST - PHYTOPHARMA, ECO-CONSTRUCTION AND BIO-BASED PACKAGING

Although Bio-based industry covers a very broad field, the findings from related studies reveal that there are some value chains with very high potential for this industry in the Danube Region, and for which some of the participating regions already belong to the European front-runners[15]. Indeed, the available assets of the Danube region allow for the identification of a bio-economy potential along three specific value-chains: **phytopharma, eco-construction and bio-based packaging.**

The potential of the **Phytopharmaceutical sector** in Danube is huge. The Phytopharmaceutical industry in the Danube Region employs more than 1.5 million workforces and provides 30 % of all sector-specific jobs in Europe[16]. Furthermore, almost half of all firms operating in this sector are based in the Danube Region (42.9 %), which demonstrates the strong role of the Region compared to Europe. Around 25.000 new jobs have been created by young, high growing companies (by so called Gazelles). Higher dynamics in terms of increased number of firms compared to all Europe can be found, whereas growth in term of employment and productivity was lower.

Table 1: Basic facts of Phytopharmaceutical industry in the Danube Region compared to Europe

	Danube Region		Europe	
	Level in 2014	Change since 2008	Level in 2014	Change since 2008
Employment	1,529,292	1.4 %	5,100,742	0.7%
Establishments	535,517	33.0%	1,249,705	16.2%
Average Wage (EUR)	20,197	-3.2%	30,787	2.9%
Gazelle Employment	24,676	1.7%	87,023	-0,2%

Source: Meier zu Köcker, Dermastia, 2018, Cluster Mapping Synthesis Report – PhytoPharma - DOI: 10.13140/RG.2.2.20871.09126

Natural conditions of the Danube enable the cultivation of high-quality medicinal and aromatic plants (MAP) for a use in several Phytopharmaceutical Value Chains (rosemary, lime, willow, velvet, chamomile, and many others). Markets in phytopharmaceutical and natural cosmetics are constantly evolving and expanding. The demand for natural products increases from year to year. Europe is the largest herbal product market worth USD 7.5 billion. Germany and France are the region's market leaders. In 2015, the German market alone had an annual volume of 4 billion EUR. In the European market, Germany's share is 50%. The supplier companies of herbal material stated that their main challenge is how to keep up with high demands from pharmaceutical industry. They are challenged to grow a wider variety of species as the options for wild harvesting decrease. They are also called upon to apply EU standards for physical chemical analyses to meet all required parameters and to engage more in organic production. New markets on the local and global level will likely be developed as the overall market increases on the global and local level.

Eco-construction is an emerging market in the construction industry. The analysis of this sector within the DanuBioValNet project has shown that interest in eco-construction products is expected to grow in the future. The Eco-Construction industry in the Danube Region[17] employs more than 1.2 million workforces and provides 26% of all related jobs in Europe. Furthermore, almost a quarter of all firms operating in this sector are based in the Danube Region (24%). More than 29,000 new jobs have been created by young, high growing companies (by so called Gazelles).

15) The studies from the DanuBioValNet project can be downloaded from the DanuBioValNet Library: http://www.interreg-danube.eu/approved-projects/danubiovalnet/outputs
16) Meier zu Köcker, Dermastia (2018), Cluster Mapping Synthesis Report – Phytopharma - , DOI:10.13140/RG.2.2.20871.09126
17) 63 Member Regions with data; no data available for Ukraine (4 NUTS-2-Regions) and Moldavia (1 NUTS-2-Region)

The companies from the wood processing industry cover the entire value chain of the eco-construction sector, from processing of round logs to end-market products. Further potential is notably arising from bio-based insulation materials. Companies active in this value chain have a strong local/regional orientation. Market trends in this sector point to the development of new technologies and innovation in wooden construction, with multi-story wooden buildings, eco-friendly insulation (straw, paper, hemp, cellulose, and wool), composite beam design and "smart eco-houses". Due to the increasing demand for housing, the ongoing urbanization demands fast construction methods with low emissions. The further use of renewable insulation and construction materials could have a positive impact on resource efficiency within a region. With the increase of new breakthrough technologies and production capabilities, costs of the eco-based composite materials and prefabricated structures will be reduced, thus making them more affordable to a wider range of customers.

The **Bio-based Packaging industry** in the Danube Region is one of the main markets for bio-based polymers. Within the Danube Region more than 450,000 employees have been working in the Biobased Packaging industry in 2014, this equals a share of approximately 27 % of all related jobs in Europe[18]. The share of respective firms in the Danube Region, compared to Europe as a whole, ranges at the same level (28 %). Thus, the Danube Region is well-positioned in terms of Biobased Packaging, however, it does not play an outstanding role like it does in the Phytopharmaceutical industry[19]. Nevertheless, above-average growth rates of nearly 10 % since 2008 regarding the number of operating firms in the Biobased Packaging sector indicate an increasing importance. Contrary to these developments, employment in the Danube Region is regressive (-4,6 %) and, moreover, average wages display lower growth rates in the Danube Region than in Europe.

