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BIOECO-R.D.I

BIO-ECOnomy Research Driven Innovation International Strategy

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1. INTRODUCTION

We live in a world of limited resources. While facing global challenges like climate change, land and ecosystem degradation and growing human population, we need to start respecting the ecological boundaries of our planet. With increasing awareness of the consequences of climate change there is a growing pressure on designing more sustainable production and business models.

Production of biomass should be optimised to increase efficiency and improve management of bioresources. With a shift in this direction, it would be possible to reduce waste generation, environment contamination and usage of fossil-based resources (Bioeconomy development in EU regions, 2017). We can make that possible by modernising our industries by using innovative ways to produce and consume food, products and materials within healthy ecosystem made possible through a sustainable bio-economy (A sustainable bioeconomy for Europe: strengthening the connection between economy, society and the environment, 2018).

Overall agriculture and forestry are accounted for ca. 30% waste produced worldwide. However, the shift to more sustainable models should also happen in the industrial and economic processes that are commonly addressed as bioeconomy. EU started the strategic journey to bioeconomy in 2012, when the first European Bioeconomy Strategy was presented from European Commission.

The ADRION region is identified as the area with relevant unexploited potential of biomass from agricultural, fisheries and forestry waste and residues. Since the bioeconomy is not fully matured in the region yet, there are significant delays in the green reconversion, multi-functioning, technology innovation and cross-sector integration within the companies operating in the sectors dealing with biomass. BIOECO-RDI project is trying to guide the structured bio-economy sector through the development of Research Driven Innovation (R.D.I.) to develop a Regional Innovative System for the Adriatic-Ionian region.

2. OVERVIEW

BIOECOnomy Research Driven Innovation (BioECO-RDI) International Strategy for ADRION region is one of the main outputs of the project. It highlights the results of national SWOT analysis and national BioECO-RDI strategies prepared by the partnership.

The transnational BIOECO- RDI Strategy is a result of the first year's BIOECO RDI project activities, which were mostly related to analysing the regional/national bioeconomy and its development in project regions (Umbria region (Italy), Slovenia, Croatia, Serbia, Albania, Region of Western Macedonia (Greece)). It is conceived as a complementary part of the regional/national strategies with the aim to support the development of regional /national bioeconomy RDI policy in an international scenario. The findings in the document are based on national and international work group meetings, and meetings with chosen representatives of industry, research and policy in each country.

The transnational strategy contributes to the programmes specific objective because it aims to lead the regions of the area toward the creation of development of a model which guarantee:

- ✓ Creation of collaborative network among regions, enterprises and academia aimed at developing a common path towards improvement of regional research driven innovation in the area of bioeconomy and therefore the maturity of bieoconomy business;
- ✓ Transition toward higher level of green chemical research and technology applications
- ✓ Promoting cross-sector clustering process oriented toward creation of integrated supply chains at regional and international level
- ✓ Integration of bioeconomy enterprises in the international innovation network
- ✓ Development of bio based market in the region
- ✓ Activation of collaborative research, knowledge transfer, industrial innovation and skill development in the field of bioeconomy and by that help bridging the gap between countries in the region and help reducing large regional disparities in the area of bioeconomy.
- ✓ **Creating opportunities for direct contacts among SMEs working in the bioeconomy, renewable energy, waste management sector in order to support the start-up of commercial and industrial relations**
- ✓ **Also support the start-ups in each country involved in the project that can be put in**

contact with the network of companies, research centers and institutions involved in the project

- ✓ **Development of a common virtual platform in order to give international visibility to the requests and offers of collaboration that could therefore activate partnerships also with others different countries than those already involved in the project**

The document is twofold and identifies common fields of cooperation and specific development targets for all actors involved in the collaboration network. In the first part it describes the international collaboration network and its objectives while the second part describes more in detail bi and multi-actors collaboration initiatives. The activities in the strategy will be executed in the second part of the project duration.

BIOECO- RDI PROJECT

The ADRION region is identified as the area with relevant unexploited potential of biomass from agricultural, fisheries and forestry waste and residues. The development and implementation of bioeconomy throughout the region is very diverse in sense of its bioeconomy development. While some parts of region are recognized as being in its mature stage (according to the bioeconomy RDI level and business maturity), the majority of region is in its initial or in driving to maturity stage. Therefore significant delays in the green reconversion, multi-functioning, technology innovation and cross-sector integration within the companies operating in the sectors dealing with biomass were identified. The regional mainly traditional business (chemical, plastics, etc.) needs to start investing in more eco oriented process. In this perspective bioeconomy guarantees a research driven innovation process for a new sustainable development of the area.

