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D4.2 - Opportunities for local value chains

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FINAL

13/05/2024





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DOCUMENT CONTROL SHEET

Deliverable name and number	D4.2 - Opportunities for local value chains
Deliverable version	1.1
WP number / name	WP4 – New and updated network-oriented business models, governance and local capacity building
Number of pages	53
Delivery due date	M18
Actual date of submission	
Dissemination level	Public
Lead beneficiary	RINA-C
Main Author	RINA-C
Contributors	All partners

DISSEMINATION AND UPTAKE: Public

VERSIONS AND HISTORY OF CHANGES

Version	Due date	Author/Editor	Contributors	Description
V1.0	12/03/2024	RINA-C	All partners	First draft of D4.2
V1.1	13/05/2024	RINA-C	All partners	Second version of D4.2

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Executive summary

The present deliverable **D4.2 “Opportunities for local value chains”** has been developed in the framework of **WP4** activities related to **“New and updated network-oriented business models, governance and local capacity building”** and it is the outcome of **T4.2 “Matchmaking and creation of opportunities for local value chains”**.

The aim of the work carried out in this document is to create a list of possible opportunities for each participating region, also considering the local strategies and ongoing initiatives.

In **D4.1 “Analysis of local context”** the biobased value chains in each region participating in the BIOLOC project was analysed. Consequently, this analysis was used as the basis for the work carried out in this document. In particular, the information in D4.1 was useful in identifying the main strengths and weaknesses of the biobased value chains and helped to identify the main opportunities arising from these sectors. The analysis focused on identifying sectors and products with particular characteristics and which consequently may represent an opportunity for the development of the bio-based value chain. In order to achieve this objective, sectors with particular relevance in the analysed regions and those for which rapid growth is expected in the coming years were specifically analysed.

Chapter 3 is the main part of the document, where the opportunities identified for each analysed area have been reported. This chapter is divided into different paragraphs, one for each region. In each of them, there is a brief description of the main characteristics of the analysed area and a table in which the key information for the opportunity and the description of the opportunity itself are reported. The aim of the tables is to provide the reader with a quick reading tool that can provide an overview of the selected opportunity. It should be noted that the information analysed is first described in a broader form in the first description and then summarised in the tables.

The opportunities deemed most interesting will be used in **T4.3 “Definition of network business models for regional clusters”** to define the business models.



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1. Introduction

The aim of BIOLOC is to advance the role and impact of Circular Bioeconomy (CBE) and social innovation to revitalise European local communities and accelerate the all-inclusive transition to resource-efficient and circular biobased production and consumption systems. BIOLOC project will inspire and support the communities of participating European regions to unlock and propel local development potentials by fostering sustainable, innovative, tangible, and participatory pathways to green transition through grassroots inclusive CBE nexuses.

The objective of this document is to provide a list of possible opportunities in the bio-based value chain for each region involved in the BIOLOC project. In order to create this list, the bio-based value chain analyses in D4.1 were mainly used. For each analysed region, the sectors considered particularly relevant and for which certain key characteristics for the creation of opportunities are present were identified. Specifically, sectors and individual products were analysed which through their size and market volumes are deemed already 'mature' for the development of the bio-based value chain, and those which meet particular needs and possess certain characteristics that allow for rapid development in the coming years.

The major opportunities regarding the bio-based value chain have been identified in the following regions:

- Spain – ***region of Aragon***
- Greece – ***region of Western Macedonia***
- Bulgaria – ***region of Plovdiv***
- Slovakia – ***the Nitra Self-Governing Region***
- Slovenia – ***whole country***
- Croatia – ***region Adriatic Croatia***
- Hungary – ***region North-Hungary***
- Romania – ***West region***
- Czechia – ***Moravian-Silesian region***
- Netherlands – ***region Apeldoorn***
- Germany – ***region Baden-Württemberg (Ba-Wu)***
- Italy – ***region Campania***



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2. Methodology

In this document, as opportunities, a select number of sectors and within them, where possible, specific solutions that are part of the bio-based value chain have been chosen. Specifically, we selected sectors and single bio solutions that seem to have on the basis of the analysed data, the best characteristics for further dissemination in the coming years.

In most cases, the sectors chosen are those within the analysed country/region that have a significant amount of resources that can be utilised for the development of the biological value chain. In other cases, however, bio solutions that could solve a certain 'need' within a given sector and therefore represent an opportunity for the area have been reported.

The sectors and single solutions were chosen using three main inputs as a basis: the value chain analysis described in D4.1, the questionnaires shared within the project with local partners and a list of new sources. Specifically, D4.1 was used as a basis for mapping the characteristics of each sector and consequently which of them present the best features for future development of the organic value chain. For instance, the resources currently present in each region, the presence of an established organic value chain and the need to develop organic solutions were taken as reference. The information shared by the local partners was very useful for this analysis, as for some regions it was more difficult to assess which sectors have the best characteristics for the development of the organic chain, due to the presence of documentation only in the original language. In this sense, the local partners provided us with a lot of data in English that was useful for the analysis. Furthermore, all considerations and analyses were facilitated by the work already done in other BIOLOC project documents, such as **D2.2 “Report on the Regional biobased systems cases description”** and **D2.3 “Report on the assessment of local needs, conditions, opportunities”**.



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3. List of possible opportunities for participating regions

3.1 Spain – region of Aragon

The information analysed in this chapter has been collected directly from the local partners involved in the BIOLOC project.

Sustainable agriculture

At the national level, Aragon excelled in increasing the area dedicated to organic farming by 47.5% in 2021. The national average, in fact, is much lower, at about 14.8%.

Aragon's agri-food sector is the fifth most competitive in the country, with a gross value added of 4 396 million euros in 2021, 12.9% of its total¹.

In the region of Aragon, the 47% of the arable land is occupied by cereals, almost all of it barley and wheat, with a certain predominance of the former. In addition to the normal crops, in this region there are products famous for their quality, such as cherry trees from the Jalón Valley and peaches from Lower Aragon. Another important crop is fodder crops, mostly irrigated, with leguminous plants standing out in terms of surface area. Vineyards account for barely 3% of the total cultivated area. Agriculture in this region is also supported at the national level; in fact, farmers may receive different types of subsidies such as the Common Agricultural Policy, the Rural Development Program etc.

The agricultural sector obviously has a very important effect on food production, which in the region of Aragon is traditionally based on the model of family farming. However, this business model is no longer sustainable, as globalization and the growing need for new investments to improve technological development and digitalization create disadvantages for this type of company. This type of company now has an increasingly small weight in the sector due to the very high-income gap compared to large companies and the impossibility of exploiting economies of scale. A solution quite widely used is to create cooperatives formed by family businesses. These cooperatives help to increase competitiveness. Local and regional cooperatives in turn belong to national cooperative associations that are linked to European associations representing them.

Table 1: #1 Opportunity - Spain Region of Aragon – Agriculture

Spain – region of Aragon	
Sector	Agriculture
Opportunity	The size of arable land and the presence of crops famous for their quality can create opportunities in the agricultural sector.
Description	Aragon has a strong agricultural sector. In this region, there are several possibilities to develop new technologies for sustainable agriculture, such as precision farming and agroforestry.

¹ <https://www.elperiodicodearagon.com/aragon/2022/11/30/sector-agroalimentario-aragon-crece-superficie-79338618.html>



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Agri-food industry

The agri-food industry supports more than 11,000 jobs in Aragon and accounts for 10% of the region's GDP. In Aragon there are 1,027 companies active in this sector. The main products made in the agri-food sector of Aragon are meat, milk, hides, derivatives of these products such as cheese, butter, cream and the manufacture of utensils using the skins of animals such as sheep, goats, pigs, bulls and cows. In the region of Aragon subsidies are granted to companies producing organic products.

Table 2: #2 Opportunity - Spain Region of Aragon – Agri-food

Spain – region of Aragon	
Sector	Agri-food
Opportunity	In the agri-food sector there are several opportunities related to the bio-economy because this is one of the main sectors of the region, with a large number of active companies.
Description	The agri-food sector represents about 10% of the GDP of the region of Aragon. The products where it is foreseeable there are the greatest opportunities given the presence of an already consolidated value chain are: meat, milk, skins, derivatives of these products such as cheese, butter, cream and the manufacture of utensils using the skins of animals such as sheep, goats, pigs, bulls and cows.

Biomass

The forest area in Aragon occupies 2,608,312 hectares, which represents 54.7% of the total regional area, and has been increasing over the last years. More than two thirds of Aragon municipalities are rural forest municipalities. Public subsidies are also provided for the forestry sector. An important development opportunity in this sector comes from the exploitation of biomass. In Spain, the potential biomass resources calculated in the Renewable Energy Plan (PER) are around 19,000 ktoe, of which more than 13,000 ktoe correspond to residual biomass and almost 6,000 ktoe to energy crops. Biomass energy (bioenergy) can be generated both in the domestic environment, by means of a boiler, and on a large scale in an industrial building. Existing forest biomass in the natural environment is an excellent source of energy for biomass boilers. The most common solid biofuel obtained from forest biomass is wood chips.



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Table 3: #3 Opportunity - Spain Region of Aragon – Forestry

Spain – region of Aragon	
Sector	Forestry
Opportunity	The large forest area in the region of Aragon may represent an opportunity in this sector. Specifically, the use of forest biomass as an energy resource are one of the main opportunities in the sector.
Description	The use of biomass from forests as an energy resource is one of the main uses of this sector. Forest biomass is used as an energy source for biomass boilers. The capacity of forest harvests that can be used for biomass, coming from the forests of Aragon, amounts to about 600,000 tonnes per year. More generally, as regards Spain, the potential biomass resources calculated in the Renewable Energy Plan (PER) are around 19,000 ktoe, of which more than 13,000 ktoe correspond to residual biomass and almost 6,000 ktoe to energy crops.

Renewable energy

In the region of Aragon, the main source of renewable energy is wind, while the main fossil source is natural gas. The production of renewable energy is increasing sharply, this is due to public subsidies and the commitment at the national and regional level to decrease the dependency of fossil fuels. In 2022, about 75.2 % of Aragon's electricity production derived from renewable sources. According to this data, the region of Aragon is second in Spanish green energy production. The Aragon region reached that level by increasing solar energy production by 47.9 percent over the previous year. Photovoltaic energy with a 14 percent share has become the third largest technology in the region's energy mix. Wind energy currently has the highest value reaching a share of about 46.2 percent. Aragon with 5,028 MW is the second largest region in Spain in terms of installed wind power capacity².

The forest area in Aragon is 2,608,312 hectares, which represents 54.7% of the total regional area, and it is increasing. The main uses of forestry biomass are as an energy resource, in fact existing forest biomass in the natural environment is an excellent source of energy for biomass boilers. The most common solid biofuel obtained from forest biomass is wood chips. In Spain, the potential biomass resources calculated in the Renewable Energy Plan (PER) are around 19,000 ktoe, of which more than 13 000 ktoe correspond to residual biomass and almost 6,000 ktoe to energy crops. The capacity of forestry harvests that can be used for biomass, originating in the forests of the Autonomous Community of Aragon, amounts to some 600 000 tonnes per year.

² Red Eléctrica, https://www.ree.es/sites/default/files/07_SALA_PRENSA/Documentos/2023/NP_Aragon_ENG.pdf



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Table 4: #4 Opportunity - Spain Region of Aragon – Energy

Spain – region of Aragon	
Sector	Energy
Opportunity	In the energy sector, the share of energy produced from renewable sources, in particular biomass, is expected to increase in the coming years.
Description	Aragón is the region with the third greatest potential for production of this fuel, generated by fermenting organic matter ³ . Opportunities in this area arise from the possibility of increasing the production of bioenergy from both solid biomass and waste and the production of biofuels (e.g. biodiesel) and biogas.