A great majority of the companies within the Danube region are interested in cooperation to further develop the bio-based packaging sector. There is a huge and unexploited potential in the area of biodegradable compostable materials. Also, products that can be used in the agricultural sector have high market development opportunities. There are many national and multinational initiatives that further fuel the demand for new bio-based packaging material. Among others, compostability is a very appealing property when the packaging meets the end of its useful life. This is a key functional property for purposes of successfully reaching the goal of the Circular Economy. For the Danube region, potential markets for bio-based products include the packaging sector, disposables and consumables and, in general, articles with a short lifespan. Food packaging is among the sectors with the highest potential markets for such materials. Due to various environmental concerns, the use of biodegradable materials may contribute to the sustainability and the reduction of environmental impacts as well as to the greenhouse gas balances. Future perspectives of the bioplastic packaging also depend on solving the recycling issues dedicated to bioplastics in general. The biodegradable bioplastics cannot be recycled together with oil-based plastics because it would debase the quality of recycled material. So, the product cycle of the biodegradable bioplastic packaging (liquidation, recycling) is still significant issue. Improvement of the current recycling system of oil-based plastic products is still more eco-friendly than the current production of bioplastics. Now, the industries of greatest relevance to this sector are the food and pharmaceutical sectors. Stronger cooperation with food processing and manufacturing companies is a key to further development of advanced bio-based packaging materials. However, the pharmaceutical and phytopharma sectors are also interested in new packaging solutions.

18) Meier zu Köcker, Gerd; Sedlmayr, Benedikt and Neugebauer, Kim (2017): Cluster Mapping Synthesis Report on Bio-Packaging, http://www.interreg-danube.eu/approved-projects/danubiovalnet/outputs

19) Meier zu Köcker, Gerd., Dermastia, Mateja (2017), Cluster Mapping Synthesis Report – Phytopharmaceutical Sector, http://www.interreg-danube.eu/approved-projects/danubiovalnet/outputs

THE STRATEGY

PROBLEMS AND GAPS

Despite their biomass potential, Danube regions are lagging behind in industrial bio-based activities and their potential remains largely untapped. Challenges are identified at multiple levels. In general, a lack of coordination causes **existing biomass providers, processors and end markets to operate in a disjointed manner**. In addition, there is a **significant a gap in empirically derived statistics for the bioeconomy sector**, as well as a lack of knowledge on what sectors can become part of the bio-based industry under which circumstances. This starkly contradicts the impression derived from current policy statements that bioeconomy is high on the agenda. The absence of systematic and serious, holistic policy making is reflected by an evident mismatch between Smart Specialisation Strategies and concrete support measures in practice. In the following, the challenges and gaps identified within the DanuBioValNet project are briefly presented for the three identified value chains of interest for a bio-based economy in the Danube, phytopharma, eco-construction and bio-based packaging. It is the aim of this strategy document, to contribute to overcoming such challenges through a joint cluster policy. Therefore, a focus is subsequently put on the challenges identified at the policy level and on the interaction of S3 and clusters.

GAPS IN THE VALUE CHAINS

In the **phytopharma** value chain, added value services are the key missing link in several regions. This is partly due to the cost optimization but mainly due to absence of service in the region (i.e., absence of standards, equipment, and knowledge). Establishment of specialized services depends on the demand as well as on other economies of scale thresholds. However, value added is unevenly distributed across the Danube Value Chain. Regions with a significant production of Medical Aromatic Plants (MAPs) in general do not equal the production of countries with extraction companies and with big manufacturing companies. Most cultivators and producers see the potential in organic production and in broader cooperation with the pharmaceutical industry and other sectors. They see the opportunities in the development of new business models (sharing economy) and in new technologies (weather forecasting, virtual technologies, analytics, logistics). They also see huge potentials in bio based (herbal) pharmacy. Value chain mapping exercises reveal the same pattern. Baden-Württemberg has many firms positioned in the end-market side, with well-established global players. While several other regions covered whole value chain, their market penetration and access to Europe and global markets such as US and China are limited. Currently, the value chain has several non-contributing intermediaries. Minimizing the dependency on these intermediaries by developing new databases, networks and payment methods will help to ensure increased profits for both cultivators/collectors and sales. The development of new databases and knowledge networks is of critical importance for staying informed about the market tendencies and opportunities in phytopharmaceutical sector.

