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Country Report

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

Framework Conditions for Cluster Development in bio-based industry in **the Republic of Croatia**

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Introduction

Description of the region

There are three main geographical and climate zones in Croatia: Mediterranean coastal zone, plains in the north and mountainous area in the middle. About 48 percent of Croatian land territory is covered with forest (i.e. about 2,5 mil. ha) and 47 percent is agricultural land (about 2,9 mil. ha). Main sources that could provide additional biomass and support growth of bio-based industries in Croatia could be derived from field **agricultural residues, forest biomass and municipal and industrial waste.**

Although there are some differences in experts opinions regarding potentials, agricultural and forest residues are rather well analysed for years and municipal and industrial waste is only recently started to be of greater interest. In terms of agricultural residues, there is the potential of about 1.250 t yearly and the potential of biomass of livestock farming is estimated on about 382.000,000 t yearly. Available forest biomass amounts about 1,4 mil. m3. However, the experts estimate that with some improved approach at least 20 percent more of both agricultural and forest biomass could be available for bio-based industry (energy and other products).

In Croatia live 4,5 million Inhabitants but there are also about 11 million of Tourists, mostly during summer season. According to the official data, the total amount of municipal waste is around, 1,8 million t yearly and about 75 percent is mixed municipal solid waste.

Potential sources of biomass in the food processing industry, among others, include the production of wine and spirits drinks, fruit processing, sugar production, oil, other primary processing and the food industry. Wastes from wood processing industry include waste from wood processing and products of wood and cork (except furniture) and furniture production.

Biomass provides opportunities to certain industry sectors that will need to orient towards different niches and new technological directions. For example, chemical industry, and provides excellent basis for implementation of bioprocesses, as is already the case in companies like Hospira, Jadran Galenski Laboratorij, or Fidelta.

Important prerequisite for above mentioned bio potential as part of "cascade" economy circle will be to provide solutions and products for efficient collecting, compacting and discharge of municipal and selected waste. The need for environmental friendly equipment and machinery largely depends on overall industrial activity, mentioned policy framework that is changing due to the EU accepted norms and goals, as well as the state of agriculture, construction, production, exploration and exploitation of oil and gas, and the production of electricity..

Current situation in the region

Key asset	Primary biomass sector	Food & Feed	Pulp & Paper	Chemicals	Polymers	Phytopharma	Textile & Clothing	Energy	Construction
Cluster organization		X		X		X		X	X
Enterprises	X	X		X	X	X	X	X	X
Policy makers		X		X				X	X
Knowledge institutes								X	
Biomass supply								X	
Competitive bio-based industry product on the market					X	X	X	X	
Funding								X	
Policies, programs and regulations								X	X
Comment						competitiveness cluster on personalized medicine (indirect)		energy from biomass	oriented mostly on energy efficiency

Bioeconomy and the bio-based industries provide a prominent opportunity for growth and jobs in Croatia, but Croatia is far behind in these sectors if compared with other (Northern) EU Regions, despite the great potential in terms of availability of agricultural, forestry and marine bioresources as well as rural and marginal land exploited. In order to develop a successful bio-based economy all these sectors should fully cooperate. The strong position of core economic national clusters such as Automotive, Wood-processing, Food-processing industry, Defence, Health, Chemical, Electro and production machinery and technologies, ICT, Maritime, Construction, Textile and Creative and cultural industries, means that Croatia is ideally suited to the development of bio-based economy. The future of bio-based industry cluster in Croatia should gather enterprises from different industries as well as R&D community to develop novel high-tech approaches to the conversion of biomass, renewable raw materials and waste streams into value-added products and applications.

Challenges for the development of the bio-based industry clusters:

- build new interconnections between different sectors
- build new bio-based value chains (from feedstock to products)
- small core of existing members and early stage of their business development
- lack of funding availability / accessibility
- lack of clear understanding by community of ˝bio-industries˝

Relevant strengths and opportunities in bio-based industry in Croatia:

Although bio-sector is fairly new to Croatia, **biotechnology** is one of the most important and most widespread key technologies in public research organisations as well as in business sector.