Social economy

Another very important sector for the development of the region is the social economy. This sector, in fact, is very active in the area and allows people in difficulty to overcome social and economic barriers, through the creation of fair and inclusive employment. The social economy is based on the values of reciprocity, solidarity and social justice and enables the inclusion of marginalised groups in society with the aim of the fair distribution of wealth. Organizations and companies active in this sector have different sizes and operate in different sectors, such as the industrial sector, healthcare, agriculture, the energy sector, etc. Entities active in this sector generally carry out socio-economic activities and are formed by collaboration between public and private bodies in the form of non-profit associations. Cooperatives have the largest number of employees, followed by foundations and associations. About 3% of Aragonese cooperatives are active in the third sector, for trade and hospitality, mining and manufacturing, agriculture, livestock, hunting, forestry and fishing⁴.

Table 5: #5 Opportunity - Spain Region of Aragon – Social economy

Spain – region of Aragon	
Sector	Social economy
Opportunity	In the region of Aragon there are many institutions active in the social economy. This sector represents a great opportunity for the development of the bioeconomy.
Description	The social economic sector is important to the economy of the region of Aragon given the large number of entities present. Social economy generates 20,000 jobs with 5,000 organizations/entities active and represents 6% of GDP in the region of Aragon. The development of the social economy in this region is also helped by the policies introduced in recent years. In this region, in fact, a regulatory framework has been introduced (the law on the social economy of Aragon) and the Aragonese Plan for the promotion of the social economy 2022-2025 has also been created.

³ <https://www.fundacionnaturgy.org/en/the-region-of-aragon-could-potentially-replace-44-of-its-total-natural-gas-consumption-with-natural-gas/>

⁴ 51. PLAN ARAGONÉS DE IMPULSO A LA ECONOMÍA SOCIAL 2022-2025– available at https://transparencia.aragon.es/sites/default/files/documents/plan_aragones_impulso_economia_social_2022_2025.pdf.



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Pork production

With 34 million animals produced every year, Spain leads the sector of pig production in the European Union and is the third largest producer in the world. Within Spanish territory, the Aragon region plays a fundamental role in the production of pork. Over the last decade, more and more Spanish pork producers have chosen this region to build mega farms. In 2017, Aragon surpassed Catalonia in terms of the number of animals, reaching around 10 million animals and 4,577 farms in 2022. The meat complex accounts for between 6% and 7% of Aragon's GDP and total employment⁵.

Thanks to public support, through subsidies and appropriate regulations, several companies active in the Spanish pork sector are interested in developing their production in these vast sparsely populated areas of the territory. For example, the government of Aragon, the Ministry of Agriculture and the European Fund EAFRD supported the project through a grant to the Vall Companys company which invested 25 million to open a feed factory in the city of Ejea de los Caballeros⁶.

Table 6: #6 Opportunity - Spain Region of Aragon – Pork production

Spain – region of Aragon	
Sector	Pork production
Opportunity	It could be an opportunity to develop bio-based value chains by boosting the valorisation of slurry.
Description	Currently, pig production plays a very important role in the economy of the Aragon region. The meat sector accounts for about 6% to 7% of the region's GDP. Several major players in the sector have decided to localize their productions in this region, allowing the Aragon region to become the national leader in this sector. A very important factor for the development of this sector is the public aid granted to companies that decide to locate their plants in sparsely populated areas.

3.2 Greece – region of Western Macedonia (WM)

Western Macedonia has a unique status as Greece's only land-locked region, covering 9,451 km² with a population of 271,500. Despite its role in energy production, the region faces economic challenges due to reliance on coal mining and lignite-fired power generation, contributing over 34% to the regional GDP. The decline in GDP per capita, exacerbated by the country's financial crisis, underscores the need for economic diversification. The Regional Government aims to transition the economy away from coal, focusing on attracting investments, re-skilling workers, and developing renewable energy sources. Plans include decommissioning coal-fired power plants by 2028, with stakeholder engagement being crucial for a just transition. Various programs like Territorial Just Transition Plan for Western Macedonia, the Program “Western Macedonia” 2021 – 2027 Special Transition Program and the Just Transition Development

⁵ Aragon, on the rise in meat exports, with destinations such as China, Italy and Japan, April 22, 2023. Link: <https://www.goaragon.eu/aragon-on-the-rise-in-meat-exports-with-destinations-such-as-china-italy-and-japan/>

⁶ Aragón, land of world-class pork megaproducers, Datadista, July 24, 2022. Link: <https://especiales.datadista.com/medioambiente/contaminacion-agua-macrogranjas/aragon-macrogranjas/eng/#:~:text=Since%20overtaking%20Catalonia%20in%202017,or%20more%20than%20400%20mother s.>



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Programme (JTDP) 2021-2027 aim to mitigate social and economic impacts, emphasizing employment, social cohesion, and economic diversification. The Smart Specialization Strategy and Entrepreneurial Discovery Process offer frameworks for identifying key sectors and fostering innovation. Leveraging EU funding and aligning with national strategies, Western Macedonia seeks to transform into a sustainable, knowledge-driven economy, marking a pivotal shift away from coal dependency.

In response to these challenges, the Regional Government of Western Macedonia is spearheading an ambitious energy transition initiative aimed at diversifying the economy, reducing unemployment, and safeguarding social cohesion. This transition hinges on several key opportunities that emerge from the region's commitment to moving away from coal dependency. These opportunities involve mainly the agri-food sector, renewables, the exploitation of valuable bio-based products from urban biowaste and wastewater and the transformation of the food industry by-products into secondary feedstocks via circular-economy schemes.

Agricultural Diversity and Production

The agricultural sector in Western Macedonia is currently characterized by its focus on low-value, low-labor-intensive crops and livestock activities. A strategic shift towards high-value agricultural practices, closely linked with food processing, is proposed as a catalyst for regional development. This would include the cultivation of aromatic and pharmaceutical plants, saffron, fruits, vegetables and dairy products. These sectors not only hold the potential for higher economic returns but also include products that have received Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI) certifications, emphasizing their quality and uniqueness. Localized agro-processing and the success of contract farming support fostering partnerships between farmers and businesses, would not only add value to production but also create more jobs in the region.

Biomass production emerges as a key opportunity for job creation and regional growth, with the proposal for the establishment of a biomass trade center poised to optimize the supply chain, guaranteeing the requisite quality and quantity for effective biomass energy generation, thereby meeting Western Macedonia's ambitions for sustainable energy and economic expansion.

Renewable Energy Development

Transitioning from coal dependency opens avenues for renewable energy development. Western Macedonia can capitalize on its natural resources, such as ample sunlight and wind, to establish solar and wind power projects. Investments in renewable energy infrastructure not only mitigate environmental impacts but also create job opportunities in construction, maintenance, and management of renewable energy facilities. By embracing renewable energy, the region can foster sustainable economic growth while reducing reliance on fossil fuels, thus aligning with global climate objectives and enhancing its energy security.



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Greece's plan includes seven reforms and four investments to reduce dependence on fossil fuels, in line with one of the objectives of the REPowerEU plan.

The reforms aim to facilitate the production of renewable hydrogen and biomethane, optimise the use of land and sea space for renewable energy development, and promote energy efficiency.

Investments aim to support energy efficiency measures, the expansion of energy storage capacity, pilot projects for biomethane and renewable hydrogen production, and support for carbon capture and storage infrastructure⁷.

Table 7: #1 Opportunity – Greece region of Western Macedonia (WM) – Energy / Renewables

Greece – region of Western Macedonia (WM)	
Sector	Energy / Renewables
Opportunity	Renewable Energy Development
Description	The shift towards renewable energy sources presents a promising avenue for sustainable economic growth and environmental stewardship. Western Macedonia possesses abundant natural resources, such as sunlight and wind, which can be harnessed to establish solar and wind power projects. Investments in renewable energy infrastructure not only contribute to mitigating climate change but also create employment opportunities and enhance energy security.

Exploitation of valuable bio-based products from urban biowaste and wastewater

Developing urban bioeconomies through piloting circular bioeconomy cities via Horizon Europe presents a unique opportunity for Western Macedonia to spearhead innovation and sustainability in urban development⁸. By participating in initiatives aimed at supporting a pilot group of European cities to launch, finance, implement, and assess their urban circular bio-based economy strategies, Western Macedonia can leverage its resources and expertise to catalyze transformative change. The region's involvement in this endeavor holds immense potential for addressing pressing challenges related to waste management, resource efficiency, and environmental sustainability. With a focus on harnessing urban biowaste and wastewater as valuable resources for the production of safe and sustainable bio-based products, Western Macedonia can demonstrate leadership in the transition towards a circular bioeconomy model. Through targeted investments, research collaborations, and policy interventions, Western Macedonia can establish itself as a living laboratory for innovative approaches to urban bioeconomy development. By piloting circular bioeconomy cities, the region can showcase scalable solutions that optimize resource utilization, minimize environmental impact, and create new economic opportunities.

Key components of this initiative include:

- **Infrastructure Development:** Investing in the necessary infrastructure for collecting, sorting, and processing urban biowaste and wastewater to extract valuable bio-based materials and energy resources.

⁷ European Commission: https://commission.europa.eu/business-economy-euro/economic-recovery/recovery-and-resilience-facility/country-pages/greeces-recovery-and-resilience-plan_en

⁸ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52022SC0162>



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- **Technological Innovation:** Supporting research and development efforts to develop advanced technologies for converting urban biowaste and wastewater into high-value bio-based products, such as bioplastics, biofuels, and biochemicals.
- **Policy Support:** Implementing supportive policies and regulatory frameworks that incentivize the adoption of circular bioeconomy practices and facilitate the scaling up of innovative projects and initiatives.
- **Public Engagement and Education:** Engaging with local communities, businesses, and stakeholders to raise awareness about the benefits of circular bioeconomy approaches and promote active participation in waste reduction and resource recovery efforts.
- **Monitoring and Evaluation:** Establishing robust monitoring and evaluation mechanisms to track the progress and impact of circular bioeconomy initiatives, ensuring accountability and informing future decision-making processes.

By embracing the circular bioeconomy paradigm and participating in Horizon Europe's pilot program for circular bioeconomy cities, Western Macedonia can position itself at the forefront of sustainable urban development in Europe. Through collaboration, innovation, and commitment to shared goals, the region can unlock new pathways towards prosperity, resilience, and environmental stewardship.

Table 8: #2 Opportunity – Transformation of the food industry by-products into secondary feedstocks via circular-economy schemes

Greece – region of Western Macedonia (WM)	
Sector	Bio-based products
Opportunity	Exploitation of valuable bio-based products from urban biowaste and wastewater
Description	Participating in Horizon Europe's circular bioeconomy cities initiative empowers Western Macedonia to pioneer urban sustainability. Leveraging its expertise, the region can address waste challenges, harnessing biowaste for safe, sustainable products. Through strategic investments and collaborations, Western Macedonia becomes a hub for innovative urban bioeconomy solutions. This initiative showcases scalable models, optimizing resources, and fostering economic growth while minimizing environmental footprints.