In the **eco-construction sector**, one of reported problems is that the clients do not focus on eco-construction products but are only interested in the certification and price. The „eco "-impact is not as important to them as the awareness campaigns are. Legislation unification throughout EU for eco-construction products is a priority interest. The technical standards for wood construction and the certificates are too demanding and are not valid across Europe. One of the identified gaps is also a poor implementation of the "green" strategies. A lack of a skilled workforce in the sector of eco-construction is mentioned as an obstacle. Intellectual property protection related to innovative idea is an issue for pioneering companies. For the companies that plan to expand internationally, the main gap seems to be the difficulties in access to the market.

The biggest challenge in **bio-based packaging** remains the development of new markets as well as the costs and performance of bio-based packaging materials. According to the respondents and participants in the DanuBioValNet project, there is much work to be done on the regional and EU policy level to push the bio-based plastics/packaging market forward. At the EU and national level, it is necessary to create better legal frameworks for the use and application of bioplastics. The public must be better informed about the use of bio-based plastic packaging material. Consumers must be made aware of the fact

that the right waste separation is essential for the successful biodegradability of the materials. Significant efforts must be made to raise awareness of the public regarding benefits of bio-based materials against raw materials considering public health and environmental impacts. Therefore, better recycling strategies in general and a better "End-Of-Life" infrastructure must be developed on a national and EU level. In addition, on the EU level, there should be a progressive ban on plastic packaging and better mechanisms in place for promotion of biodegradability and environmentally friendly plastics.

CROSS-REGIONAL BIO-BASED VALUE CHAINS: THE NEED FOR SYNCHRONIZED FUNDING

Alongside these specific challenges, a common problem is identified at the level of cross-regional cooperation. Even though some industry value chains in the Danube region have developed well in the past, the overall regional bio-economy is notably still in an emergent state because **cross-regional cooperation along bio-economy value chains is critically missing**. Critical mass is crucially missing to close the gaps, leading to fewer numbers of actors ready to invest in innovation or resulting in disconnected value chains. The findings reveal that there is a **funding gap for cross-regional cooperation within the Danube Macroregion**. There are many funding opportunities offered within the EU, but there is a lack of coordination hampering effective transnational cooperation. There is a critical need to streamline funding and synchronize funding schemes at macroregional, regional as well as EU level. This will motivate and engage actors to take more risks and to further develop policy instruments according to the real demands of the bio-based industry. This is especially important along the cross-regional value chains since they are cross sectorial by nature. In addition, there is a critical underrepresentation of actors from the Danube region in the Bio-based consortium / Bio-Based Industries Joint Undertaking (BBIJU) that disconnects Danube actors from the cutting-edge research, innovation and high-end value chains on the European level.

POLICY CHALLENGE: MAKING BETTER USE OF CLUSTER-BASED REGIONAL INNOVATION POLICIES

As outlined above, Smart Specialisation Strategies (S3) are in place in all participating regions of the DanuBioValNet project. Nevertheless, this potential remains largely untapped, as is revealed by a detailed analysis of the regional approaches conducive to implement S3 through clusters performed within the project[20]. By having a deeper look at the content of the individual S3 or related cluster-based regional innovation policies, of the Danube regions, it became clear that they, in most cases, are not aligned, neither with related policies and programmes on national level nor with neighbouring regions. The S3 **are very broad** and do not **identify concrete activities to transform existing regional capacities into bio-based value chains (transformative activities).**

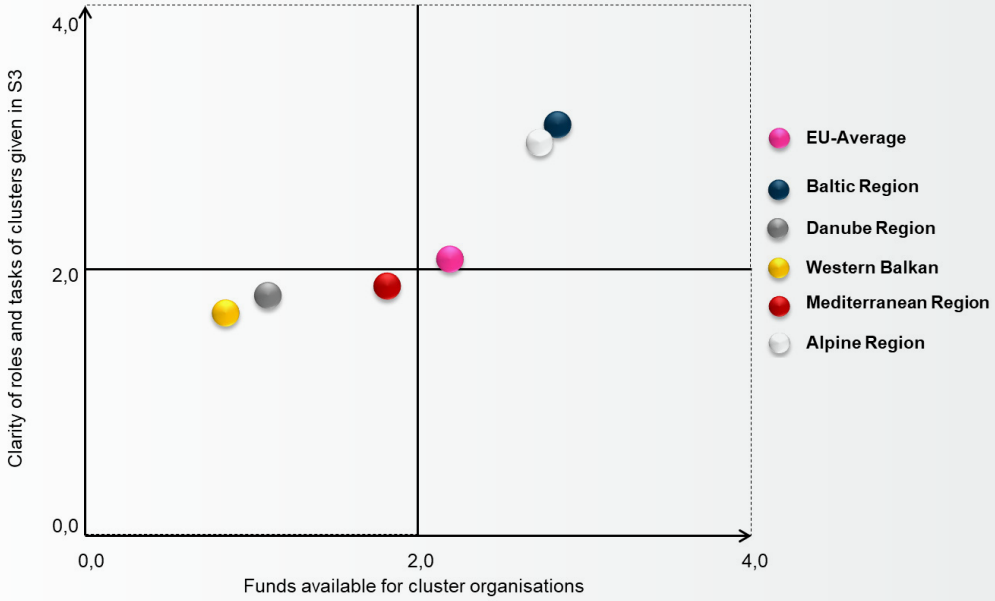
Intensity and kind of involvement of cluster initiatives in the development of S3 varies significantly between the studied regions of the Danube, depending on the capacities and professionalization of the cluster managements as well as of the regional policy approaches applied. Like the development phase, the involvement of the cluster initiatives in the implementation phase varied considerably. In some cases, they just contributed by providing content, in other cases they were in an exposed position and significantly contributed to the implementation of S3. In these cases, they were considered as "peer partners" for policy implementation. However, such cases are the exception. In general, it can be observed that **although cluster initiatives in the Danube region are high on the policy agenda and recognized as tools to implement S3, the readiness on policy level to invest in them is found to be comparably low.** Weak or unstable public support schemes (and entire cluster policies) hamper the capabilities of cluster initiatives to follow the role given in the respective S3 as well as to deliver the requested support measures for the public and private sector. Therefore, cluster initiatives in the Danube region tend to be smaller in terms of cluster actors, under critical in terms of full-time equivalent of the cluster management as well as low in terms of overall capabilities.