The BIOECO- R.D.I. project is designed to support research driven innovation and cluster maturity in the ADRION region. The project is trying to guide the structured bio-economy sector through the development of Research Driven Innovation (R.D.I.) to develop a Regional Innovative System for the Adriatic-Ionian region. The implementation of the national and international strategies would enable to design a suitable process of incorporation and development of bio-economy for all the countries in the region. That is important since not all countries have the same maturity of bio-economy processes, yet they all need an eligible process that guarantees that enterprises in the region are able to operate successfully in a more advanced and integrated market. That market should be supported with efficient policies on regional and national levels, strongly based on the circular economy approach.

The project addresses some of the main challenges and needs identified in the region and highlights the possible areas of collaboration where the international group could contribute to the

development of local and regional bioeconomies. Its expected results are implementation of regional and international Innovation system based on BIO-economy research driven innovation strategies. The recommendations given in project documents will work towards promoting the benefits of the bioeconomy for development and uptake of research driven innovation in the bio based products sector for the national as well as for the regional economy development.

3. OVERVIEW OF THE CURRENT SITUATION IN ADRION REGION

3.1. AN OVERVIEW OF THE EXISTING SITUATION

The overview of the ADRION region based on prepared national SWOT analyses and work group meetings provides the insight into the bioeconomy of the region dealt with in the project and the disparities that exist within it.

At the same time it lists the possibilities and opportunities which should be pursued with the aim to improve the regions framework condition for improving the bioeconomy RDI level, bioeconomy cluster maturity and for supporting the Biobased (BB) product market uptake.

There are many differences between the partner countries / regions involved in terms of overall economic development and the current economic situation as well as in terms of demographic development and geographical characteristics. These differences are also reflected in the bioeconomy development of respectable countries /regions.

The biomass potential of the region is high. However, its exploitation in terms of bio-economy - that is, the development of new innovative materials and products, and the replacement of non-renewable energy sources with biomass - is rather poor.

The most developed in a sense of bioeconomy is the **region Umbria** in Italy. The major sources of biomass in it are coming from agriculture, zootechnic industry and from residual of wood industry supply chain. Also relevant is the waste specially the food industry waste. Despite the importance of wood surface and agrifood industry in Umbria, the main bioeconomy sector in this region is represented by the bioplastic supply chain using agricultural biomasses as raw material. This supply chain is based on a strong collaboration between bioplastic industries (Novamont, Tarkett) and agro industries and it stimulated the emergence of many companies involved in the packaging value chain in the region. The region developed an advanced bio-based product industrial sector with high level of research driven innovation and integration among bio-based product industries and biomass productive sector. Several bioeconomy products have been developed and reached the market, mainly in the sector of bio-polymers. While agricultural biomass is well exploited in

bioeconomy the rest of biomass available in the region such as wood is mainly used for energy purposes. The presence of large bio-industry and of bio clusters present in region (green chemistry cluster SPRING and Agrifood cluster) also have a lot of credit for good cooperation between R & D and industry, and in some cases even for the establishment of private research institutions, as well as for the creation of a Biomass research center (CRB) within the University of Perugia. The clusters are also well involved in the political creation and implementation of bioeconomy strategy in region and in the country.

Despite all these advantages, the region still faces a low level of demand for bioeconomic products and a poorly developed market for Biobased products.

According to the above said, one can imagine why the situation in other parts of ADRION region is at a much lower level. There the economy is significantly less developed, the economic standard at a much lower level and some parts of region are still facing high unemployment rate (Greece). The market consists of predominantly small sized companies, and the investment potential is low. Last but not least, the recent history and lack of political strategy and will in the direction of the bioeconomy, does not help the overall situation. We could say that this part of the region is still being introduced with the term bioeconomy, so producers and consumers have not yet recognized all of its benefits, and policy has not yet put it into their agenda. Bio-economy is relatively poorly developed, and biomass is mainly used for energy and heating plants and for the production of biogas and biofuels. In some countries, we find some good examples of using local biomass for development of new products and materials with a higher added value, but this are mostly niche products.

Slovenia and Croatia, that according to the bioeconomy RDI level and business maturity fall into categorization “drive to maturity” have developed some models of collaboration among applied research and industry for technology transfer; however the biobased product market in both countries is still largely undeveloped. Although competitive bioeconomy products in the markets exist and are sold on the market, commercially viable products are scarce. Mostly these are niche products. But the countries have some very good experiences in the research area in particular in the utilization of residues deriving from wood industry, invasive plants and aquaculture industry as a raw material for bio-based product which could be transferred in the whole area.

