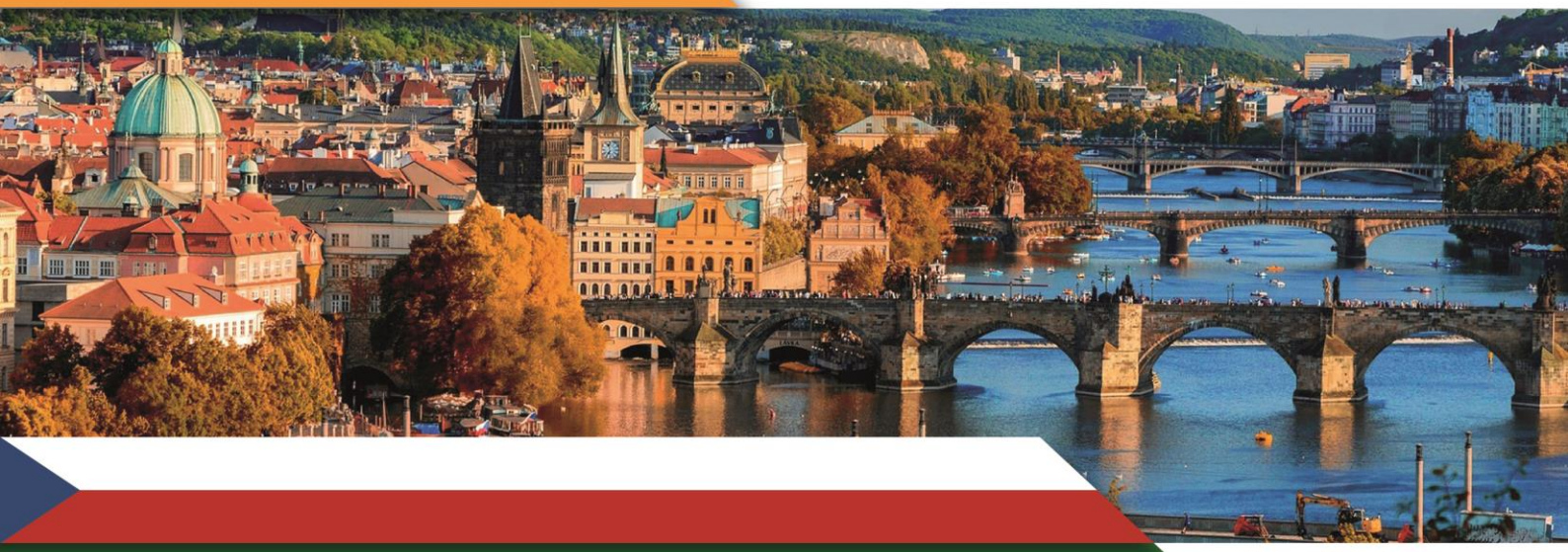
BIOECONOMY CONCEPT PAPER

EXECUTIVE SUMMARY



CZECH REPUBLIC

EXECUTIVE SUMMARY OF THE STRATEGIC CONCEPT PAPER FOR BIOECONOMY: CZECH REPUBLIC

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Endorsement: **The BIOEAST Initiative aims to build knowledge-based agriculture, forestry and aquaculture in the bioeconomy. For this reason, the BIOEASTsUP Horizon 2020 EU project was launched under the auspice of the macro-regional governmental initiative to support eleven countries in building up their own bioeconomy strategies and action plans.**

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Executive summary

The Russian invasion of Ukraine shows that, unfortunately, peace and stability cannot be considered the norm in Europe either European value, interests, security, independence, and integrity are neither self-evident nor free. Europe must be ready and prepared to defend them and actively contribute to preserving peace, preventing conflict, and strengthening international security. The issue of security must be conceived in a broader sense; it is not 'only' about the defence of populations and territories, but also about the security of food, raw materials, and energy supplies. In the immediate aftermath of the unprecedented COVID-19 pandemic and social isolation, Europe is thus facing new crises to which it must respond.

The Bioeconomy Strategy was introduced by the European Commission a decade ago. Through the revision in 2018 it was updated, putting more emphasis to food sustainability and security, reducing dependence on non-renewable resources and the need for sustainable management of natural resources. Considering the current challenges these measures seem to be of importance as the war in Europe and the interconnected security, energy and food crises, COVID-19 and also the climate crisis. The need to transform Europe's economy into a more sustainable, safer, and less environmentally damaging system is emphasized in most of the new European strategies; bioeconomy is generally understood as a tool to enable this transition. A review of this key European strategy has just been provided.

The Czech Republic, together with other Central and Eastern European countries (the BIOEAST macro-region), has not yet sufficiently exploited the potential offered by the bioeconomy. The Ministry of Agriculture of the Czech Republic has supported the implementation of bioeconomy and was part of the BIOEAST initiative from the very beginning. In July 2019, the Ministry of Agriculture of the Czech Republic was the only one to prepare a Bioeconomy Concept in the Czech Republic from the perspective of the Ministry of Agriculture for the years 2019-2024, which considers the bioeconomy as one of its key priorities. The Concept Paper of the Ministry of Agriculture of the Czech Republic aims to support the development of the bioeconomy to ensure sustainable management of natural resources, sustainable agriculture, forestry, water management and aquaculture, sustainable production of food and feed, and strengthening the role of primary producers and their integration into the bioeconomy value chain, as well as on the forestry side the involvement of the entire value chain of downstream sectors. At the end of August 2022, the Government of the Czech Republic approved the Strategy of Research, Development, and Innovation of the Ministry of Agriculture for the years 2023-2032, one of the key areas (or one of the three horizontal areas) is bioeconomy.