20) Meier zu Köcker G. (2018). Regional Approaches Conducive to Implement S3 through Clusters- DanuBioValNet.

These findings raise concerns to what extent the cluster approach is fully understood and seriously turned into practice in the Danube region, since 75 % of the cluster initiatives are under-funded and lack financial stability. Additional interviews with cluster managers confirmed that due to this situation too much attention is given to assure financial stability in day-to-day business, and European projects are more considered as a very welcome financial source and less as a support scheme to internationalise.

When comparing the Danube region with other macro regions, it becomes clear that others, like the Baltic or the Alpine Region, are well ahead in systematically making use of clusters as a tool for regional development. As far as the S3 implementation approach through cluster initiatives is concerned the Danube region, in this regard, is clearly lacking behind other macro regions. Figure 5 compares the funding situation of cluster initiatives as well as role of them given in S3 between different macro regions. The commitment, incl. funding, that cluster initiatives are important tool for regional development, including S3 development and implementation is much higher in the Baltic as well as in the Alpine Region compared to the Danube region.

Figure 1: Impact of S3 on cluster organisations



Source: Meier zu Köcker G. (2018). Regional Approaches Conducive to Implement S3 through Clusters- DanuBioValNet.

VISION AND OBJECTIVES

The present strategy document aims at using a macro-regional, cluster-based, policy approach as a key lever to contribute to the realization of a common bio-economy vision for the Danube region.

To transform the Danube region into a front-runner in the bioeconomy by supporting "bioeconomic distributed manufacturing environments" to achieve manufacturing scenarios that use locally available renewable raw and residual materials for conversion into locally required materials and use of existing regional potentials.

The JBCS aims at the following strategic objectives:

1) To turn the approach of Bioeconomic Distributed Manufacturing Environments (BDME) into industrial practice;
2) To create strong bioeconomy players in the region;
3) To further bioeconomise key industrial sectors of Danube Region;
4) To develop an efficient and effective bioeconomy support system that stimulates biobased innovation and competitive advantages for actors engaged.

In a context of finite fossil fuels, the bio-economy represents a much-needed alternative. In the words of the German Bioeconomy Council, *"the bio-economy is understood as "the production and utilization of biological resources (including knowledge) to provide products, processes and services in all sectors of trade and industry within the framework of a sustainable economy"*. Prof. Dr. Ralf Kindervater, CEO BIOPRO Baden-Württemberg GmbH (lead partner of DanuBioValNet) summarizes the objective of a bio-based economy as follows:

"The aim of the bio-based economy is to make the carbon stored in renewable resources accessible for industrial value-added chains. It implies, on the one hand, using food and feed plants for the sustainable production of food and feed products, and, on the other hand, application of specific technologies (e.g. biogas plants, biorefineries, gasification and other conversion methods) for converting plants, residual biomass and biowaste into ethanol, methane, phenols, biopolymers, pharmaceuticals and many other products to be used in industrial applications. The bioeconomy takes limited resources such as arable land and water into consideration and is strictly focused on sustainability, resource efficiency and material and waste cycles. The burden on individual resources is therefore considerably lower than in fossil-based economies. Furthermore, technologies associated with the bioeconomy open up additional development potentials for rural areas. This applies to countries that have large areas available for agriculture and forestry. By opening such new opportunities, bioeconomy-based technologies can enable progress." The JBCS and its strategic objectives aims exactly follow this idea and shall paves the way to turn Danube region into a bio-based economy. It puts dedicated attention to a better and more aligned use of cluster-based regional innovation strategies.