In **Slovenia** there is a sufficient amount of biomass resources such as wood, its residues and waste, as well as biomass from other bio-waste such as bio-garbage, agricultural waste, food waste, waste from livestock production, municipal wastes, sewage water etc. However most of this biomass is significantly unexploited. Wood and wood biomass are the most abundant in Slovenia (due to the fact that almost 60% of the area is covered with forest), and in addition, wood was also recognized as a strategic renewable resource at the state level. Yet its use is very poor. Due to the collapse of

the wood processing industry, mostly private forest ownership and therefore lack of more sustainable forest management, most of the timber harvested is exported to neighbouring countries. The residues are mostly processed into pellets and used for energy and heat. According to the research, the amount of wood biomass, despite the improvements in ownership and the wood processing industry, would be hardly sufficient enough to trigger higher production of bio-economy products. Therefore, in the field of bioeconomy and the use of wood biomass for these purposes, it would be worthwhile to think in the direction of content route to bioeconomy by processing small scale, high added value products where high knowledge is needed and to look for opportunities for products from wood biomass in the chemical, automotive, cosmetic, construction industry.

One of the potentially very attractive biomass in Slovenia, where research is already underway, is biomass from invasive alien plants, where attempts are being made to use them in the chemical and paper industry.

There is also great potential for the use of waste biomass from bio-municipal waste, livestock waste, where certain solutions already exist (biogas, methane).

The main obstacle to the use of all these biomasses for high added value products is the lack of technology for its processing- biorefinery. However, as all biomasses mentioned, have a problem of seasonal availability and spatial dispersion an opportunity in seen in local small biorefineries and in the closure of local circles.

However, the bio-economy in the country is present in value chains (automotive, packaging, chemical), but the companies in them usually represent a small part of larger value chain and usually do not use local biomass resources but imported.

The research on the other hand is on a very high level and the direction in the production of small scale and high added value products where high level of knowledge and services is needed represents the direction in which it is worth proceeding.

Croatia has a relatively high biomass potential which besides forestry and wood industry residues, comprises residues from agriculture and biomass obtained from animal carcasses and by-products. Aquaculture and fisheries are also significant sources for biomass exploitation, especially when the total Croatian mariculture production, freshwater fish production, and fisheries catch are considered, as well as the fish processing industry. Besides meat processing industry and almost entire food industry, fish processing industry is one of the most significant environmental pollutants. The country has a well-developed aquaculture and fisheries sector as well as forestry and wood industry, but the problem is again in the consistent provision of quality biomass resources, since the availability of it is restrained by technical, economic and environmental

factors.

In **Region of Western Macedonia** which is also called the »Energy heart of Greece, the following biomass is available: biomass from agriculture (energy crops and residues), biomass from livestock (manure and animal residues) and wood and wood waste biomass. At the moment the majority of biomass is used for biofuels and energy production. Cultivation of energy crops is still rather in small scale and should be examined carefully taking into account competitive cultivations and energy crops demand on resources (water).

Forest biomass is not exploited sufficiently due to terrain morphology (unreachable forests) and the non-cultivation of forest trees.

Since there is no chemical industry in the region the green chemistry has not yet been exploited. But at the region there are a lot of mink farms, and some first attempts to use the mink urine as fertilizers were the first attempts toward the green chemistry although event that only reached the small scale pilot phase.

Biomass represents a significant energy potential of the **Republic of Serbia**. The biomass potential is estimated at 3.448 million ton and the share of RES accounts for 61%. The biggest part of this potential lies in wood and agricultural biomass (comprising also residues in agriculture, cattle breeding, fruit growing, viticulture and primary processing of fruits), while the potential of biodegradable municipal waste (comprising also waste edible oils and animal waste (waste slaughterhouse waste) in a lot lower.

However, while the degree of utilization of woody (forest) biomass potential is relatively high (66.7%), the potential of agricultural biomass is slightly used (~ 2%), while the potential of biodegradable municipal waste is not used at all. But having in mind the existing structure of industries in Serbia, there is no doubt that agriculture; including both plant-biomass and animal breeding are the fundamental for the development of bioeconomy in the country, as well as in the region of Vojvodina, which is countries basis for agriculture.

Food and feed procesing industries are also very important, while forestry, pharmaceutical industry chemical and biodegradable materials industry, construction industry and bio-energy sector are not to be neglected.

Albania has high amount of biomass production. Due to the significant forest surfaces, large number of processors and timber suppliers and co-production of sawmills, the wood biomass is abundant. Also agricultural waste coming from large areas of cultivation of grain crops, corn, soybeans, and significant areas of fruit trees, olive trees (cultivated for oil production) and citrus fruits represent another source of biomass with high exploitation potential.

Despite the significant biomass source in the country, its exploitation is very low and benefits for

bioecomy at this stage are small. Wood biomass in mainly used for heating, while there is no use of agricultural waste biomass at the moment.