Transformation of the food industry by-products into secondary feedstocks via circular-economy schemes

Turning food industry by-products into secondary feedstocks via circular-economy schemes presents a significant opportunity for Western Macedonia⁹ to enhance resource efficiency and promote sustainable practices within the food industry. By leveraging circular economy principles, the region can transform food industry by-products, such as agricultural residues, food waste, and processing by-products, into valuable secondary feedstocks for various applications¹⁰. Through initiatives focused on waste valorization, resource recovery, and value-added processing, Western Macedonia can mitigate the environmental impact of food production and consumption while creating new economic opportunities. By adopting innovative

⁹ https://prima-med.org/wp-content/uploads/2021/12/PRIMA_booklet_2020.pdf

¹⁰ https://projects20142020.interregeurope.eu/fileadmin/user_upload/tx_tevprojects/library/BRIDGES_RWM%20mapping_31_10_2016_2nd%20draft.pdf



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technologies and business models, the region can unlock the latent value in food industry by-products, turning waste streams into valuable inputs for other industries, such as bioenergy production, animal feed, or biochemical manufacturing. Collaboration between food producers, research institutions, and government agencies will be essential to facilitate the development and implementation of circular-economy schemes for food industry by-products in Western Macedonia. By fostering partnerships and knowledge-sharing initiatives, the region can accelerate the transition towards a more sustainable and resilient food system, contributing to both environmental conservation and economic growth.

The potential circular-economy schemes to turn food industry by-products into secondary feedstocks, contributing to sustainability and resource efficiency in Western Macedonia are presented:

- **Olive Pomace:** Greece and Western Macedonia are leading producer of olive oil, generating significant quantities of olive pomace, a by-product of olive oil extraction. Through circular-economy schemes, olive pomace can be utilized as a secondary feedstock for various applications such as bioenergy production, soil amendment, or animal feed.
- **Citrus Waste:** Western Macedonia's citrus industry generates substantial amounts of waste, including peels, pulp, and seeds. Circular-economy initiatives aim to valorize citrus waste by converting it into secondary feedstocks such as pectin, essential oils, and animal feed additives.
- **Winery By-Products:** The wine industry in Western Macedonia produces grape pomace, grape marc, and other by-products during wine production. Circular-economy schemes focus on repurposing winery by-products as secondary feedstocks for applications such as biofuel production, composting, or dietary supplements.

These cases demonstrate how circular-economy schemes in Western Macedonia can effectively turn food industry by-products into secondary feedstocks, contributing to the circularity of resources, reducing waste generation, and creating economic value from previously underutilized materials.

Table 9: #3 Opportunity – Transformation of the food industry by-products into secondary feedstocks via circular-economy schemes

Greece – region of Western Macedonia (WM)	
Sector	Food industry
Opportunity	Transformation of the food industry by-products into secondary feedstocks via circular-economy schemes
Description	Turning food industry by-products into secondary feedstocks via circular-economy schemes offers Western Macedonia a significant opportunity to boost resource efficiency and sustainability in the food industry. By applying circular economy principles, the region can convert agricultural residues, food waste, and processing by-products into valuable resources for various applications. Through waste valorization initiatives and value-added processing, Western Macedonia can reduce the environmental impact of food production while creating economic opportunities. Adopting innovative technologies unlocks the latent value in by-products, enabling their use in bioenergy, animal feed, or biochemical manufacturing. Collaboration among stakeholders is crucial for implementing circular-economy schemes, facilitating the transition to a more sustainable food system and driving economic growth.



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3.3 Bulgaria – region of Plovdiv

Some of the information analysed in this chapter has been collected directly from the local partners involved in the BIOLOC project.

Paper, textile and clothing sectors

Forestland covers 25% of total territory, which corresponds to 151,915.9 ha mostly state-owned. The main products obtained are timber, cellulose, wood mulch and pellets. The main uses of forestry biomass are construction, followed by shredded paper and chipboards¹¹. Given the large resources available, Bulgaria's paper production industry plays an important role in Eastern Europe. The wood, paper and paperboard sectors account for about 1.4 percent of the country's industrial output.

Currently Plovdiv region has a significant forest resource. The share of forested land in the district has increased over the last 10 years by 3.93%. The expansion of forest areas and the increase in the production of forest products are the factors that have an impact on the export of products produced by the sector. Exports of forest products have increased 1.4 times in the last 10 years.

The main uses of forestry biomass are:

- construction 70%;
- shredded paper – 10%;
- chipboards – 15%; cellulose – 5% of the produces wood in the region

Textile and clothing production represent the main opportunities to increase exports and create new jobs, in fact thanks to considerable investments they have become two of Bulgaria's most competitive industries in recent years. The effects of these investments are already visible, as textile exports are growing strongly and are recovering rapidly from the COVID crisis. European market (Germany, followed by Italy, France, Greece and Spain) are the main importers of these products.

The paper and textile sectors are among the main activities in the Plovdiv region, however, like other sectors, such as agriculture, the wood and energy sector, research and development of bio-based solutions are currently not widespread. Consequently, to remain competitive, these sectors will necessarily have to introduce the logic of the bioeconomy into their production processes.

¹¹ D2.2 - Report on the Regional bio-based systems cases description, Maider Gómez, Paula de la Sen, 15/09/2023



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Table 10: #1 Opportunity – Bulgaria region of Plovdiv – Wood and paper

Bulgaria – region of Plovdiv	
Sector	Wood and paper
Opportunity	This sector in Bulgaria can represent a great opportunity given the abundance of raw materials. Plovdiv district has a significant forest resource. Forest areas occupy more than a quarter of the region area (25% of total territory, which is 151,915,9 ha). The sector is mostly dominated by state-owned enterprises, which gives reason to believe that the state is interested in reacting quickly in the regulatory framework to support forestry to be part of the local bioeconomy. The bio-waste amounts up to 50% of the wood harvested in the forest holdings. Residual lignocellulose products represent a huge raw material source for industry and energy for the size of the region.
Description	Paper production plays a very important role in Bulgaria's economy. This country, in fact, has many resources that can be used in this sector. For this reason, Bulgarian paper industry plays an important role at European level. The production of wood, paper and board account for about 1.5% of Bulgaria's industrial production.

Agriculture and agri-food

Another sector that is very important for the economic development of the region is agriculture. The country's main crops are cereals, wheat and fodder plants. In addition to normal agricultural activity, good growth prospects derive from the processing of residues of agricultural products. For example, straw, corn cobs, and other products can be dried and later processed to become feedstock to produce solid fuels. These techniques are not yet widespread in the area, but they could produce significant added value by generating positive cash flows from biobased residues.

The main actors involved in agricultural production are private farmers and farmers' associations, such as the Association of vegetable greenhouse producers, Association of essential oils and cosmetics producers, National Association of Grain Producers, Livestock producers' associations, etc.

The development of this sector is also facilitated by the presence of numerous state subsidies such as the CAP and Rural Development Programme (RDP).

To be competitive, the agricultural sector of this region in the coming years will have to enhance primary agricultural production, increase the quality of agricultural production, implement circular economy models and will have to be supported through national and European public funding.



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Table 11: #2 Opportunity – Bulgaria region of Plovdiv – Agriculture

Bulgaria – region of Plovdiv	
Sector	Agriculture
Opportunity	Currently, there are mainly private farmers or farmers' associations in the agricultural sector. This situation can represent an opportunity, as the barriers to entry into the market are not too restrictive.
Description	Currently the use of plant residues to produce renewable energy is not widespread, as in some cases it may not be simple (for example burning straw requires special equipment). However, the many benefits of these activities can represent a great opportunity for the agricultural sector. Straw can be used for co-firing in fossil power plants, which is very economically efficient and can affect harmful emissions. The areas to produce some cereals, corn and sunflower have remained constant over the years, so it is possible to predict the amount of plant residues and the raw material for the possible production of renewable biofuels. All this allows for predictable cash flows and therefore guarantees the sustainability of investments.

Table 12: #3 Opportunity – Bulgaria region of Plovdiv – Agri-food

Bulgaria – region of Plovdiv	
Sector	Agri-food
Opportunity	Cereal straw is the main source of biomass potential from agrifood processing industries in Plovdiv region. Other sources of biomass are rice straw, maize stover and sunflower straw.
Description	Food and fruit processing residues can improve the cost efficiency of agri-food processors. For this reason, the generation of value from food waste is a good opportunity to improve the competitiveness of companies active in the food sector. Food and fruit processing residues can create important opportunities for companies active in the agri-food sector, as they can improve their cost efficiency.

Forest biomass

Another important resource of this region is forest area. In fact, the share of forest area has increased in recent years, also allowing an increase in exports. In Plovdiv region forests occupy more than a quarter of the region area (151,915.9 ha). Bio-waste amounts to up to 50% of the wood harvested in the forest holdings. Residual lignocellulose products represent a huge raw material source for industry and energy sectors. The main uses of forestry biomass are construction (70% in percentage of the produces wood in the region), shredded paper (10%), chipboards (15%), cellulose (5%). The share of forested land in the district has increased over the last 10 years by 3.93%. The main factors related to expansion of exports in this sector are the increase in forest areas and the increase in the production of forest products.

This sector receives public funding that helps those involved to further grow. The main stakeholders in this sector are producers of wood products, forest management bodies, pellet producers, companies involved in the management of energy from wood residues and paper producers.

Table 13: #4 Opportunity – Bulgaria region of Plovdiv – Forestry



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Bulgaria – region of Plovdiv	
Sector	Forestry
Opportunity	Presence of different forest residues that could be exploited for biomass production.
Description	The forestry sector represents a great opportunity for as a source of biomass. In this area, the presence of abundant resources due to the presence of a large forest area can contribute to the development of the biomass sector.

Bio-based products

In this region, the three relevant bio-based industries in terms of revenues and role to meet the government strategic objectives are the food industry, forestry and medical (pharmaceutical) industry. In these sectors, the bioeconomy has already been successfully integrated, while in others it has not, and this could lead to new opportunities that have not yet been fully exploited. Some important solutions could be, for example, the development of large-scale composting of the organic residues from plant and animal origin generated by agriculture, large-scale production of bioenergy i.e., biomethane from biogas installations and the production of pellets and other materials to replace diesel and other fossil fuels used for energy production.

The public aid granted for the bioeconomy sector and the growing demand for these products can lead to interesting opportunities contributing to further development of this sector.

Table 14: #5 Opportunity – Bulgaria region of Plovdiv – Bio-based sectors

Bulgaria – region of Plovdiv	
Sector	Bio-based sectors
Opportunity	There are several bio-based products that given the conditions of the Bulgarian market can represent an opportunity.
Description	Competitive Bulgarian bio-based products for the market are herbal pharmaceutical products, oil products for plant-based cosmetics, pharmaceuticals, timber houses, furniture, bio-oils, pellet production and textiles. The 3 bio-based solutions with more relevance in Plovdiv region are: • large-scale composting of the organic residues from plant and animal origin generated by agriculture. • large-scale production of bioenergy i.e., biomethane from biogas installations • production of pellets and other materials to replace diesel and other fossil fuels used for energy production.

3.4 Slovakia – the Nitra Self-Governing Region

With 2,385 thousand hectares of agricultural land, representing 49% of the country's territory, Slovakia surpasses the EU average in land availability. However, extreme land fragmentation poses a challenge, hindering efficient land use and consolidation. Nitra Region is located in the southwestern part of the Slovak Republic. Nitra Self-governing Region has an area of 6,343 km²¹².

¹² <https://www.invest-alliance.eu/nl/Home/Texts?link=20-5-living-lab-nitra-slovakia>



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Water resources, including reservoirs and rivers, offer opportunities for agricultural needs, but investments in irrigation systems are essential due to challenges from climate change. The food industry faces a persistent issue of increasing negative balance between imports and exports, signalling the need for self-sufficiency. Slovakia aims to achieve this through processing domestic agricultural products locally and promoting sales within the country. The National Strategy for Increasing Domestic Food Production outlines measures like establishing a working group, developing investment plans, and coordinating agricultural policies to stimulate growth. Despite deficits in various commodities like cereal processing and milk production, Slovakia seeks to prioritize sectors with high development potential within its food production strategy. Innovation in agriculture and food production is central to Slovakia's innovation strategy, aiming to generate solutions in research, development, and distribution. The Smart Specialization Strategy highlights Slovakia's potential in the bioeconomy alongside the ICT industry, with significant opportunities for growth. However, challenges like low-added value and exporting raw materials need addressing. Agriculture and forestry form the foundation of the bioeconomy, presenting avenues for innovation and growth. Consultations with experts underscore significant potential for the bioeconomy, with prospects of reaching two-thirds of the automotive industry's turnover within a decade. While Slovakia has resources like land and water, challenges remain in enhancing competitiveness against countries with larger land areas. Overall, Slovakia's agricultural and bioeconomy sectors present opportunities for innovation, investment, and sustainable growth.