Biomass and bio-based products are related to the applications of life sciences and biotechnology in a broad variety of sectors as the main innovation drivers of the knowledge-based bioeconomy (KBBE), leading to new growth and competitiveness. The potential of biomass comprising plant (mainly wood but also several other fast growing plants) and single cell biomass, originating from agriculture, industrial wastes, or cultivation, is in Croatia explored both for the conversion to energy, bio-based products and **biofuels**, as well as for the production of chemicals (mainly pharmaceuticals).

There is an increasing interest for biomass production present among Croatian entrepreneurs who require significant RDI contribution to the optimal use of resources that may provide competitive advantages for Croatia. Agrokor, one of the largest Croatian companies, is investing in **bio-production facilities** and will certainly create demand for next-generation management systems for this type of investments. Croatian producers of complete projects in the area of renewable energy sources, such as Đuro Đaković ltd. (one of the largest industrial groups in Croatia and the region) have capacity for production integrated bio-production facilities which together with KONČAR generators and control systems, can establish unique manufacturing and create potential for large number of RDI investments.

Examples of successfully translated R&D into manufactured goods and products in **biochemical and bio plastic production** and in development of environmentally friendly new materials and substances can be found in Croatian relatively large pharmaceutical companies like Pliva, Belupo, or JGL, and in smaller producers like Genera, PharmaS, BioPharm etc. In the recent years also small knowledge-based companies providing biotechnology services like Genos, SemGen, etc. have emerged. Larger companies are all exporters with already established position in the market. Several SMEs are emerging in the biopharmaceutical sector through the technology transfer process from Croatian universities.

Recent investments in RDI were made in order to address and support next technological readiness level phases, especially when it comes to biotechnology. **BIOCentre in Zagreb** will play an important role in transfer of knowledge and technology, and it is one of the first real “open” research infrastructures in the country and an important tool to support the biotechnology sector and to increase the deployment of Industrial biotechnology.

There are several globally competitive industry segments in Croatia, which coincide with also a strong research capacity in pharmaceutical, agriculture, chemistry, healthcare, etc. Also, some fields are characterized by a highly trained technical workforce, including biotechnology and engineering, ICTs and the transport sector. There is an opportunity for Croatian science and research sector to turn to developing innovative solutions with strong commercial potential in this field and transform these sectors in bio-based. For example, **traditional and declining automotive and maritime industry** can develop advanced structures and materials.

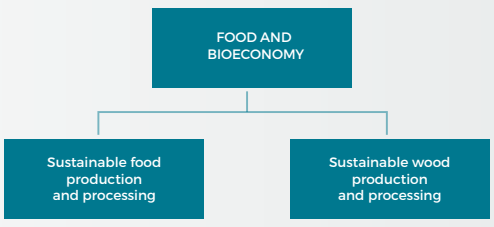
In textile production are also introduced novel and durable eco-driven surface modification processes together with the recyclability of newly developed product without significant environmental burden. University of Zagreb Faculty of Textile Technology (TTF) and its Textile Science Research Centre (TSRC) have strength and knowledge to support industrial development of advanced textile materials and develop innovative textile products which are directed towards the needs of the following industries: textile/clothing/leather/footwear, defence (protective clothing/ footwear), medical (medical textiles), wood (textiles/leather for furniture) and automotive (bio-composites and

leather).
Chair for **polymer** processing (CPP) as a part of the UNIZAG FSB (Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb) is oriented on research and projects to enable economically viable recycling of advanced polymeric materials. This field is of particular interest to companies operating with polymers (like Šestan Busch; DOK-ING; Đuro Đaković). There are companies in Croatia specialized in innovations in packaging waste based on **bio-degradable materials and bio-polymers** (such as Mi Plast company, member of Bio-based industry consortium).
The Croatian food and wood production and processing sector will also face major opportunities for global growth in the coming decades. The potentials can be seen in the increased demand for eco-products and materials on the EU and global market and trends of increasing the usage of wood products for eco and sustainable constructions and interior design. The further increase in competitiveness of the wood sector can be facilitated through ICT and creative services as well as advanced engineering, investments in development and implementation of product design and inclusion of advanced technologies in manufacturing capacities, with an aim to develop and promote safe, healthy and **new value-added wood products, bio-based paints and eco-surface treatments**.