Two highly potential sources of biomass were defined in the country which could be interesting for the development of bioeconomy. Due to high production of olive oil and a network of olive oil extraction plants (about 400 factories) a high amount of waste such as pits, the vegetal waters, or pulp is produced which represent a huge burden for the environment and are responsible for the pollution of great number of water and ground ecosystems.

Another source of potentially interesting biomass also comes from agriculture, more specifically from poultry business where different kinds of poultry biomass can be found. From chicken manure, which is currently in the sense of bioeconomy in some good practise cases in the country dries and turned into organic fertilizer in agricultural economies, instead of just disposed in the field; and in the waste of poultry farms and egg farm. The potential is seen however in the transformation of it into bioenergy. Another opportunity is seen in using the eggs which are out of standard, cracked or broken by establishing a plant where such eggs could be converted into frozen or powdered form which can be used in food production.

The research part varies among countries but is mostly very good in all involved regions. A wide range of knowledge and research organizations makes a good basis for knowledge exchange between countries within the region. The problem present in most countries is however a transfer of this knowledge from research institutions to industry and integration of research outputs to industry and then further on to market (the exception here is Umbria, where the link between the biopolymer industry and the research organizations is very good and the level of research results transferred to industry is higher).

The poorly developed markets and low demand for bio based products; low awareness of the full potential of bioeconomy among entrepreneurs (SMEs) and consequently the weak industry's interest in investing in bio-economy are on the top of the list when we try to find the reasons for it. Lack of innovation culture among entrepreneurs and therefore lack of their incentives and funding the research are also very common. The biggest challenge for the industry in the region remains the development of new markets as well as the high investments that usually accompany the transition to the production of bio-based materials and products.

One of the characteristics of this area which is not helping the situation is also the weak linkage between industry and research organizations. These linkages could be significantly improved by clusters. The positive example can be seen in Umbria, where the presence of bio clusters has made huge improvements in regional entrepreneurship and their understanding of bioeconomy. In other

parts of the region bio clusters are rear and usually still in initial stage. Therefore, their role as a catalyst for bioeconomy has not yet been fully developed and their progress is not yet visible. However, traditional industrial clusters (potentially dealing with bio-based industry) are present and can be the driving force in the development of bioeconomy clusters.

One of the areas where cluster active involvement could also have a huge impact is policy. Region seriously lacks supportive policies in this area. While policy is slowly getting to know bioeconomics, its behaviour is too slow and too decisive for more visible progress (excluding the Umbria region). None of the region countries, with exception of Italy, have bioeconomy strategy. In some regions bioeconomy has been partially integrated into the Smart Specialization Strategy and in some much more focus has lately been given to the attempts to adopt the circular change concept. Also noticed in majority of region is that the area of bioeconomy, which is indeed large, is usually dispersed among various governmental bodies, which complicates and slows down the management of the area. In all countries it was observed that communication to policy makers is a challenge. Their involvement in the projects is usually negligible, which makes it difficult to make progress. Often we are witnessing non-cooperation among different levels of government and among different ministries, which should work closely together if the country wants to make such big moves as is the move toward more sustainable and circular bioeconomy.

Most of the countries are included in several EU programmes for funding which gives them the opportunity to obtain funds for research projects in this area. However all countries are lacking the EU and national funds for transfer of research outputs to application level and for development of new products. Heavy bureaucracy associated with obtaining EU funding discourages industry to enter the EU and national projects and partnerships, which further slows down the transfer of research results to application-level and the development of new products.

The biomass applications with higher added value in the region are rear (except in Umbria where different biomass is used for production of different kind of plastic products) and biomass is usually used for energy and heating. The cascade use of biomass is rear or almost none existing. There are more reasons for it but one is certainly the existence (or better the non- existence) of biorefinery in the respected countries.

3.2. OVERVIEW OF EXISTING EU REGULATIONS IN THE BIO-ECONOMY SECTOR

One of the latest strategies on EU level concerning bioeconomy is the updated version of 2012 Bioeconomy Strategy published in October 2018. The 2012 Bioeconomy strategy aims to pave "the way to a more innovative, resource efficient and competitive society that reconciles food security with the sustainable use of renewable resources for industrial purposes, while ensuring environmental protection". The updated version from year 2018 did note that there are certain adaptations needed, such as renewal of the Industrial Policy, Circular Economy Action Plan and Clean Energy for All Europeans Package (European Commission, 2018). The 2012 Bioeconomy Strategy is one of the main strategic documents on EU level in the context of bioeconomy, yet there are many more policies that are relevant for the bioeconomy (Table 1).