Slovakia's agricultural and food production sector holds considerable promise for development and innovation. With vast agricultural land covering nearly half of the country's territory, Slovakia exceeds the EU average in land availability. Despite challenges such as land fragmentation, ample water resources and reservoirs offer opportunities for agricultural expansion, especially with strategic investments in irrigation systems to mitigate climate change effects. Moreover, the food industry faces a crucial task of achieving self-sufficiency to address the growing negative balance between imports and exports. By prioritizing domestic food production and implementing a comprehensive strategy, Slovakia aims to bolster its food industry and enhance economic resilience.

Land and water management

Slovakia's extensive agricultural land area of 2,385 thousand hectares presents a significant opportunity for agricultural and food production development. However, the challenge of land fragmentation persists, hindering efficient land use. With ample water resources and rivers serving as significant water sources for agriculture, there's potential for enhancing irrigation systems to improve agricultural yields. Investment in modernizing irrigation infrastructure is crucial to harnessing the full potential of water resources for agricultural purposes. By addressing inefficiencies and investing in modern agricultural practices, Slovakia can increase agricultural productivity and contribute to food security both domestically and regionally. Furthermore, efforts to streamline land ownership and encourage consolidation can facilitate more efficient land management and resource utilization, paving the way for sustainable agricultural development. Overall, the development of agriculture and food production holds promise for economic growth and rural development in Slovakia.



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Table 15: #1 Opportunity – Slovakia – the Nitra Self-Governing Region – Agri-food

Slovakia – the Nitra Self-Governing Region	
Sector	Agri-food
Opportunity	Agricultural and Food Production Development
Description	Slovakia's extensive agricultural land area and ample water resources provide significant potential for the development of agriculture and food production. Addressing challenges such as land fragmentation and investing in irrigation systems can enhance agricultural efficiency and productivity.

National Strategy for Increasing Domestic Food Production

The formulation of a comprehensive national strategy for increasing domestic food production is pivotal for Slovakia's long-term agricultural development¹³. Gradually increasing food self-sufficiency and reducing reliance on food imports are essential components of this strategy. By establishing a working group dedicated to implementing the National Food Strategy, Slovakia can coordinate efforts across various sectors and streamline policy initiatives. Developing a long-term investment plan for selected sectors of the food industry is critical for attracting investment and mobilizing financial resources. Aligning the Common Agricultural Policy (CAP) and the national subsidy system can create a conducive environment for business development and innovation in the food industry. By prioritizing strategic measures and quantifying necessary financial resources, Slovakia can foster a resilient and sustainable food production system that meets the needs of its population while contributing to economic growth.

Table 16: #2 Opportunity – Slovakia – the Nitra Self-Governing Region – Food Industry

Slovakia – the Nitra Self-Governing Region	
Sector	Food Industry
Opportunity	National Strategy for Increasing Domestic Food Production
Description	The formulation and implementation of a comprehensive national strategy are crucial for enhancing domestic food production. This strategy involves initiatives such as increasing food self-sufficiency gradually, establishing investment plans, and coordinating agricultural policies to stimulate the business sector.

Bioeconomy and Smart Specialization Strategy

Slovakia's recognition of the bioeconomy as a key driver of economic growth underscores the importance of strategic planning and investment in this sector. With significant resources available, including land, water, and energy, Slovakia is well-positioned to capitalize on opportunities in the bioeconomy. However, challenges such as low-added value in key sectors, particularly agriculture and the food industry, and the export of raw materials need to be addressed to unlock the full potential of the bioeconomy. Embracing innovation and technology transfer in agriculture and the food industry can enhance productivity and competitiveness. Aligning with the Smart Specialization Strategy allows Slovakia to leverage its strengths in

¹³ https://agriculture.ec.europa.eu/cap-my-country/cap-strategic-plans/slovakia_en



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the bioeconomy and ICT industry to drive innovation and sustainable development. By prioritizing investments in research, development, and infrastructure, Slovakia can establish itself as a leader in the bioeconomy, creating new opportunities for economic diversification and job creation.

Table 17: #3 Opportunity – Slovakia – the Nitra Self-Governing Region – Bioeconomy

Slovakia – the Nitra Self-Governing Region	
Sector	Bioeconomy
Opportunity	Bioeconomy and Smart Specialization Strategy
Description	Slovakia recognizes the potential of the bioeconomy as a driver of economic growth and structural change. With significant resources available, including land, water, and energy, the country seeks to capitalize on the bioeconomy's potential to match or even exceed the turnover of its automotive industry. Aligning with the Smart Specialization Strategy, Slovakia aims to leverage its strengths in the bioeconomy alongside the rapidly growing ICT industry to drive innovation and competitiveness.

3.5 Slovenia – whole country

The information analysed in this chapter has been collected directly from the local partners involved in the BIOLOC project.

Food production

Food and beverage production are very important activities for the Slovenian economy and have one of the biggest multiplier effects on the national economy due to a strong involvement in domestic supply. In Slovenia there are 789 enterprises active in the agrifood industries.¹⁴ Following are the main productions of agri-food sector:

- meat products (712.2 million EUR turnover)
- dairy products (407.3 million EUR turnover)
- bakery
- farinaceous products (378 million EUR turnover)
- food products (361 million EUR turnover)
- beer (170.7 million EUR turnover)

In this sector, there are several growth opportunities for the bioeconomy, such as the brewing industry, which is a source of raw materials for a wide range of products, or the fruit and vegetable industry, which produces residues that can be used for the isolation of biologically active compounds or to produce microbial enzymes from residues (e.g. potato processing). Food waste can also be used to produce biogas.

¹⁴ Data for 2021, Poročilo o stanju kmetijstva, živilstva, gozdarstva in ribištva, https://www.kis.si/f/docs/Porocila_o_stanju_v_kmetijstvu/ZP_2021_splosno_priloge_6.9.2022.pdf.



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Table 18: #1 Opportunity – Slovenia whole country – Food

Slovenia – whole country	
Sector	Food
Opportunity	The food sector is central to the economy of Slovenia. The introduction of increasing quantities of organic products can be an opportunity for growth in this sector.
Description	The food sector plays a very important role in the country and in recent years the number of companies active in this sector has grown. Most companies are small, but the few large companies present account for more than half of the added value created. Currently the main activities carried out are the production of manufacture of bread, manufacture of fresh pastry goods and cake, production of meat and poultry meat products, processing and preserving of meat and manufacture of beer. In this sector it is possible that in the coming years there will be a growth of the chain of bio-based products.

Agriculture sector

The Slovenian agricultural sector is characterised by the presence of small and non-specialised farms, which require a major structural change to increase the contribution of this sector to national added value. The agriculture sector contributes only in a small part to Slovenia's Gross value added (GVA), in fact due to the small dimension of the Slovenian farms that are also not specialised, agricultural sector needs a structural change. In addition, only 5% of the farm owners are under 35 years, and most of the agricultural land is located in areas with natural or other restrictions. Agriculture sector covers only 6% of total employment in the country¹⁵.

In addition to the structural problems of the sector, there are also the effects of climate change, which are causing more and more damage to agriculture. To help the Slovenian agricultural grow and to mitigate the effects of climate change, various funds are made available at both national and European level to support the sector. In the strategic plan 2023-2027, Slovenia aims to support the green transition and sustainable development of agriculture, forestry, the food industry and rural areas. Regarding climate change, the Strategic Plan places emphasis on sustainable food production across the country and the promotion of self-sufficiency.

Almost 1.8 billion euros are available to implement the measures:

- 700 million euros for the first pillar – direct payments, wine sector and beekeeping (EU funds);
- billion euros for the second pillar – rural development (half from the EU budget and half from the budget of the Republic of Slovenia)¹⁶.

¹⁵ Statistical Office of the Republic of Slovenia GOV.SI, <https://pxweb.stat.si/SiStatData/pxweb/en/Data/-/0301975S.px/>

¹⁶ Republic of Slovenia, <https://www.gov.si/en/policies/agriculture-forestry-and-food/agriculture-and-rural-development/>



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In this context, several opportunities can be envisaged in this area for the bioeconomy, as to increase agricultural production in a sustainable way. In order to adapt to climate change, the more efficient use of resources and the reduction of waste will be crucial.

Table 19: #2 Opportunity – Slovenia whole country – Agriculture

Slovenia – whole country	
Sector	Agriculture
Opportunity	There are several products that have experienced production growth in recent years and can represent an opportunity for the bioeconomy.
Description	As for the dairy sector, the production of animal oils, fats, bakery products, flour products and beverages are the areas that have had the fastest growth. As for the agricultural sector, the production of cereals oil plants, potatoes, hops, vegetables, fruit, beef, poultry, sheep and goats, milk have grown in recent years.

Forestry and energy sector

Important opportunities for the development of the bioeconomy can also be identified in the Slovenian forestry sector. Mainly, the opportunities come from wood, which can be used as an input raw material for biorefining processes and the subsequent production of new bio-based materials. Other opportunities arise from the exploitation of secondary sources of raw materials (waste biomass, lignocellulosic fibres) produced in extraction, processing and consumption processes. This type of analysis was already conducted in D4.1 Analysis of local context". Below is an abstract:

"Generally, for wood industry is expected a growth by 5.89% of GDP in the next decade, with a consequently increase in the employees which is expected to achieve 2 608 people and an increase in sales and productively respectively of 66% and 9.8%. Wood processing sector can represent a great opportunity for Slovenia due to the trend of exporting wood and subsequently buying back products, e.g. plywood.^{17 18.}"

The valorisation of primary and secondary sludge and wood wastes represents another important opportunity for both the forestry and energy sectors.

The development of the forestry sector can be supported through public aid for investment in forestry technologies and in the processing, mobilisation and marketing of forest products.

Over the past decade, Slovenia has been the EU country with the lowest increase in the share of renewable energy consumption. In order to reverse this trend, in the National Integrated Energy and Climate Plan Slovenia has set a target of consuming at least 27% of energy from renewable sources by 2030. This target should also be upgraded to a share of around 30%-35% renewable energy.

¹⁷ Data for 2021, Statistical Office of the Republic of Slovenia, <https://pxweb.stat.si/SiStatData/pxweb/en/Data/-/1673145S.px>.

¹⁸ Juvančič L., Gasan Osojnik Črničec I., et al., Strategic Concept Paper for Bioeconomy: Slovenia, BIOEAST, 2023 – available at <https://www.daes.si/storage/post-content/eRZ8nYZHrhR7z0GVyCfw5Xz2HGO2WLOdKUoFbov.pdf>.



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This plan will on the one hand promote energy efficiency, while on the other hand it should incentivise the use of renewable energy. One of the goals of the plan is to have a rapid expansion of solar and wind power plants in areas with different primary uses (agricultural, road, water, etc.).

The plan also foresees an increase in the share of gaseous fuels from renewable sources to 10-30% by 2030. For this reason, guidelines have also been defined for woody biomass. High-quality wood from Slovenian forests should be processed into products with the highest possible added value, while only lower-quality wood should be used for energy purposes (as a source of fuels and synthetic gases).

The development of technologies for the production of sustainable biofuels, advanced gaseous and liquid synthetic fuels is also planned¹⁹.