IMPLEMENTATION - WHO AND WHAT?

The Joint Bio-Based Industry Cluster Policy Strategy **focuses on regional strengths and macro-regional assets.** It is intended as a framework to pave the way for **clusters** in the Danube region to become the key lever of the regional bio-economy. The DanuBioValNet project identified three value chains, for which the region has specific advantages and belongs, partly, already to the European front-runners. It is therefore justified, to prioritize actions and actors related to **phytopharma, eco-construction, and bio-based packaging.** As noted above, regional strengths also particularly rely on **SMEs**. It is therefore crucial to involve these actors at all stages of the strategic recommendations. Since the objective is to promote a **joint cluster strategy**, the recommendations are formulated in broad strategic terms and limited to **six Focus Areas,** for which a **joint macroregional alignment** seems within the realms of possibility. In addition, it should be noted that, given the interdisciplinary nature of bio-economy, the recommendations target a variety of policy responsibilities to be taken up and further developed by **multiple ministries** in individual Danube countries. Regions are therefore encouraged to **clarify and streamline responsibilities** within their individual institutions.

The main stakeholders of the strategy are **clusters and cluster initiatives, Academia** (research and educational institutions), **Policy** (Ministries, State Agencies, etc.), **SMEs** (biomass producers, production companies, R&D companies) and **large companies.**

FOCUS AREAS

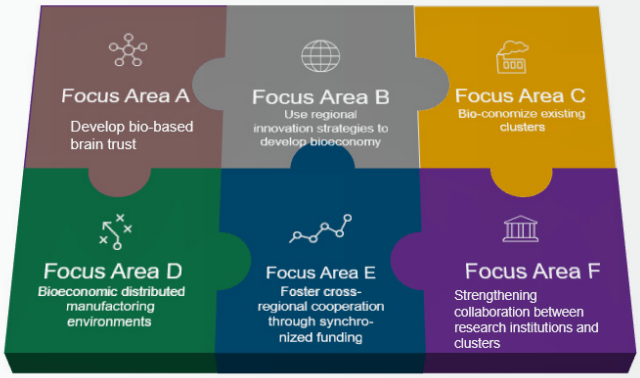
Drawing on the existing assets and identified challenges, strategic Focus Areas where policy actions are needed to be undertaken. The Focus Areas are presented according to the following structure: In order to fully make use of the existing assets and to address the specific challenges, the bio-economy potential and clusters need to be understood in their beneficial interplay. Existing clusters need to turn their strengths into assets for the bio-economy. A set of propositions are given, ranging from general policy issues, to aspects of specific importance for the identified key value chains to promote bio-economization of clusters. On the other hand, clusters need to be turned into the key actors for the implementation of regional and macro-regional innovation policies of relevance for the bio-economy. Propositions are made to provide framework conditions under which clusters really can take over this role as key instrument to turn regional innovation policies into practice.

Both levels of this strategic approach (bio-economization of clusters and cluster-based regional development) crucially depend on two additional, transversal, levers: First, it is crucial to strengthen the need-based collaboration between research

institutions and clusters as well as among clusters. Second, cluster-based regional innovation strategies are the ideal policy framework to support the strategy. It is crucial that regional strategies address the potential represented by bio-based industries in a way that can be operationalized. This directly supports the effort to bio-economize existing clusters on the one hand, and helps to clarify the role clusters need to take over in the implementation of these regional innovation policies on the other. Third, both levels of the strategic approach are crucially dependent on need-based cross-regional cooperation between clusters in order to assure critical mass of innovation actors and to bridge existing gaps within the emerging value chains of bioeconomy. It is therefore suggested to synchronize funding schemes for the development of specific transformative activities of relevance for the bio-based economy of the Danube region. Finally, business intelligence on the bio-economy needs to be developed into bio-based brain trust. Figure 6 represents the strategic approach. In a nutshell, the strategy includes the following six Focus Areas:

- Focus Area A: Develop Bio-based brain trust
- Focus Area B: Use regional innovation strategies to develop Bio-Economy by using Clusters as Tool for Regional Bioeconomy Development
- Focus Area C: "Bio-Economize" Existing Clusters
- Focus Area D: Bioeconomic distributed manufacturing environments
- Focus Area E: Foster Cross-Regional Cluster Cooperation through Synchronized Funding
- Focus Area F: Strengthen the collaboration between research institutions and clusters