Strategies relevant to the bioeconomy	
Bioeconomy specific	➢ Commission communication 'Innovating for sustainable growth: a bioeconomy for Europe' (EC 2012a)
Sectors mainly supplying biomass	
Agriculture	➢ Commission communications: legislative proposals on the common agricultural policy (CAP) beyond 2020 (COM/2018/392 final; COM/2018/393 final; COM/2018/394 final/2) ➢ Commission communication 'Thematic Strategy for Soil Protection' (SEC(2006)620)
Forest-based sector	➢ Commission communication 'A new EU forest strategy: for forests and the forest-based sector' (EC 2013a) ➢ Commission staff working document 'Multiannual implementation plan of the new EU forest strategy' (EC 2015a) ➢ Blueprint for the EU Forest-based Industries (SWD(2013)343)
Fisheries, aquaculture and algae	➢ The Common Fisheries Basic Regulation (EU) No 1380/2013 ➢ Commission communication 'Blue growth: opportunities for marine and maritime growth' (EC 2012e) ➢ Report on the Blue Growth Strategy, Towards more sustainable growth and jobs in the blue economy, SWD (2017) 128 final ➢ Commission communication 'Strategic guidelines for the sustainable development of EU aquaculture' (EC 2013e) ➢ Joint communication "International ocean governance agenda for the future of our oceans" (EC 2016)
Waste	➢ See cross-cutting policies (below)
Sectors mainly using biomass	
Food and nutrition security	➢ Commission communication 'An EU policy framework to assist developing countries in addressing food security challenges' (EC 2010e) ➢ Commission communication ' Increasing the impact of EU development policy: an agenda for change' (EC 2011c) ➢ Commission communication 'Enhancing maternal and child nutrition

	in external assistance: an EU policy framework' (EC 2013b) ➢ Commission communication ' The EU approach to resilience: learning from food security crises' (EC 2012c)
Energy	➢ EU Renewable Energy Directive (2009/28/EC) ➢ Commission communication 'An energy policy for Europe' (EC 2007a) ➢ Commission communication 'A European strategic energy technology plan (SET-plan) — Towards a low carbon future' (EC 2007b) ➢ Commission communication 'Limiting global climate change to 2 degrees Celsius — The way ahead for 2020 and beyond' (EC 2007c) ➢ Commission communication 'Energy 2020 — A strategy for competitive, sustainable and secure energy' (EC 2010f) ➢ Commission communication 'Energy roadmap 2050' (EC 2011d) ➢ Commission communication 'A policy framework for climate and energy in the period from 2020 to 2030' (EC 2014a) ➢ Commission communication: 'Accelerating Europe's transition to a low-carbon economy' (EC 2016k) ➢ Clean Energy Package (2016) ➢ Commission communication 'The role of waste-to-energy in the circular economy', (EC 2017a)
Bio-based industries	➢ Commission communication 'A lead market initiative for Europe' (EC 2007d) ➢ Commission communication 'Preparing for our future: developing a common strategy for key enabling technologies in the EU' (EC 2009) ➢ Commission communication: 'A stronger European industry for growth and economic recovery' (EC 2012d) ➢ Commission communication 'For a European industrial renaissance' (EC 2014f) ➢ Future strategy on plastics use, reuse and recycling (EC 2016l)

Cross-cutting policies relevant for the bioeconomy	
Environmental protection and Climate Change	➢ EU Action Plan for Nature, People and the Environment (COM(2017)0198 final) ➢ EU Biodiversity Strategy (COM/2011/0244 final) ➢ EU Strategy on adaptation to climate change (COM/2013/0216 final)
Circular economy — Waste	➢ Commission communication 'Towards a circular economy: a zero waste programme for Europe' (EC 2014e) ➢ Commission communication 'Closing the loop — An EU action plan for the circular economy' (EC 2015b) ➢ Commission communication 'The role of waste-to-energy in the circular economy' (EC 2017a) ➢ Future strategy on plastics use, reuse and recycling (EC 2016l) ➢ Waste package 2018 ➢ Fertiliser Regulation (Regulation (EC) No 2003/2003) ➢ A European Strategy for Plastics in a Circular Economy (EC 2018)
Regional policies — Smart specialisation	➢ Commission communication 'Regional policy contributing to smart growth in Europe 2020' (EC 2010g) ➢ Commission communication 'Strengthening Innovation in Europe's Regions: Strategies for resilient, inclusive and sustainable growth (EC 2017)
Research and innovation	➢ Commission communication 'Europe 2020 flagship initiative — Innovation union' (EC 2010a)
Industrial policy	➢ Commission Communication 'Investing in a smart, innovative and sustainable Industry- A renewed EU Industrial Policy Strategy' (COM/2017/0479 final)

Table 1: EU policies relevant for bioeconomy (European Commission, 2018).

The key factors in the area of growth and employment are gathered in the Europe 2020 Strategy that gives the following guidelines to achieve the goals:

- Smart growth conducted from research and innovations
- Sustainable growth from meaningful exploitation of resources and policy of greenhouse gas emission
- Inclusive growth, based on employment, productivity and social and territorial cohesion.