Table 20: #3 Opportunity – Slovenia whole country – Forestry

Slovenia – whole country	
Sector	Forestry
Opportunity	Due to the large forest area, this sector in Slovenia represents a great resource from which many opportunities for the bioeconomy can be generated.
Description	Slovenia has, among the countries of the European Union, one of the highest forest coverage, being behind only Finland and Sweden. In Slovenia there are forests of beech, fir-beech and beech-oak. In recent years, moreover, the importance of this sector has increased due to the increase in the added value generated from forest products. The possibility of obtaining woody biomass in this country is very high²⁰. The wood industry in Slovenia is expected to grow over the next decade²¹. Wood processing sector can represent a great opportunity for Slovenia due to the trend of exporting wood and subsequently buying back products, e.g. plywood.

3.6 Croatia – region Adriatic Croatia

In the region of Adriatic Croatia, several key opportunities emerge, shaping its economic landscape and fostering growth across diverse sectors. The agricultural sector stands out prominently, with a rich array of crops such as corn, wheat, and soybeans dominating the landscape. Notably, the region boasts a flourishing production of olives, grapes, and citrus fruits, underpinning its reputation for high-quality olive oil and wines. With an extensive agricultural supply chain and robust governmental support, there's ample scope for enhancing productivity and market competitiveness. Simultaneously, the wood processing and furniture industry offer avenues for sustainable development, with products ranging from charcoal to wood-based panels catering to diverse consumer needs. Mariculture emerges as another promising arena, ready for innovation and strategic investment, though it currently lacks a comprehensive bioeconomy strategy. Bio-based products present lucrative opportunities, from biodegradable plastics to biodiesel, signaling a potential shift towards a circular economy. Moreover, the Smart Specialisation Strategy (S3) beckons Croatia towards leveraging its intellectual capital, particularly in Information and Communications Technology (ICT) and

¹⁹ Renewable energy in Slovenia: <https://cms.law/en/int/expert-guides/cms-expert-guide-to-renewable-energy/slovenia>

²⁰ Juvančič L., Gasan Osojnik Črničev I., et al., Strategic Concept Paper for Bioeconomy: Slovenia, BIOEAST, 2023 – available at <https://www.daes.si/storage/post-content/eRZ8nYZHlrhR7z0GVyCfw5Xz2HGO2WLOdKUoFbov.pdf>.

²¹ Slovenia's Sustainable Smart Specialisation Strategy, January 2023.



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biomedical sciences. Despite challenges such as limited science-business cooperation, Croatia's wealth of tertiary education institutions and doctoral graduates provides a solid foundation for fostering innovation and driving economic transformation. As the region navigates towards a more integrated and sustainable future, strategic alignment and cross-sectoral collaboration hold the key to unlocking Adriatic Croatia's full potential.

Agricultural Diversity and Production

The fertile lands of Adriatic Croatia present a diverse range of agricultural opportunities. From staple crops like corn and wheat to specialty products such as olives, grapes, and citrus fruits, the region boasts a rich agricultural landscape. With a focus on sustainable practices and innovative farming techniques, there is significant potential to expand production, improve quality, and capture niche markets both domestically and internationally. Collaborative efforts across the agricultural supply chain, coupled with targeted government support, can drive growth and enhance the region's competitiveness in the global market.

Table 21: #1 Opportunity – Croatia – region Adriatic Croatia – Agri-food

Croatia – region Adriatic Croatia	
Sector	Agri-food
Opportunity	Agricultural Diversity and Production
Description	Adriatic Croatia boasts a diverse agricultural landscape, including staple crops like corn and wheat, as well as specialty products such as olives, grapes, and citrus fruits. By implementing sustainable farming practices and adopting innovative techniques, the region can enhance productivity and quality while meeting growing consumer demands. There are several stakeholders in the agri-food industry. At a micro-scale there are a number of stakeholders such as feedstock suppliers; agro-chemical manufacturers and suppliers; machinery and equipment manufacturers and suppliers; farmers; produce marketers and sellers; food processors; suppliers of food additives; packaging suppliers; transport companies; food retailers; consumers; and waste processors. Another stakeholder is formed by private and public research centres in the different subsectors of the agri-food sector ²²²³ .

Wood Processing and Furniture Industry

Forest area in Adriatic region is equal to 596.840 ha²⁴. The productive forest is made about 55% of total forest area in 2016^{25 26}. There are also several subsidies received by the forestry sector, such as:

- Ministry of Agriculture:
 - Subsidies for private forests

²² <https://www.tecnoali.com/files/emensa/D3/Report%20Ainia.pdf>

²³ <https://hrcak.srce.hr/file/406172> -

²⁴ <https://hrcak.srce.hr/file/179319> -

²⁵ <https://www.hrsume.hr/o-nama/pristup-informacijama/>

²⁶ Celebio d2.1: https://mingor.gov.hr/UserDocsImages/KLIMA/SZKAIZOS/december_nfap_2019.pdf - CRO



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- Strategic plan of the Common Agricultural Policy - Subsidies for forest management restrictions (NATURA 2000, NKS), Reconstruction (conversion) of degraded forests
- Tender for operation type 4.3.3 Investment in forest infrastructure.
- Tender for implementation of operation type 8.5.1 Conversion of degraded forest stands and forest cultures.
- Tender for the type of operation 8.6.1 Modernization of technologies, machines, tools and equipment in wood extraction and forestry works
- Tender for operation type 8.6.2 Modernization of technology, machines, tools and equipment in pre-industrial wood processing^{27 28 29 30 31 32}.

The main stakeholders involved in the forest biomass production are^{33 34}:

- Forest owners (state/private)
- Forestry professionals (engineers and technicians) and workers in the direct forest production
- Public supervisory bodies

Table 22: #2 Opportunity – Croatia – region Adriatic Croatia – Wood processing

Croatia – region Adriatic Croatia	
Sector	Wood processing
Opportunity	Wood Processing and Furniture Industry
Description	With abundant forest resources, Adriatic Croatia has a strong foundation for its wood processing and furniture industry. By investing in modern technologies and optimizing production processes, the region can capitalize on its raw materials to manufacture high-quality wood products. Emphasizing innovation in design and manufacturing techniques can enhance the sector's competitiveness and appeal to diverse consumer preferences. Strategic initiatives aimed at sustainable forest management and value-added processing can further strengthen Adriatic Croatia's position in the global market.

²⁷ <https://www.hsups.hr/subvencije-za-privatne-sume/>

²⁸ <https://ruralnirazvoj.hr/indikativni-plan-objave-natjecaja-u-2023/>

²⁹ <https://ruralnirazvoj.hr/natjecaj-za-tip-operacije-4-3-3-ulaganje-u-sumsku-infrastrukturu-4/>

³⁰ <https://ruralnirazvoj.hr/natjecaj-za-provedbu-tipa-operacije-8-5-1-konverzija-degradiranih-sumskih-sastojina-i-sumskih-kultura/>

³¹ <https://ruralnirazvoj.hr/natjecaj-za-tip-operacije-8-6-1-modernizacija-tehnologija-strojeva-alata-i-opreme-u-pridobivanju-drva-i-sumskouzgojnim-radovima/>

³² <https://ruralnirazvoj.hr/natjecaj-za-tip-operacije-8-6-2-modernizacija-tehnologija-strojeva-alata-i-opreme-u-predindustrijskoj-preradi-drva-2/>

³³ https://www.researchgate.net/figure/Key-stakeholders-and-their-primary-and-secondary-forest-ecosystem-services-ES-stakes_tbl3_322578625

³⁴ <https://www.sumins.hr/wp-content/uploads/2017/08/Prirucnik.Biomasa-hrv.pdf>



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Mariculture and Bio-based Products

Table 23: #3 Opportunity – Croatia – region Adriatic Croatia – Bio-based products

Croatia – region Adriatic Croatia	
Sector	Bio-based products
Opportunity	Mariculture and Bio-based Products
Description	The Adriatic Sea offers favorable conditions for mariculture and the production of bio-based products. By leveraging its pristine waters and biodiversity, the region can cultivate a variety of seafood and marine resources sustainably. Investing in research and development initiatives aimed at enhancing the quality and value of bio-based products can unlock new economic opportunities. Collaborative partnerships between industry stakeholders, research institutions, and government agencies are essential for driving innovation and promoting sustainable practices in the bioeconomy sector.

Smart Specialisation Strategy (S3) in Innovation

Table 24: #4 Opportunity – Croatia – region Adriatic Croatia – Bio-based products

Croatia – region Adriatic Croatia	
Sector	Smart Specialisation Strategy
Opportunity	Smart Specialisation Strategy (S3) in Innovation
Description	Croatia's Smart Specialisation Strategy (S3) focuses on key sectors such as Information and Communications Technology (ICT), biomedical sciences, and creative services. By nurturing a culture of entrepreneurship and innovation, Adriatic Croatia can leverage its intellectual capital to drive economic growth. Strengthening research capabilities, fostering technology transfer, and providing support for startups and SMEs are critical components of the S3 framework. Strategic investments in education, infrastructure, and ecosystem development can accelerate the region's transition towards a knowledge-based economy.

3.7 Hungary – region North-Hungary

Agricultural sector

The natural characteristics of the Hungarian territory are favourable to the development of agriculture, so this sector will have significant growth margins in the coming years. In addition to the central role it already has in the national economy, the main factors favourable to the development of the agricultural sector are its location, suitable climatic conditions and abundant agricultural area. The most important crops are cereals, grain maize and oil crops. The biggest opportunity in this area comes from the fact that Hungary



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wants to double organic farming by 2027. That is why part of the rural development budget is earmarked for measures related to the development of organic farming³⁵.

The agricultural sector is supported at national level to create a path of sustainable development by exploiting the opportunities offered by new technologies. The application of innovative agricultural technologies and competitive solutions will be key to increasing the volume of exports and the competitiveness of this sector.

In Hungary, there are approximately 8 500 agricultural cooperatives that cultivate 40% of the available agricultural land. Given the large number of activities in the agricultural sector, Hungary has great potential for the development of residual biomass from arable land.

Hungary allocates 38% of the rural development budget to agri-environmental interventions, 8% to the further development of organic farming³⁶.

In the document published by the Hungarian Ministry of Agriculture, clear targets are set for the development of organic farming by 2027. This plan analyses opportunities for the development of organic farming and envisages the creation of a support system for organic farmers. The main goal of this plan is to increase the share of agricultural land devoted to organic farming to at least 10 per cent.

Goals on the market for organic products are included in this plan, such as increasing the share of domestic organic food in the total turnover of the Hungarian food market to 5% and doubling the average domestic consumption of organic products per capita³⁷.

If these targets are met, the number of local farms processing organic products and the amount of organic raw materials produced should increase by 2027.

Table 25: #1 Opportunity – Hungary region North Hungary – Agricultural

Hungary – region North-Hungary	
Sector	Agricultural
Opportunity	Hungary has great potential for the development of value chains using residual biomass from arable crops. In addition targets for biological agricultural production can be an important growth engine for all this sector.
Description	Given the large number of activities carried out in the agricultural sector, Hungary has great potential for the development of value chains from residual biomass from arable crops. The agricultural sector is focused on major field crops and on the production of fruit and vegetables. Hungary wants to double organic farming by 2027.

Renewable energy

³⁵ BUDAY Z., SZABÓ M., D4.4 National bioeconomy dossier: Hungary, CELEBio, 2020, available at: https://www.cei.int/sites/default/files/2022-04/CELEBio_Bioeconomy%20Dossier_%20Hungary.pdf

³⁶ European Commission. Available at: https://agriculture.ec.europa.eu/news/commission-approves-cap-strategic-plan-hungary-2022-11-07_en

³⁷ New action plan to help develop Hungarian organic agriculture. Available at: <https://biokutatas.hu/en/page/show/new-action-plan-to-help-develop-hungarian-organic-agriculture>



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Another opportunity for the bioeconomy comes from the energy sector. In fact, most of Hungary's energy is produced from non-renewable sources, and because of this, the country still depends on natural gas for energy. In recent years, however, some improvement has been made in this respect; In fact, some thermoelectric power plants have been converted to large biomass plants that process forestry resources³⁸. There are three wood species utilized for energy purposes in this country: acacia, willow and poplar. The use of biogas represents an opportunity for the bioeconomy; in fact, Hungary is a country with a higher density of livestock and consequently should support investments in biogas.