Regional Bio-based industry Strategy

Criteria	Indicator	Region	
		2010	2015
Land use	Forestry land (% of total land area)	48	48
	Agricultural & horticultural land (% of total land area)	47	48,4
Biomass availability	Agricultural biomass production (kg/capita]	0,30	0,33
	Blue biomass production (kg/capita)		
	Forestry biomass production (m^3/capita)	0,53	0,65
	Waste production (kg/capita)	0,39	0,45
Innovation	SME birth rage (% of total firms in region)	5	3
	R&D expenditure (index (EU = 1))	-	0,42
	R&D employment (% of total employment in region)	0,99	0,88
Cluster size [6)]	Firms in total bio-based industry sectors (% of total firms in region*)		0,1
	Employment in total bio-based industry sectors (% of total employment in region**)		0,02
Quality of workforce	Secondary & Tertiary education in bio-based industry (% of total population in region)	0,2	

There is no a specific national strategy for the bio-based industry strategy, but some government action plans provide guidance for the development of this sector, especially in agriculture, forestry, timber and paper industry.
Republic of Croatia has **Smart Specialization Strategy 2016-2020 (S3)**, which identifies five thematic priority areas (TPAs) and and 13 sub-thematic priority areas.
Food and Bioeconomy have been selected as an important TPA based on significant natural resources (plenty of good quality arable land and sea, natural forests and water resources that enable their conversion into food, feed, wood and bio-based products) successful companies, including large companies with their own R&D institutes or departments, and most progressive SMEs, combined with proven research excellence in the public sector. Food and Bioeconomy as a priority area has logical and functional links with other TPAs such as Health and Quality of Life, Energy and Sustainable Environment and cross-cutting sub-thematic priority areas KETs and ICT, providing space for cross-sectorial cooperation and the development of new emerging niches through research and product development.

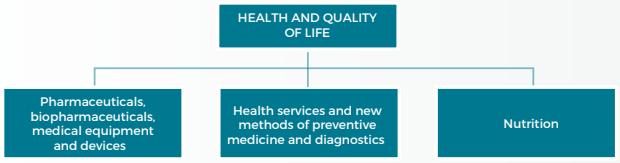


- **Sustainable food production and processing** covers three very important and dynamic sectors for the Croatian economy: Agriculture, Fishery and Aquaculture, and the Food

processing industry, which are based on traditional production, strong R&D, rich and diverse resources for the development of primary production as well as educated and trained people. Activity is characterized by a high degree of product completion and as such, the activity is capable of attracting investment and capital needed for development.

II **Sustainable wood production and processing** has big export-oriented subsections (furniture production, industrial sawn timber, etc.) which employ a significant number of workers. Its strengths lie in the long tradition of sustainable forest management, availability of high quality raw material and export orientation.

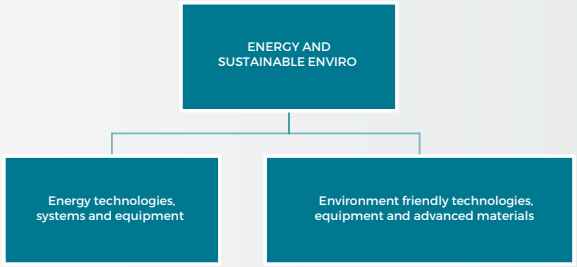
Health and quality of life is also one of TPAs for smart specialization in Croatia. TPA competitiveness is based on traditionally recognized expertise in R&D as well as in industry applications dating back to early 1960s, modern research infrastructure, developed technologies and continuous investments in production. This TPA covers public research organizations; biotechnology and pharmaceutical companies involved in drug discovery and drug development, etc.
The sub-thematic priority areas are **(I) Pharmaceuticals, biopharmaceuticals, medical equipment and devices; (II) Health services and new methods of preventive medicine and diagnostics; (III) Nutrition.**