These guidelines are followed in the documents and initiatives such as Digital agenda for Europe, Innovation Union, Youth on the move, Resource efficient Europe, An industrial policy for the globalisation era, An agenda for new skills and jobs and European platform against poverty. Within these initiatives the bioeconomy is addressed as a key element for smart growth and green economy in Europe.

Financial support is one of the most important instruments to enhance the commercialisation of

bio-based products and services. EU is a crucial stakeholder in this perspective, since it enables the funding through EU, national and regional strategies for bioeconomy development. Together with other stakeholders it forms a supportive environment for the development of bioeconomy:

- Horizon 2020: Research and Innovation programme that works as a financial instrument implementing the Innovation Union, a Europe 2020 flagship initiative aimed at securing Europe's global competitiveness
- SET (Strategy Energy Technology) Plan: technological pillar of funding in the fields of energy and climate policy
- Joint-Technology Initiatives (JTIs): public-private partnerships that join industry, research institutions and public institutions to encourage international research projects
- Bio-based Industries (BBI): initiative for public-private partnership to enhance private co-financing investments in bio-industries in Europe, financed from Horizon 2020.
- NER300 is an EU funding program for innovative low carbon demonstration projects in the field of renewable energy sources, specifically for carbon capture and exploitation
- European Investment Bank: an example of financing with loans and bank guarantees from EU intended for small and medium-sized Enterprises (SMEs), regional development, environmental sustainability, innovations, trans-European networks and energy sector.

The EU multiannual financial framework is an important factor for achieving goals in the area of bioeconomy. There are two highlighted programmes that concern bioeconomy:

- COSME

  EU programme for the Competitiveness of small and medium-sized Enterprises running from 2014 - 2020, with a planned budget of EUR 2.3 billion. SMEs are the backbone of Europe’s economy, providing 85% of all new jobs. The European Commission aims to promote entrepreneurship and improve the business environment for SMEs to allow them to realise their full potential in today’s global economy.

- Horizon 2020

  Horizon 2020 is an EU Research and innovation programme that supports and promotes research in European research area. It works as a financial instrument to fund research, technologic development and innovations. The latter are expected to contribute to economic growth and providing solutions for end users. The most important areas for bioeconomy development within this programme are:

- health, demographic changes and welfare,
- food supply, sustainable agriculture, marine and maritime research and the bio-economy,
- safe, clean and efficient energy,
- smart, environmentally-friendly and connected traffic,
- climate action, efficiency of resources and raw materials,
- an inclusive, innovative and secure society.

3.3 CURRENT TRENDS IN THE BIO-ECONOMY SECTOR

Five main objectives from 2012 Bioeconomy Strategy are still relevant and are the basis for new actions predicted in the updated version of the 2012 Bioeconomy Strategy (European Commission, 2018):

- Ensuring food and nutrition security,
- Managing natural resources sustainably,
- Reducing dependence on non-renewable, unsustainable resources whether sourced domestically or from abroad,
- Mitigating and adopting to climate change,
- Strengthening European competitiveness and creating jobs.

The key actions that are leading towards more sustainable bioeconomy in the context of evolved policy priorities are (European Commission, 2018):

A) Strengthen and scale-up the bio-based sectors, unlock investments and markets

The 2017 Review concluded that "… Further mobilisation of investments is still needed, which requires a stable regulatory environment" and that "… Funding of high risk investments is not well supported by current EU instruments". Matching the financing needs of the EU sustainable bioeconomy relies heavily on private investment which should be extensively further mobilised. As an illustration, according to some estimates approximately 300 biorefineries will need to be deployed in Europe by 2030 in order to meet the growing EU market demand in this sector.

Strengthening and scaling-up the bio-based sector focuses on the research of biorefineries in the EU. The number and location of biorefineries differ from study to study due to differences in

definition of biorefinery. Figure 1 is showing the biorefineries distribution in the EU. As we can see, the distribution of biorefineries is not even throughout Member States. Furthermore none of the project regions has a biorefinery that would enable the production of more added value materials or products deriving from different kinds of biomass.