Table 26: #2 Opportunity – Hungary region North Hungary – Energy

Hungary – region North-Hungary	
Sector	Energy
Opportunity	Hungary's energy sector is mainly dependent on fossil fuels. To reduce this dependency, it will be necessary to use renewable sources, and among these, biomass from forest resources and biogas from livestock have great opportunities for growth.
Description	To reduce dependence on fossil fuels, it is necessary to increase the amount of energy produced from renewable sources. This process is already underway, in fact some thermal power plants have been converted to the combustion of biomass from forest resources. North Hungary has a lot of biomass resources, including agricultural crops, forestry residues, and municipal solid waste. Another opportunity is related to investments in biogas, as Hungary is a country with a high density of livestock³⁹.

3.8 Romania – West region

Romania's Energy Strategy (2016-2030), promoting renewable energy, including biomass, is pivotal, aligning with EU directives to derive 20% of global energy from renewables⁴⁰. Legislation like Law 220/2008 supports energy production from renewables, fostering job creation and sustainability. Biomass plays a significant role, contributing to about 5% of total energy consumption in Europe. Romania's initiatives focus on biomass utilization for energy production, particularly in biorefineries. Investments by companies like OMV Petrom and Clariant signify a shift towards biofuel production, reducing carbon emissions and creating green jobs.

Several biomass sources are found in the western part of Romania, so this region may play an important role in this sector. There is a higher share of biomass deposits exploited in the Transylvanian area and outside the Carpathian arc, but this resource is also an important business in the western part of Romania⁴¹.

The circular bioeconomy gained prominence, emphasizing smart waste management and reduced environmental impact. Biomass sources, both from energy crops and residual biomass, are tapped for

³⁸ Celebio, D4.4 National Bioeconomy Dossier: Hungary, Z.Buday, M, Szabó, 12/2020. Available at: https://www.cei.int/sites/default/files/2022-04/CELEBio_Bioeconomy%20Dossier_%20Hungary.pdf

³⁹ NATIONAL ENERGY STRATEGY 2030, Ministry of National Development, 2012 – available at <https://2010-2014.kormany.hu/download/7/d7/70000/Hungarian%20Energy%20Strategy%202030.pdf>

⁴⁰ ROMANIAN ENERGY STRATEGY 2016-2030, WITH AN OUTLOOK TO 2050 - <https://energie.gov.ro/wp-content/uploads/2016/11/Romanian-Energy-Strategy-2016-2030-executive-summary3-1.pdf>

⁴¹ Deliverable D.T2.1.1 Biomass Report (Romania), Activity A.T2.1: Biomass potential analysis



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biorefineries. However, challenges like resource availability and pollution necessitate careful planning and regulation to ensure sustainable practices.

Overall, Romania's strategic initiatives reflect a concerted effort towards green energy, sustainable resource management, and circular economy principles, aligning with EU objectives for a cleaner, more resilient future.

Renewable Energy and Biomass Utilization

Romania's focus on renewable energy, particularly biomass, presents an opportunity to reduce reliance on fossil fuels and combat climate change. Legislative support and technological advancements enable the efficient conversion of biomass into electricity and biofuels. By harnessing agricultural residues and forestry by-products, Romania can diversify its energy mix, enhance energy security, and promote environmental sustainability.

Table 27: #1 Opportunity – Romania – West region – Renewables

Romania – West region	
Sector	Renewables
Opportunity	Renewable Energy and Biomass Utilization
Description	Romania's emphasis on renewable energy sources, particularly biomass, offers opportunities for reducing dependence on fossil fuels and mitigating climate change. Investments in biomass-based energy production, supported by legislative frameworks and technological advancements, can drive economic growth, job creation, and environmental sustainability in the energy sector.

Biorefineries and Biofuel Production

Investments in biorefineries, exemplified by OMV Petrom's initiatives, signify a transition towards sustainable energy solutions. By converting agricultural and forestry residues into value-added products such as biofuels, biochemicals and bioenergy, biorefineries contribute to carbon emission reductions and promote circular resource utilization. The expansion of biofuel production facilities creates employment opportunities, stimulates rural economies, and advances Romania's energy transition goals. OMV Petrom will acquire 50 per cent of the capital of 'Respiră Verde', a leading company in the collection of used cooking oil in Romania. Used cooking oil is one of the main renewable feedstocks to produce sustainable aviation fuel (SAF) and biodiesel (hydrotreated vegetable oil - HVO1)⁴².

⁴² OMV Group: <https://www.omv.com/en/news/omv-petrom-to-acquire-50-stake-in-respir-verde-a-leading-company-in-the-collection-of-used-cooking-oil-in-romania>



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Table 28: #2 Opportunity – Romania – West region – Biofuel Production

Romania – West region	
Sector	Biofuel Production
Opportunity	Biorefineries and Biofuel Production
Description	Investments in biorefineries, such as OMV Petrom's initiative in Romania, signify a shift towards sustainable energy production and reduced carbon emissions. Utilizing agricultural residues and other biomass sources for biofuel production not only contributes to energy security but also creates employment opportunities and supports the transition to a circular economy.

Rural Development and Agricultural Sustainability

The European Union's commitment to rural development aims to booster agricultural competitiveness while fostering balanced economic growth. Initiatives like the Common Agricultural Policy (CAP) and the European Network for Rural Development (ERDN) empower farmers and rural communities to address climate challenges and ensure generational renewal.

In Romania, the Ministry of Agriculture and Rural Development approved the State Aid Scheme regarding the support of investments in new production capacities of electricity produced from renewable sources for the self-consumption of enterprises in the agricultural sector and the food industry⁴³.

Table 29: #3 Opportunity – Romania – West region – Agriculture

Romania – West region	
Sector	Agriculture
Opportunity	Rural Development and Agricultural Sustainability
Description	Following the agreement reached with Bulgaria, Hungary, Poland, Romania and Slovakia on 28 April, the European Commission allocated a support measure worth EUR 100 million. This amount, taken from the agricultural reserve for 2023, will go to farmers producing cereals and oilseeds in these five frontline member states. The Commission proposes to allocate EUR 29.73 million to Romania. The five countries can supplement this EU support up to 200% with national funds that would amount to a total financial aid of EUR 300 million for the affected farmers ⁴⁴ .

Circular Bioeconomy and Sustainable Resource Management

Embracing circular bioeconomy principles offers a pathway to sustainable resource management and waste reduction. Romania can capitalize on residual biomass from diverse economic sectors (agriculture, forestry, food) to create value-added products and minimize environmental impact. By integrating biorefining processes and promoting smart waste management practices, Romania can foster a resilient and

⁴³ <https://oportunitati-ue.gov.ro/en/sprijin-pentru-agricultura-din-romania/>

⁴⁴ European Commission: €100 million to support farmers from Bulgaria, Hungary, Poland, Romania and Slovakia



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environmentally conscious bioeconomy. Prioritizing circularity in resource utilization enhances food security, reduces pollution, and promotes public health across communities.

Table 30: #4 Opportunity – Romania – West region – Bioeconomy

Romania – West region	
Sector	Bioeconomy
Opportunity	Circular Bioeconomy and Sustainable Resource Management
Description	The concept of circular bioeconomy presents an innovative approach to resource management, waste reduction, and environmental protection. By harnessing residual biomass from various economic activities, Romania can build integrated value chains, promote smart waste management, and reduce environmental impact. Adopting circular bioeconomy principles can lead to enhanced food security, decreased pollution, and improved public health outcomes. The strengths of this area are mainly linked to the regional potential regarding strong agriculture, food industry and related material flow in the regional bioeconomy.

3.9 Czechia - Moravian-Silesian region

Food and beverage processing

The region has a rich agricultural tradition, with a variety of crops grown in the area. Food and beverage processing companies can capitalize on this by exploring new types of products and ingredients, such as organic or specialty crops, to appeal to niche markets.

The main subsector in Czech process industries is food and beverage, which represent 2.7% of the GDP. The main branches of food and beverage industry are processing meat and meat products, processing fruit and vegetables, dairy industry, processing meat and meat products, production of flour and starch products, production of beverages, beer making and wine making.

In the Czech Republic there are several agrifood industries active in the production of dairy products, treatment of milk, processing and canning of meat and meat product, bakery, confectionery and other flour products, sugar from sugar beet, canning of fruits and vegetables, mill and starch products⁴⁵.

The food sector could grow in the coming years thanks to aid granted at European level. In this context, the share of organic food offered by this sector could also increase. The agri-food industries in this region are mainly concerned with dairy products, meat and fruit and vegetable processing and canning, flour products, beet sugar. Building strong partnerships with local farmers, producers, and suppliers can help food and beverage processing companies in the region ensure a secure and sustainable supply chain. Collaborating with local suppliers can also promote the use of locally sourced ingredients and support the local economy.

⁴⁵ https://celebio.eu/wp-content/uploads/2021/04/CELEBio_D.2.1_Biobased-Economy-Business-Opportunities-in-CZ.pdf



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Table 31: #1 Opportunity – Czechia Moravian-Silesian region – Food

Czechia - Moravian-Silesian region	
Sector	Food
Opportunity	The importance of the food sector and the type of products used are two main characteristics that make it particularly relevant in terms of opportunities for the dissemination of organic products. Wasted foods can be an important source of biomass for this region.
Description	One of the main industrial sectors in the Czech Republic is food and beverage processing. This sector mainly uses agricultural and forestry products, and the activities of greatest interest are the processing of meat, of fruit and vegetables, the dairy industry, the production of flour, the production and production of beverages. The Moravian-Silesian region in 2021 was one of the regions with the highest number of eco-farms, 433 out of a total of 4 794. 65 organic food producers out of a national total of 944 were based in the Moravian-Silesian Region in 2021 ⁴⁶ .

Renewable energy production

The Moravian-Silesian region in the Czech Republic has the potential to tap into a variety of opportunities in the bio-based value chain, due to its strong focus on industry and innovation. The region's strong academic and research institutions can foster innovation in the bio-based value chain, leading to the development of new products and processes. Collaborating with these institutions can help companies in the region stay at the forefront of bio-based technology and create a competitive advantage in the market.

The Czech Republic is the fourth largest exporter of electricity to the EU⁴⁷. Heat is mainly produced by the combustion of lignite and natural gas. The main source of renewable energy is wind energy. To reduce the use of coal in power plants, Czech Republic wants to expand the production of nuclear and renewable energy. Another important solution to decarbonise the energy sector could be the use of biogas by exploiting existing infrastructure and building new ones. The use of renewable energy is also subsidized through dedicated public aid programs.⁴⁸ The exploitation of biogas is also linked to the agricultural sector through the treatment of slurry and manure.

⁴⁶ Čermáková E., Grešlová P., et al., Zpráva o životním prostředí v Moravskoslezském kraji, 2021 – available at https://www.cenia.cz/wp-content/uploads/2023/02/Kraje_MORAVSKOSLEZSKY_2021.pdf.

⁴⁷ Statista, <https://www.statista.com/statistics/1405405/net-electricity-exports-europe-by-country/#:~:text=Sweden%2C%20Germany%2C%20and%20Spain%20were,hours%20of%20electricity%20that%20year>.