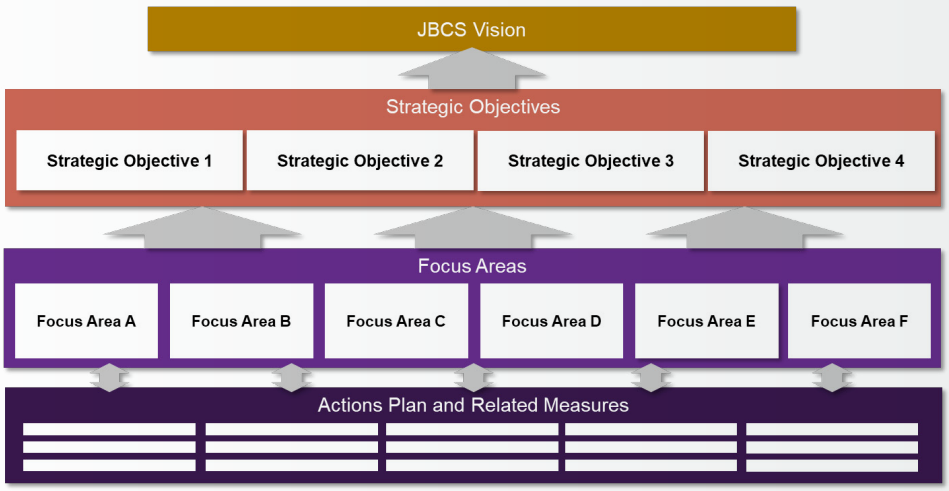
Figure 2: Joint Bio-based Industry Cluster Policy Strategy – The Focus Areas



Source: Authors' elaboration.

Activities implemented in the different Focus Areas shall finally contribute to meet the strategic objectives defined in the previous chapter (Figure 7).

Figure 3: Joint Bio-based Industry Cluster Policy Strategy – The interplay between Vision – Strategic Objectives and Focus Areas



Source: Authors' elaboration.

FOCUS AREA A: DEVELOP BIO-BASED BRAIN TRUST

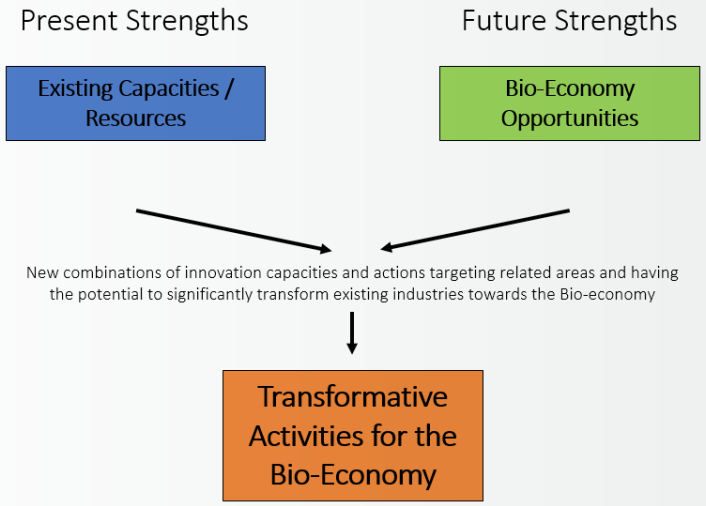
To help identify activities that push the knowledge frontier and empower existing clusters in their shift towards bio-economy opportunities it is critically important to stay informed about market tendencies as well as to gain better understanding of the socio-economic and environmental impacts. The targeted bio-based business intelligence trust should serve as the motivation and information point for the bioeconomy development, demonstrate business opportunities, develop a "brain trust" as a network and provide the observatory tool for Biobased economy. The **actors of the quadruple helix should be involved in a joint macroregional brain trust to set up an ongoing bio-economy dialogue across the relevant value chains including topics such as the respective technological trends, areas and applications, market developments and socio-economic factors including legal considerations or human resources.**

FOCUS AREA B: USE REGIONAL INNOVATION STRATEGIES AS A FRAMEWORK TO DEVELOP BIO-ECONOMY AND CLUSTERS AS A TOOL

As a common policy framework, available in all regions of the Danube, regional innovation strategies, like S3, offers an innovative approach to improve innovation and value chain development in the Danube region in fields related to the bio-economy. **In order to do so future regional innovation strategies must** address bio-economy potentials in a more concrete way than by focusing on mere priority areas. What is needed, is to define regional strategies, including concrete activities, that contribute to transform existing capacities into assets for the bio-economy.