National Health Care Strategy 2012-2020 is an umbrella document determining the context, vision, priorities, and goals for health care in the Republic of Croatia over this period. S3 strategy will provide a great opportunity to stimulate the Croatian National Health, Biotechnology and Pharmaceuticals Initiative. This can be helped through the Health Competitive Cluster.

Within **TPA Energy and Sustainable environment** substantial contributions to meet global challenges in relation to secure, clean and efficient energy, climate change, and resource efficiency can be made. As indicative RDI topics relevant for this STPA and related to bio-based industries have been selected:

- researching biopolymers and bio-plastic of 1st and 2nd generation, bioreactors, atmospheric biotechnology;
- novel sources of biomass and bio-based products;
- added-value bio-based chemical products and

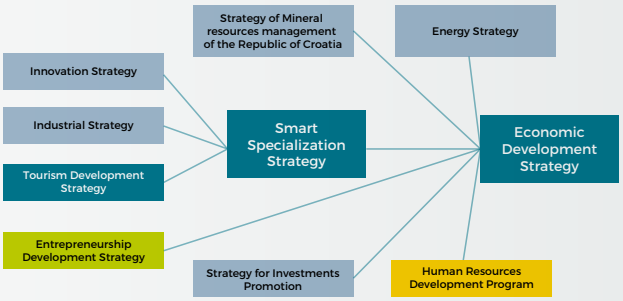


environmentally friendly biomaterials;

National Competitiveness clusters contributed to raise competitive value of these thematic areas.

S3 Strategy aim to direct policy initiatives and actions towards increasing smart, inclusive and sustainable growth in Croatia **to upgrade in global value chain** and promoting internationalization of Croatian enterprises.

Industrial Strategy of the Republic of Croatia 2014-2020 follows the global business trends and the EU Industrial policy, therefore recognizes industrial biotechnology (one of the Key enabling technologies KET) and Bio-based product markets as one of the fields, which will contribute to Croatia's societal development and EU climate change targets.



Industrial Strategy of the Republic of Croatia and S3 Strategy are basis for the Economic Development Strategy.

Strategy implementation

Croatian Clusters of Competitiveness (CCCs) (all mentioned in chapter 2) participated in the development of S3 and defining of thematic and sub-thematic areas.
Competitiveness clusters contribute to raise competitiveness of these thematic areas and promote cooperation between the public, private and science sector. Clusters support SMEs performance and activities, especially in relation to innovations and development of new technologies; strengthen entrepreneurship and competitiveness in rural areas; change policy measures in agreement with policy decision makers.
In 2017 for the Ministry of Economy grant scheme for financing RDI projects, Clusters will have an additional important role through giving labels for all collaborative projects proposed for financing through the grant scheme, which will strengthen further their relevance in boosting the connection between the industry and the research sector.
Realization of S3 Action plan will be ensured through different initiatives and by policy mix driven by government, as well as their financing. To be able to realize all goals set in this Strategy, a strong financial support should be ensured. S3 strategy sets out the framework for investments in research and innovation, not only from **ESIF**, but also from other funding sources. For that reason, necessary resources will have to come from various sources: **national funds and other public and private resources.**
For S3 Action plan implementation the most relevant investments will be funded under **ERDF - OP Competitiveness and Cohesion (OP CC),** and the **ESF - OP Efficient Human resources (OP EHR),** to S3 implementation in the field of smart skills.
European Union programmes could also support the implementation of S3 strategy in Croatia. **Horizon 2020** complements ESIF and supports capacity building of public RO that have shown the most success in commercialize their KET know-how.
Supplementary programmes financed from national budget and managed by Croatian Science Foundation will also support S3 strategy through **Research project grants and through Career development of young researchers (doctorate and post-doc grants).**
Croatian SMEs, especially those innovative and high risk, or in sectors with lower rates of return, are facing a challenging environment for financing. Bank lending is unavailable and expensive, and requires sufficient collateral, what is the main problem for SMEs. The Croatian Agency for Small Business, Innovation and Investment – **HAMAG-BICRO** is the best available resource for financing operation and development of small business entities by loans and guarantees issuing for approved loans by creditors as well as promotion of investments in SMEs.