⁴⁸ European Commission, https://ec.europa.eu/commission/presscorner/detail/en/ip_23_5991



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Table 32: #2 Opportunity – Czechia Moravian-Silesian region – Energy

Czechia - Moravian-Silesian region	
Sector	Energy
Opportunity	The energy sector can offer different growth opportunities to the economy; in fact, to reduce the use of coal in power plants and continue to have a central position in electricity export it will be important to increase the use of biomass. Biogas production can also be an important factor for the decarbonization of the energy sector in the coming years. Further possibilities for developing bio-based solutions in this sector may arise from the use of public funding. Many companies, in fact, will be able to use these incentives in order to decarbonise their production processes through the use of more efficient solutions.
Description	In the coming years, the demand for biomass as a heating source is expected to increase due to the conversion to more renewable energy sources and the reduction of dependence on coal. Waste can be an important source of biomass for this country, especially by using currently wasted plant foods ⁴⁹ . In the Moravian-Silesian region there are heat sources (biogas stations, industrial operations, an incinerator for hazardous waste in Ostrava and a plant to produce cogeneration of electricity and heat) that are currently blocked because no use has been found or the necessary agreements have not been reached between the heat producer and the customer.

Agriculture

The Moravia-silesian Region has a residual biomass potential from several arable crops. According to the data collected in 2020, the main residual biomass potential is related to cereals straw (48,018 ton d.m), Maize stover (12,092 ton d.m), Oil seed rape straw (9,643 ton d.m), sugarbeet leaves (6,989 ton d.m), and finally sunflower straw (169 ton d.m). This region also has a biomass potential from unused land of 73,822 ton d.m. The biomass potential from agrifood processing industries in Moravian-silesia region is equal to 38,540 (all derived from cereal bran)⁵⁰.

Table 33: #3 Opportunity – Czechia Moravian-Silesian region – agriculture

Czechia - Moravian-Silesian region	
Sector	Agriculture
Opportunity	The region has a diverse agricultural product that can be utilized to produce biomass, such as crops, forestry residues, and animal waste. This biomass can be processed into biofuels, bio-based chemicals, and other bio-based products.
Description	In the Moravian-Silesian region there is a significant share of ecologically managed land, where there are mainly activities related to organic farming for cattle, sheep, goats, horses and for fruit cultivation. In this region there are many eco-farms and organic food producers.

⁴⁹ d. National Bioeconomy Dossier CR: https://celebio.eu/wp-content/uploads/2021/04/CELEBIO_D.4.4_National-Bioeconomy-Dossier_CZ.pdf

⁵⁰ Celebio, D2.1 Country report: Czech Republic, M. Dettenhofer, Phd Ceitec, 05/ 2020. Available at: https://celebio.eu/wp-content/uploads/2021/04/CELEBio_D.2.1_Biobased-Economy-Business-Opportunities-in-CZ.pdf



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3.10 Netherlands – region Apeldoorn

In the region of Apeldoorn, key industries include food production (including slaughterhouses and calf farms) and paper mills, both of which engage in intensive biobased product manufacturing. Opportunities lie in the transition from animal protein to plant-based proteins, digitization, and addressing raw material scarcity, promoting sustainable solutions like unbleached products and increased recyclability, and exploring alternative food sources like seaweed. There are also opportunities regarding the valorisation of residues that in this area are mainly derived from: animal and plant waste, mineral/stones, sludge and mixed waste.

The region has a circular bioeconomy strategy, focusing on, biogas, and compost production, with operational facilities like Attero for composting and biogas. Recycling stations serve as collection hubs, feeding thrift shops equipped with repair, sewing, wood, and laundry facilities. CODA Culture Centre offers workshops on topics like Fixing Fashion, Plastic Recycling, and Bio design. The plastics industry, producing 553 kton of products annually in Gelderland, is exploring circular options like better separation for plastic regranulate production, increased use of recycled plastics in manufacturing, and the adoption of biobased raw materials from fiber-rich and carbohydrate-rich crops, replacing fossil fuels in production processes. Companies like Rymoplast produce regranulate from plastic waste streams, contributing to a more sustainable plastics industry in the region.

Circular Bioeconomy

The emphasis on circularity presents opportunities for innovative solutions in waste management, composting, and biogas production. Initiatives like Attero and recycle stations offer platforms for collecting and repurposing materials, while workshops and cultural centers foster public engagement and awareness.

Table 34: #1 Opportunity – Netherlands – region Apeldoorn – Circular Bioeconomy

Netherlands – region Apeldoorn	
Sector	Circular Bioeconomy
Opportunity	Circular Bioeconomy Innovations
Description	The region's territory is covered by 78% vegetation. This offers a great opportunity to develop a circular bioeconomy. The agricultural and food sector can be the main source of residues that can be used to create biomass. Biomass could be used for energy purposes, converting it into biogas and reducing the demand for imports and to some extent greenhouse gas emissions. At the Vallei en Veluwe water utility's Apeldoorn sewage plant, biogas is produced from sewage sludge ⁵¹⁵² .

Construction and Housing Sector

With plans for 74,000 new homes by 2030 and a focus on sustainable construction practices, there's a significant demand for materials and technologies that promote reuse and reduce environmental impact.

⁵¹ <https://cityloops.metabolismofcities.org/city/apeldoorn/>

⁵² <https://www.energievanapeldoorn.nl/duurzame-energie-opwekken/duurzame-warmte-bronnen#:~:text=Bij%20de%20RWZI%20Apeldoorn%20van,aardgasvrije%20wijk%20van%20Apeldoorn%20geworden.>



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Repurposing existing real estate and adopting circular housing concepts present opportunities for flexible, adaptable housing solutions.

Table 35: #2 Opportunity – Netherlands – region Apeldoorn – Construction and Housing Sector

Netherlands – region Apeldoorn	
Sector	Construction and Housing Sector
Opportunity	Sustainable Construction and Housing
Description	Apeldoorn is specialized in construction, with plans for 74,000 new homes until 2030, accompanied by renovation and repurposing of existing homes. Demand for materials, notably stony building materials, creates opportunities for high-quality reuse and alternative biobased materials like wood and flax. Demographic shifts towards an aging population and single-person households prompt the need for flexible, adaptable housing solutions. Initiatives like the Living Lab and Circular and Biobased Construction Knowledge Center promote the use of reclaimed materials and biobased products in construction projects. Circular procurement models facilitate the reuse of demolition waste. Repurposing existing real estate, such as office buildings into residential spaces, reduces demolition and conserves raw materials.

Other Industrial sectors

In this region, industries such as plastics production, the food industry and paper production present different opportunities for future development of the organic value chain. Paper mills generally used 'virgin pulp' bought mainly from abroad. The use of 'virgin' materials could be replaced through organic solutions such as the use of renewable raw material and recycled fiber. Some projects for recycling products have already been organized in the area. Organic waste from public spaces in Apeldoorn has been used in the production of fibre-based products, such as paper, cardboard, or products made from paper and cardboard. For this project, the municipality of Apeldoorn cooperated with interested entrepreneurs. Paper products containing organic waste were produced at the Middelste Molen museum located in Apeldoorn, or on a larger scale at a paper mill. Cardboard materials were produced using binders of organic origin⁵³.

⁵³ <https://cityloops.eu/cities/apeldoorn>



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Table 36: #3 Opportunity – Netherlands – region Apeldoorn – Plastics Industry Transformation

Netherlands – region Apeldoorn	
Sector	Plastics Industry
Opportunity	Plastics Industry Transformation
Description	The plastics industry in Gelderland holds significant potential for innovation and sustainability. Opportunities lie in improving plastic recycling technologies, increasing the use of recycled materials in manufacturing, and exploring biobased alternatives to fossil fuels. The region's food and paper sectors, traditionally intensive, are ripe for transformation towards sustainability. Embracing plant-based proteins, adopting digital technologies, and exploring alternative food sources such as seaweed can drive environmental resilience and innovation in these industries.

3.11 Germany – region Baden-Württemberg (Ba-Wu)

Agriculture production

Germany is one of the EU's leading agricultural producers. France is the largest EU agricultural producer (23% of the value of EU-15 agricultural production), followed by Germany and Italy (15%)⁵⁴. Agricultural land covers almost 50% (1.4 million ha in 2016) of the total Baden-Württemberg area. Of the agricultural area nearly 58% is arable land and 38% permanent grassland. 15% of the population, that is about 12 million inhabitants (2018) lives in predominantly rural areas.

In the Baden-Württemberg region, arable land is dominant, with mainly small farms. In fact, in this region, there are nearly 40,700 agricultural holdings and only around 3,000 of them cultivate more than 100 ha⁵⁵.

Several sectors are expected to grow in this region in the coming years, including organic farming. This region ranks fourth in Germany in terms of the value of agricultural production. Vineyards, vegetables and fruit are the main crops, specifically, wheat, barley and maize. Above all, corn is used for various purposes, such as for animal feed and as a raw material, while cornstarch is used in various industrial sectors such as plastics, paper, etc. Some important growth drivers for agriculture in this area are government support programs and the development of solutions that can increase production for the same amount of arable land. The development of these technologies creates value not only for the agricultural sector but also for all related sectors such as food, the chemical and cosmetics industry and biotechnology. This region was one of the first to create a bioeconomy research strategy⁵⁶.

⁵⁴A Comparison of U.S. and EU Agricultural Productivity With Implications for EU Enlargement, Susan E. Leetmaa, Carlos Arnade, et al. Link: https://www.ers.usda.gov/webdocs/outlooks/40408/30645_wrs0404e_002.pdf

⁵⁵ Factsheet on 2014-2020 Rural Development Programme for Baden-Württemberg, European Commission. Link: https://agriculture.ec.europa.eu/system/files/2021-10/rdp-factsheet-baden-wuerttemberg_en_0.pdf

⁵⁶ STATE STRATEGY FOR A SUSTAINABLE BIOECONOMY BADEN-WÜRTTEMBERG, June 4, 2019. Link <https://um.baden-wuerttemberg.de/fileadmin/redaktion/m-um/intern/Dateien/documents/Bioeconomy-strategy-barrierefrei.pdf>



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Table 37: #1 Opportunity – Germany region Baden-Württemberg – Agriculture

Germany – region Baden-Württemberg (Ba-Wu)	
Sector	Agriculture
Opportunity	In the Baden-Württemberg bioeconomy strategy, the agricultural sector plays a central role. The need to change the current agricultural production, to make it increasingly sustainable and efficient, will create many opportunities for the bioeconomy in the agricultural sector.
Description	The Baden-Württemberg region gives particular attention to bioeconomy issues. This region was one of the first to adopt a state strategy for a sustainable bioeconomy. One of the objectives of this strategy is to strengthen rural areas based on innovative bioeconomy solutions. The demand for organic products in Baden-Württemberg is constantly increasing. In this region there are more than 13,000 companies operating in agricultural, processing and organic trade sectors. From 2010 to 2020, the number of farms growing organically increased by 47% and the area cultivated organically grew by 77% ⁵⁷ .

Development of existing bio-based sectors

As already pointed out above, the Baden-Württemberg region has already developed important value chains related to the bioeconomy. For this reason, industries are currently present in different sectors such as agriculture, forestry, fisheries, food, energy, biotechnology and others. Other very important sectors in which the decarbonization of production processes could lead to an integration of the circular economy in the coming years are the production of steel, iron and paper. This region aims to become a reference point for the sustainable development of the bioeconomy from a technological and social point of view. The bioeconomy sector in the Baden-Württemberg region already has a high number of companies, especially micro and small ones. The Bioeconomy Actor Platform provides an overview of the institutions involved, such as universities, research institutes, companies and associations, operating in the bioeconomy⁵⁸.

In this region, the growth opportunities for the bio-based sector derive from the presence of several companies and research institutions operating in this sector. In addition, bio-based pharmaceuticals could be developed in this region as there is a major pharmaceutical industry.