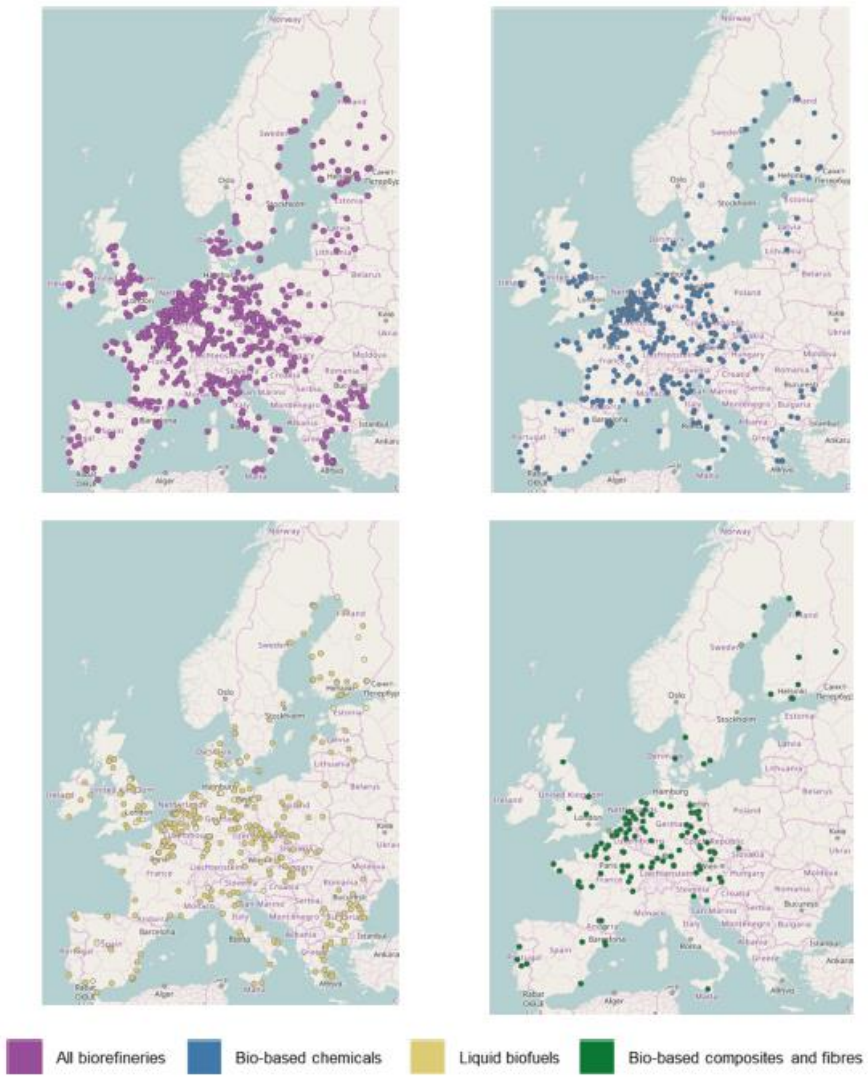

Figure 1: Biorefineries distribution in the EU as of March 2018. Purple dots indicate all biorefineries (803 in total) Blue dots indicate the 507 biorefineries producing bio-based chemicals, yellow dots indicate the 363 biorefineries producing liquid biofuels and the green dots indicate the 141 biorefineries producing bio-based composites and fibres. It has to be noted that some biorefineries produce more than one product category and are thus shown in more than one map. Dots in lighter colour in the three last figures indicate facilities that are currently inactive (but not necessarily as permanent status). Most biorefineries correspond with location of chemical industry clusters and location of ports. Highest density of facilities is in Belgium, Netherlands and some highly industrialised regions of Germany, France and Italy. Source: Parisi, C. 2018. Research Brief on biorefineries distribution in the EU. Joint Research Centre.

B) Deploy local bioeconomies rapidly across Europe

One aim of the European Bioeconomy Strategy is to deploy the bioeconomies across Europe to ensure that the bioeconomy as a whole is a vehicle for inclusive and sustainable growth at the local level. This includes local development in Member States and their territories, such as their regions, rural areas, cities and coastal areas.

A deployment agenda for sustainable food and farming systems, forestry and bio-based production in a circular economy will provide a long-term vision on pathways to development of the bioeconomy and its sustainability. It will be complemented by open innovation spaces, which will allow, on a shorter term, integrating actors across value chains to experiment and work together on new solutions that will provide enhanced sustainability and circularity, and which are adapted to local conditions.

C) Understand the ecological boundaries of the bioeconomy

The objective of the following actions is to strengthen the resilience of land and sea ecosystems, ensuring their contribution to climate mitigation, and enhancing their biodiversity. In addition, they should help us move towards sustainable, circular and post-waste food systems and mobilise the full potential of biological resources from primary production on land and sea. Promoting connections between sectors of the bioeconomy, including the bio-based sector, will also be addressed. It responds to the need to operate the European bioeconomy within the limits of our planet and supports all objectives of the Strategy.