For the three under DanuBioValNet identified value chains of interest for the bio-economy in the Danube regions, the following indicative overview can be given. Transformative activities for the phytopharma value chain are expected to arise the food industry, the pharmaceutical industry and cosmetics, with a wide range of possible products and a focus on activities concerned with "branding" for phytopharma cluster excellence, quality management, and certification and standardization of value-added activities and related conditions. In eco-construction, potential transformative activities are related to the development of new technologies and innovation in wooden construction, with multi-storey wooden buildings, eco-friendly insulations (straw, paper, hemp, cellulose, and wool), composite beam design, smart eco-houses, or 3D printing in cooperation with a broad set of economic sectors. Finally, for the bio-based packaging value chain transformative activities are expected to arise in relation to the food and pharmaceutical sectors and especially through stronger cooperation with food processing and manufacturing companies in the development of advanced bio-based packaging materials. Identifying transformative activities for the bio-economy is a crucial step in the effort to formulate a tailor-made bio-economy strategy based, as outlined in the subsequent recommendations below. Concrete transformative activities (s. Figure 8) will orient the policymakers on how to bio-economize existing clusters (Focus Area C below).

Figure 4: Transformative Activities for the Bio-Economy



Source: Authors' elaboration based on Keller et al. (2018).

Clusters need to take a stronger role as key drivers for the implementation of regional and macro-regional innovation policies of relevance for the bio-economy. Since cluster development is high on the policy agenda since a long time, it now is important that they are used as policy tool in practice. They can take overactive roles in relevant cluster-based regional innovation policies, i.e. the identification and development of transformative activities for the bio-economy.

To do so, clusters need to be organised into cluster initiatives, coordinated by cluster organisation with the appropriate financial support (mixture of public-private-partnership) to drive regional innovation strategies and implementation of trends in the field of bio-economy. Cluster initiatives must develop a stronger consciousness for this role and exercise it more proactively.

Future discussions about cluster policy in the Danube region must therefore focus on the question how the Danube region can follow a more systematic cluster approach and make more targeted use of cluster initiatives as tool for regional development and of related strategy implementation. The findings of DanuBioValNet reveal that, in general, there is no lack in terms of numbers of cluster initiatives and other intermediaries to serve as platforms to further develop the regional bio-economy. However, these entities are often not well embedded within the regional innovation system nor in policy development and implementation approaches. Neither are they actively supported by current policy making. This leads to the existence of critically under-staffed cluster organisations and similar entities shifting their focus towards new funding resources rather than operating according to regional bio-economy objectives.

The Bio-based Industry Cluster Policy Strategy therefore invites the partner regions to streamline their portfolio of cluster initiatives and entities dedicated to support the bio-based economy in the Danube region and to make more active use of cluster initiatives. The Danube regions shall set up regional innovation management structures that involve cluster initiatives for the purpose of instituting consistent innovation in the bio-economy with sustainable cooperation and networking structures, through the existing S3 framework. The Danube regions shall clarify role, tasks, coordination activities and monitoring of cluster initiatives in upcoming regional strategies and related policies On the other turn, cluster management must operate in a more professional manner to help them fulfil new tasks and challenges related to their function as regional innovation intermediaries for the bio-economy.

FOCUS AREA C: "BIO-ECONOMIZE" EXISTING CLUSTERS

The transformation of existing clusters needs to be stimulated through tailored, market-driven policy measures addressing the challenges identified for the specific value chains. For the three value chains, identified under the DanuBioValNet Initiative, in phytopharma, eco-construction and bio-based packaging, recommendations are provided in specific roadmaps[21]. Furthermore, future policies to bio-economize existing clusters can draw on the experience from the pilot actions taken during the DanuBioValNet project[9].

Policy considerations and options can be framed in both active and passive terms. This includes actions to be taken and conditions to be maintained and can involve policy options such as incentive packages, regulatory provisions, matchmaking venues or workforce training programs. Cluster mapping and value chains mapping within the DanuBioValNet project reveal that existing cluster initiatives do only rarely include biomass feedstock providers and that activities are not interlinked with industrial production value chains. It is therefore recommended to further promote bio-based value chains through the integration of biomass feedstock producers in traditional, existing, clusters rather than by establishment of specific bioeconomy / bio-based clusters. This can be facilitated through networking between existing clusters (e.g. IT, automotive, packaging, construction etc.) and bio-based actors, both at the regional and cross-regional level in the Danube region (e.g. trainings for cluster managers or Meet & Match events). Incentives should push start-ups and SMEs within clusters to investigate bio-based options, since they tend to be creators of critical ideas and innovations. In addition, bio-based cluster actors should be incentivised to use local raw materials and apply local manufacturing approaches.

To address the specific gaps in the phytopharma, eco-construction and bio-based packaging value chains, the DanuBioValNet project provides recommendations in specific roadmaps, partly implemented through pilot actions within the project duration. A short overview is given in the appendix of this strategy document. As a general guideline, it can be noted that interventions must continue to be market driven and must conform to the particular stage of development of the target value-chain.