Effects/Impact

- Developing new products
- Connecting relevant stakeholders
- Exchange of knowledge among SMEs, academia and public sector in Danube region
- Strengthening of entrepreneurship and competitiveness in rural areas, especially in processing, industry and clusters development
- Efficient SMEs measures and activities especially to support innovations and new technologies
- Value chain

Future challenges for cluster development in bio-based industry

Needs and capacities of Croatian industry sectors with high potential for growth have already been identified and facilitated through Smart specialization strategy (S3). Some sectors, for example biotechnology and pharmaceuticals (together with ICT) represent financially the strongest R&D sectors. In others, high biomass availability led to biofuel production, etc. Yet, there is still much space for improvement of the framework conditions for developing bio-based industries and new innovative bio-based products, since the production does not meet the standards of potentially complementary sectors.
Due to the lack of public support for RDI activities and relatively low interest of enterprises, especially SMEs, investments in RDI stagnated in the past years. Challenges can be seen outdated and inefficient research infrastructure, lack of resources for

conducting research, and underperformance of knowledge and technology transfer activities.
Recommendations given include private-public support; incentive mechanism for start-ups in bio-based industry; competition; finance support scheme; R&D infrastructure; smart use of local resources; triple-helix approach.
The advantages of the bio-based industry clusters could be in coupled production; cascade utilisation; speed up innovations: integrated and coordinated; from Lab to development demonstration scale; integration of the existing clusters.

Development of the bio-based industry clusters could meet following challenges: build new interconnections between different sectors; build new bio-based value chains (from feedstock to products); small core of existing SMEs and early stage of their business development; lack of funding availability / accessibility; lack of clear understanding by community of "bio-industries".
Taking all in consideration, it is necessary to set new targeted laws, standards, certification schemes and finance mechanisms to help Croatia realise significant potential for a bio-based economy by 2030.

Annex

Definitions/Glossary

Clusters: Clusters are generally described as groups of specialised enterprises, often SMEs, and other supporting actors in a particular location that cooperate closely together.

Cluster initiatives: A cluster initiative is an organised effort aiming at fostering the development of the cluster either by strengthening the potential of cluster actors or shaping relationships between them. They often have a character like a regional network. Cluster initiatives usually managed by a cluster organisations.

Cluster organisations: Cluster organisations are entities that support the strengthening of collaboration, networking and learning in innovation clusters and act as innovation support providers by providing or channelling specialised and customised business support services to stimulate innovation activities, especially in SMEs. They are usually the actors that facilitate strategic partnering across clusters. Cluster organisations are also called cluster managements.

Cluster participants: Cluster participants are representatives industry, academia or other intermediaries, which are commonly engaged in a cluster initiative. Given the case a cluster initiative has a certain legal form, like associations, cluster participants are often called cluster members.

Cluster policy: Cluster policy is an expression of political commitment, composed of a set of specific government policy interventions that aim to strengthen existing clusters and/or facilitate the emergence of new ones. Cluster policy is to be seen as a framework policy that opens the way for the bottom-up dynamics seen in clusters and cluster initiatives. This differs from the approach taken by traditional industrial policies which try (and most often fail) to create or back winners.

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