The environment, natural resources, ecosystems and biodiversity are under severe pressure at global and local scale. It is therefore imperative that the bioeconomy is developed in a way that helps reduce environmental pressures, values biodiversity and contributes to enhance the provision of all ecosystem services. Sustaining nature’s contribution to humanity requires the maintenance of a healthy planet, resilient ecosystems, an efficient use of natural resources, and conservation and sustainable management of biodiversity. Yet, European biodiversity is in continuous decline. It is therefore necessary to have at any time the required data, information, and knowledge to judge if the observed developments are in the right direction and to anticipate if possible actions are likely to promote the desired trends.

4. LONG TERM RECOMENDATIONS

As described under chapter 3, the region has high biomass potential but in majority of region low utilization of it. The benefits of using biomass for the needs of bio-economy in the region are much lower than they could have been. At the moment its use in terms of bioeconomy is still largely at the level of processing/turning it into energy and heat. As much is this one way of turning the waste biomass into something useful, it is on the other hand not its optimal use. The economies in the region should strive for solutions that would through the cascading use of the mentioned biomass provide products with higher added value (materials and chemicals for use in chemical, automotive, construction, pharmaceutical industry, etc.), and only ultimately use it for energy. But for this to realize the infrastructure such as bio refineries and knowledge is needed. Another very important for the successful operation of biorefinery is the constant supply of biomass and the proximity of biomass source to the bio plant, since the transport of it can at the end cause higher costs and environment pressure than the outcome itself. At the moment there are no large scale bio refineries present in the project region.

For the optimum functioning of a major refinery a large investment is needed and the continuous flow of large quantities of biomass is needed. This is a great bite for a region where there is a large amount of biomass, which is seasonal in character and locally fragmented, while economic infrastructure consists predominantly of small and medium-sized enterprises with lower investment potential. Therefore the region should consider going in the direction of building smaller, local bio refineries that would help close local loops.

The gap between the research and industry is highly present and the transfer of research results to industrial level and further on to market is poor. The large part of region still did not recognize the benefits of bioeconomy and consequently the market is undeveloped and the demand for bioeconomy products is low. All this lowers the interest of industry to invest into bioeconomy products. However the situation is slightly different in Umbria where the presence of industrial giants and bioclusters paths the way to a successful cooperation between biopolymer industry, research and biomass productive sector.

The large industrial giants such as present in Umbria are not very much present in other parts of the region. Therefore, it will be difficult to achieve economies of scale that would give local industry a reasonable incentive to invest in bio-economy. Therefore one of the possible directions could be small scale/high added value/high knowledge content route to bioeconomy, backed by cross regional connections and networks, which is likely to be more successful in these settings. This route builds on an active and high qualified R&D sector, rather than on traditional, high investment industry.

Another very important element for the deployment of bioeconomy in the region is the political framework and will. Majority of countries within the region lack both.

Last but not least, consumers represent a major factor in creating a market for bio-products. There is a considerable lack of knowledge about the benefits of bio-based materials in the region compared to classical, and, above all, a lack of awareness of the positive impact bio-economy can have on public health, the environment and the future.

Based on the information and data provided by international work group members the following main critical elements were identified for the ADRION region:

- Underdeveloped market for bioeconomy products and lack of market demand
- Unrecognized potential of bieconomy among enterpreneurs
- Insufficient or rather lack of active participation and investments of entrepreneurs in the development of bioconomy products
- Insufficient recognition of bioeconomy at policy level, lack of policy support and policy commitment,
- Lack of consistent long-term strategic support to transition of traditional industries towards bio-economy
- Lack of organizations for linking (clusters)
- Lack of cooperation between research organizations and industry

Recommendations for improvement of bieoconomy deployment in the region:

- Raising the level of knowledge and understanding of the principles of bio-economy, circular economy and sustainable development.
- Streamline the exchange of good practices across the region
- Facilitate awareness raising, best practices and capacity building activities- policy debates for changing or moderating the existing legislation which will also help connecting economic and environmental goals; good practise cases from regions (study visits);
- Enable technical assistance for exploiting the available biomass
- Strengthening the support environment and designing measures in the field of bioeconomy and Circular economy
- Improving cooperation between RO and Industry by establishing operating systems for enabling better overview and coordination of what is done at RO and what industry needs → wide platforms for providing and extending knowledge about current existing technology,

processes, information about suppliers of biomass, opportunities for cross-sectoral collaboration and innovation should be developed. These could be central points of contact that can provide adequate knowledge on existing national and international initiatives for bioeconomy throughout the ADRION region. These platforms should be developed by interested SME and academia and supported by a political framework.

- Enhance the cooperation between science and business, especially the applied research for concrete products, processes or services, specialized tools need to be developed for streamlined research projects in the field of bio based products and materials (Innovation vouchers, contracted research and rewarding professional performance of R&D institutions could potentially increase the output of joint projects).
- Funding schemes for SME's for new products/materials from biomass that can substitute fossil-based equivalent.