FOCUS AREA D: BIO-ECONOMIC DISTRIBUTED MANUFACTURING ENVIRONMENTS

The Future of the Bioeconomy should adapt new models (that suit for your region) like creation of "bioeconomic distributed manufacturing environments", interlinking various business sectors into value added networks and to create social-economic sustainability. The action-oriented approach facilitates an extensive involvement of stakeholders and actors and stirs interest and commitment. New industrial bio-based activities are initiated and high potentials (such as phytopharma, bio packaging) are expanding[22]. Demand responsive value networks (bioeconomic distributed manufacturing environments – BDME) that emerge, consist of local biomass, informed by both, demand (e.g., high-end markets) and by local feedstock supply (e.g., medicinal plants). Existing clusters shall turn their strengths into assets for the bio-economy to create bio-economic distributed manufacturing environments using locally available renewable raw and residual materials for conversion into locally required materials.

21) Roadmaps and documentation of pilot actions are available in the DanuBioValNet Library: http://www.interreg-danube.eu/approved-projects/danubiovalnet/outputs

22) Dermastia, M., Osvald, D., Patzelt, D., 2018, Towards a Systematic Bio-based Industry Approach for the Danube Region, DanuBioValNet

FOCUS AREA E: FOSTER CROSS-REGIONAL CLUSTER COOPERATION THROUGH SYNCHRONIZED FUNDING

To effectively support the development of bio-based industries through clusters and the bio-economisation of existing industries in the Danube Region, regional competences and capacities, in terms of actors, but also in terms of investments, need to be bundled in order to gain critical mass. No region can succeed alone in this regard. **The Danube Regions shall therefore synchronize funding for the development of specific transformative activities of relevance for the bio-based economy in order to promote need-based cross-regional cooperation between clusters. With the Bio-Based Innovation Express (BIIE)**, the DanuBioValNet provides a proposal for such a cross-regional scheme to support cluster and SME development along selected value chains in the bio-based economy.[23]

FOCUS AREA F: STRENGTHEN THE COLLABORATION BETWEEN RESEARCH INSTITUTIONS AND CLUSTERS

Clusters are the operational pillars of all the following Focus Areas (B-F). In order to best equip them with the necessary capacities on their road to bio-economization and to taking over the role as key implementation actors of bio-economy policies, their collaboration with research institutions needs to be strengthened. Clusters are the ideal platform for knowledge bridges engaging all actors of the quadruple helix (research, firms, government and customers). Increased collaboration between clusters and research institutions notably facilitates the networking opportunities between researchers, SMEs and larger firms, as well as the transfer of technology and knowledge. This must be embedded in appropriate support schemes encouraging actors from academia and industry to go the risky way toward bioeconomy-based innovations.

For all the following Focus Areas, the promotion of innovation from theory to practice, from research to market, is a key enabling capacity. Strengthened collaboration with research institutions sets the basis for clusters to ensure new knowledge and innovation in the field of bio-based economy can be quickly and efficiently shared and utilized. TO succeed on a long run cluster actor can agree in a dedicated innovation strategy, which shall pave the way towards the bioeconomisation of the entire cluster. This allows for collective dissemination of knowledge to the clusters' member firms, providing early access to innovation and research infrastructure, as well as promoting the involvement of SMEs in collaborative research projects. It is also advisable to engage cluster actors in increased and targeted interaction with available regional, national or macroregional funding instruments for research, development and innovation.

The DanuBioValNet project provides a proposal for an open space innovation arena (OSIA), which could be used as a platform to further develop initiatives to strengthen the collaboration between research institutions and clusters[24].

23) The proposal is available in the DanuBioValNet Library: http://www.interreg-danube.eu/approved-projects/danubiovalnet/outputs.
24) The proposal for an open space innovation arena (OSIA) is available in the DanuBioValNet Library: http://www.interreg-danube.eu/approved-projects/danubiovalnet/outputs.

MONITORING AND IMPLEMENTATION INDICATORS

The JBCS defines basic framework conditions the delineate objectives and priorities to meet the strategic goals. Consequent monitoring and evaluation mechanisms must be performed serving two fundamental functions:

- to inform about what the strategy achieved and whether implementation is on track and making this information available to decision makers;
- to support the constructive involvement and participation of stakeholders through transparent communication and promote trust building. The monitoring mechanism should be able to capture and follow the relevant expected changes that are foreseen in each of the Thematic Pillars by means of an appropriate choice of outcome/ result and context indicators.

The monitoring and evaluation approach will play an important role to track the implementation of the JBCS. On the one hand, it will encourage regular communication among actors concerned. On the other hand, it will provide stakeholders with data about results of planned public interventions. That will contribute to systemic learning and continuous improvement of related policies and programs as well as trust building. The monitoring system should therefore allow, through the monitoring of selected output indicators, their assessment against the targets and change the policy approach in case of failure.