⁵⁷Zukunftsfähige Land- und Forstwirtschaft. Link: <https://www.baden-wuerttemberg.de/de/bw-gestalten/nachhaltiges-baden-wuerttemberg/landwirtschaft>

⁵⁸ https://biooekonomie.baden-wuerttemberg.de/_Lde/Startseite/Akteure+in+BW/Online+Kompetenzatlas?search=true&umkreis=10&ort=&textsuche=&themen=Nahrungs-%20und%20Futtermittel&organizationType



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Table 38: #2 Opportunity – Germany region Baden-Württemberg – Bio-based sectors

Germany – region Baden-Württemberg (Ba-Wu)	
Sector	Bio-based sectors
Opportunity	In the region of Baden Württemberg there are several sectors already active in the field of bioeconomy. The opportunities here can derive both from sectors that already have a consolidated market (biotech, agricultural, forestry) and consequently already used organic products, and sectors where these products are not yet fully widespread, but which still have an interest in using them to reduce GHG emission (energy-intensive industries such as the steel, metal and paper industries).
Description	The region of Baden Württemberg is already active in the bioeconomy sector. Here, in fact, there are several bio-based sectors that have an established market base. The most structured biobased sectors in this region are agriculture, forestry, fisheries, food and bioenergy. Other opportunities may arise from the textile and clothing sector, in fact cooperation and information events have already been held on these issues. The Textile ETP has launched the Circular & Biobased Textiles Innovation Hub to help textile companies, research organisations, brands and retailers to learn, network and collaborate on the hot topics of circular and biobased textiles ⁵⁹ .

Table 39: #3 Opportunity – Germany region Baden-Württemberg – Biotechnology

Germany – region Baden-Württemberg (Ba-Wu)	
Sector	Biotechnology
Opportunity	The Baden-Württemberg region is an important technology hub for the development of biotechnology. This sector is also supported by active policies.
Description	The Baden-Württemberg region is an important technology hub; in fact, it can count on about 156 companies active in this field, especially micro and small enterprises. In this region there are some of the largest biotechnology plants in Europe, especially in the cities of Biberach, Laupheim and Ulm. This sector is also supported by active policies that support its development at the local level. This region is currently an important hub for the development of energy-saving technologies ⁶⁰ . Through its governmental strategy, this region wants to become a national and international leader for sustainable development of the bioeconomy both from a technological and social point of view.

Bio-based energy production

In the energy sector, there can be several opportunities for the bioeconomy. In fact, bioenergy production is already present in this region, which could also increase thanks to the more general objective of increasing the share of renewable energy.

The Baden Württemberg region has a large forest area and is particularly active in high-tech applications for forestry. Part of the wood produced is used for the energy sector with the aim of reducing fossil fuel

⁵⁹ <https://textile-platform.eu/innovation-hub-circular-and-biobased-textiles>

⁶⁰ Improving the energy efficiency of electricity and heat. Link <https://um.baden-wuerttemberg.de/en/topics/energy-transition/energy-efficiency>



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emissions. In this area there are several stakeholders currently involved in the production of forest biomass: landowners and sawmill industry, wood building and construction sector, etc. In addition, the use of forest biomass is supported by the government through the introduction of an action plan on the subject. This region was the first in Germany to approve a law for heat utilization from bioenergy in the building sector in 2008.

In Baden-Württemberg, 8.2 % of the agricultural land is used for bioenergy. Since 2015, the biobased waste streams are collected separately in this region to provide resources for a high value energetic and materials use⁶¹. These resources can be exploited in several ways such as composting, fermentation, thermic use.

Table 40: #4 Opportunity – Germany region Baden-Württemberg – Energy

Germany – region Baden-Württemberg (Ba-Wu)	
Sector	Energy
Opportunity	The main opportunity of the energy sector is to increase the production of bioenergy from forestry and agricultural sectors.
Description	The widespread use of the bioeconomy in the region, the presence of adequate resources and the commitment of the public entities are the main factors for a further development of value chains targeting the production of bioenergy from bio-based residual streams from forest and agricultural industries.

3.12 Italy – region Campania

The region of Campania envisions a future grounded in sustainable agriculture, technological innovation, and product diversification. With renowned products like San Marzano tomatoes, mozzarella di bufala, and fine wines, Campania's agricultural sector boasts diversity and quality. The integration of new technologies and circular economy principles promises enhanced efficiency and waste reduction, fostering a more sustainable agroindustry. Biobased waste utilization presents opportunities for the development of innovative products like bioplastics and biofuels, contributing to climate change mitigation and circular economy goals. Additionally, the focus on healthcare and the blue economy underscores Campania's commitment to research, innovation, and economic development. Investment packages in biotechnology for health aim to revolutionize oncological research, while the blue economy sector offers avenues for sustainable growth and job creation⁶². Through strategic initiatives and collaboration, Campania seeks to position itself as a leader in sustainable agriculture, innovation, and healthcare, driving economic prosperity and environmental stewardship in the region.

Sustainable Agriculture and Innovation

Campania's focus on sustainable agriculture involves adopting organic farming practices and leveraging innovative technologies like precision farming and artificial intelligence. By embracing these methods, farmers can enhance crop yield, minimize resource use, and reduce environmental impact. Moreover, the region's emphasis on product diversification, including famous items like San Marzano tomatoes and mozzarella di bufala, presents opportunities to expand market reach and meet evolving consumer

⁶¹ Interreg Danube Transnational Programme DanuBioValNet, Country report, WP3 A-3.1.

⁶² Regione Campania – RIS2 Campania Documento di aggiornamento



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preferences. Through sustainable agriculture and innovation, Campania aims to strengthen its agricultural sector, promote food security, and drive economic growth while preserving its rich culinary heritage.

Table 41: #1 Opportunity – Italy – region Campania – Sustainable Agriculture

Italy – region Campania	
Sector	Sustainable Agriculture
Opportunity	Sustainable Agriculture and Innovation
Description	Campania aims to adopt organic farming methods, embrace precision farming, and integrate artificial intelligence to enhance productivity and reduce waste.

Circular Economy Integration

The Regional Council has updated the Regional Plan for Special Waste Management in Campania.

The update of the Plan aims to achieve the objectives of circular economy and ecological transition, taking into account the effects that Special Waste management has on the environment, human health, the economy and society in general. This plan has five strategic objectives:

- Promote the reduction of the quantity and hazardousness of waste produced;
- Promote the reuse of waste produced within different production cycles;
- Promote the maximisation of recycling and other forms of recovery and the minimisation of disposal;
- Promoting the principle of proximity of facilities to the places where waste is produced in compliance with environmental sustainability criteria;
- Promoting the fight against the illegal management of special waste⁶³.

By implementing innovative technologies and sustainable practices, such as composting and waste valorisation, the region can reduce its environmental footprint while generating new revenue streams. Furthermore, promoting product diversification and adopting eco-friendly packaging solutions can enhance market competitiveness and consumer appeal. Through circular economy integration, Campania seeks to foster a resilient and sustainable agroindustry ecosystem that balances economic prosperity with environmental stewardship.

⁶³ Regione Campania – Piano Regionale di Gestione dei Rifiuti Speciali 2022:

<https://www.regione.campania.it/regione/it/tematiche/piano-regionale-di-gestione-dei-rifiuti-speciali/piano-regionale-di-gestione-dei-rifiuti-speciali-2022?page=1>



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Table 42: #2 Opportunity – Italy – region Campania – Circular Economy

Italy – region Campania	
Sector	Circular Economy
Opportunity	Circular Economy Integration
Description	Embracing circular economy principles can help Campania reduce waste, promote resource reuse, and drive innovation in the agroindustry sector. By integrating new technologies and fostering product diversification, the region can enhance efficiency, meet evolving consumer needs, and expand export markets.

Bio-based Waste Utilization

Campania recognizes the potential of biobased waste utilization to reduce environmental pollution, mitigate climate change, and promote resource efficiency.⁶⁴ By investing in biorefinery technologies and composting infrastructure, the region can transform organic waste into valuable products such as bioplastics, biochemicals, and biofuels. Moreover, utilizing biobased materials in several sectors (highlighted in the table below) can help reduce reliance on fossil resources and minimize carbon emissions. Through strategic waste valorisation initiatives, Campania aims to create a more sustainable and circular economy that maximizes resource utilization and minimizes environmental impact.

Table 43: #3 Opportunity – Italy – region Campania – Biobased Waste Utilization

Italy – region Campania	
Sector	Biobased Waste Utilization
Opportunity	Biobased Waste Utilization
Description	Campania sees potential in developing biobased products and valorising biowaste through processes like biorefinery and composting. By transforming waste into valuable resources, the region can create new revenue streams, mitigate climate change, and contribute to a circular economy. For example citrus waste is exploited to produce essential oils and animal feed, tomato pomace is exploited to produce animal feed, pectin and food additives, wine residues is used as animal feed and for fertilizer production and cheese waste is used as animal feed and for the production of biogas.

⁶⁴ Regione Campania: Proposta di Aggiornamento del Piano Regionale per la Gestione dei Rifiuti Speciali della Regione Campania - <https://www.regione.campania.it/assets/documents/01-proposta-di-aggiornamento-prgrs.pdf>



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Conclusions

The BIOLOC project aims at fostering the development of local value chains and promoting sustainable practices across participating regions. Deliverable D4.2 *"Opportunities for local value chains"* is the result of the dedicated work conducted under WP4, specifically T4.2 *"Matchmaking and creation of opportunities for local value chains."* The overarching goal is to identify and explore potential avenues for enhancing local economies while considering regional strategies and ongoing initiatives.

The foundation of this work lies in D4.1 *"Analysis of local context"* where a thorough examination of the biobased value chain in each participating region was conducted. By analyzing the intricacies of these value chains, valuable insights into their strengths, weaknesses, and inherent opportunities were gained. This analysis provided the necessary groundwork for the current document, allowing the identification of sectors and products with the greatest potential for growth and innovation.

From sustainable agriculture and technological innovation to product diversification and waste utilization, each opportunity represents a unique pathway towards enhancing the resilience and competitiveness of local value chains.

In the exploration of sustainable agriculture, opportunities for the adoption of organic farming methods and the integration of precision farming techniques have been identified. Similarly, the realm of technological innovation presents immense opportunities for advancing local value chains. Through the adoption of artificial intelligence, precision farming technologies, and digital solutions, stakeholders can optimize resource allocation, reduce waste, and improve overall efficiency. Product diversification emerges as another key opportunity, allowing regions to explore new crops, value-added products, and niche markets. Furthermore, the utilization of biobased waste presents a promising avenue for creating value and reducing environmental footprint. Through processes such as biorefinery, composting, and waste valorization, regions can transform organic waste into valuable resources, thereby promoting circular economy principles and reducing reliance on finite resources.

The potential impact of these opportunities extends beyond economic considerations, encompassing social and environmental dimensions as well. By fostering the development of local value chains, regions can create new job opportunities, stimulate entrepreneurship, and promote social cohesion within communities. Additionally, the adoption of sustainable practices and the development of biobased products contribute to environmental conservation efforts, mitigating climate change, and reducing dependence on fossil fuels.

Looking ahead, the opportunities identified in this document will serve as a foundation for the development of network business models in T4.3 *"Definition of network business models for regional clusters."* By leveraging these insights and fostering collaboration among stakeholders, the aim is to unlock the full potential of local value chains, driving economic growth and promoting sustainable development.

In conclusion, this document underscores the collective commitment to building resilient, inclusive, and sustainable local economies. Through collaboration, innovation, and strategic investment, stakeholders can harness the transformative power of local value chains, to uncover and investigate potential pathways for bolstering local economies while taking into account regional strategies and existing initiatives.



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