The main goal of this document, the so-called concept paper, is to set the framework for a national bioeconomy strategy and action plan development, aiming to generate a deeper discussion in the Czech Republic on the necessity of paradigm shift in the economic thinking regarding the valorisation of biomass as a renewable natural resource. The past decade's climate change related challenges show that without a careful planning the circular and sustainable valorisation of the available bioresources, the country's viable future will be threatened. Inter-sectorial approaches are inevitable and both visionary thinking and strategical planning is required to strengthen the systemic thinking concerning production and processing of bioresources.

The **BIOEAST Initiative** aims to build knowledge-based agriculture, forestry, and aquaculture in the bioeconomy. The strategic thinking concerning bioresources in Central and Eastern Europe should become national and macro-regional priority since it is one of the most important

regionally available resources affecting food, energy, and industrial security. The bioeconomy could bring climate neutral solutions and become the organic part of the sustainable economic model. That is why under the auspice of the macro-regional governmental initiative was launched a Horizon 2020 EU project (BIOEASTsUP) supporting eleven countries to build up their own bioeconomy strategies and action plans.

The transition towards sustainable agriculture, forestry and fisheries in the bioeconomy does require specific conditions. The premises of the transition should be enabled by principles and political willingness. The European Foresight Exercise developed by the Standing Committee of Agricultural Research (SCAR report 2015) set forth the five principles of the sustainable bioeconomy: food first, sustainable yields, cascading approaches, circularity, and diversity should be strived for. The transition cannot be governed by markets and technology, but strong strategic orientation and constant monitoring is necessary.

This Strategic Concept Paper is one of the key results of the BIOEASTsUP project. The BIOEASTsUP project was developed in 2019, started 2 months before the Green Deal was published and 5 months before the outbreak of the COVID-19 pandemic. In the last year of the project duration, the war in Ukraine started.

1.1. Understanding of bioeconomy

The current climate change show that this path cannot be pursued; the negative impacts of overloading the earth's biological resources, contamination of air, water and soil, its degradation, the dramatic decline in biodiversity and the catastrophic effects of pandemics on human health have become fully apparent. The future is closely linked to the green revolution, and other countries besides the EU are clearly pushing for a more sustainable economic policy. **Biological resources currently play an indispensable role** in addressing global challenges and are part of many sectors of the economy (Efken et al., 2016), advances in industrial biotechnology offer the potential for new materials, chemicals, and new sources of energy to replace fossil resources (Bracco et al., 2018). Biobased products go far beyond biomass processing; major advances in science, particularly in biotechnology (including microbiology, microbiomes, and enzymes), together with the digital revolution, make it possible to exploit natural resources-"biological assets" (biochemicals and biomaterials) and their "bio-characteristics" (its functions and processes) to create significant new sources of economic value and future revenue (EU, 2018).

Life and biological sciences and technologies are enablers for bio-based innovations that bear the potential to use natural resources sustainably, by reducing dependence on fossil fuels, by protecting the environment and climate, ensuring food security, and maintaining international competitiveness. Fraunhofer´s study (2021)[1] identified **50 top biotechnology innovations, 12 of which relate to new breeding techniques**. Plant breeding in the EU secures less GHG being emitted by helping avoid negative land use change. Until 2020, a total of almost 4.0 billion tons of direct CO2 emissions have been avoided by crops improvements in major arable crops in the EU in the past two decades (Noleppa and Cartsburg, 2021)[2]. New breeding programs are vital for in-field diversity, and participatory breeding programs where farmers act in

1 Life and biological sciences and technologies as engines for bio-based innovation (EU, 2021) https://op.europa.eu/en/publication-detail/-/publication/df6b2239-9b3e-11eb-b85c-01aa75ed71a1/language-en
2 Noleppa, S., and Cartsburg, M. (2021). The socio-economic and environmental values of plant breeding in the EU and for selected EU member states. HFFA Research
Razzaq, A., Kaur, P, Akhter, N, Wani, S.H., Saleem, F. (2021) Next-Generation Breeding Strategies for Climate-Ready Crops doi: 10.3389/fpls.2021.620420

the selection of plans leading to rapid local developments and adoption (Weltzien and Christinck, 2017)[3].w

Bioeconomy is an economy based on new, more efficient ways of using biomass and new biological processes and innovations (McCormick and Kautto, 2013). Bioeconomy is a way to enable economic growth that does not lead to environmental degradation (Schmid et al., 2012) and is inherently circular and sustainable (Ronzon and Sanjuan, 2020); bioeconomy therefore makes an important contribution to the carbon economy. Bioeconomy is already much more than an umbrella keyword and a holistic understanding of bioactivities which have served mankind for thousands of years. It has already become a discipline with defined subsciences and growing interest; bioeconomy demands new skills and approaches towards simultaneously solving multiple challenges occurring at different levels.

The **Bioeconomy Strategy** was introduced by the European Commission a decade ago. Through the revision in 2018 it was updated, putting more emphasis to food sustainability and security, reducing dependence on non-renewable resources and the need for sustainable management of natural resources. Considering the current challenges, these measures seem to be in particular of importance as the war in Europe and the interconnected security, energy and food crises, the COVID-19 pandemic and also the climate crisis. The need to transform Europe's economy into a more sustainable, safer and less environmentally damaging system is emphasized in most of the new European strategies; bioeconomy is generally understood as a tool to enable this transition. A review of this key European strategy has just been provided.

1.2. National strategies related to bioeconomy

The Czech Republic, together with other Central and Eastern European countries (the BIO-EAST macro-region), has not yet sufficiently exploited the potential offered by the bioeconomy. As bioeconomy is still a relatively unknown concept for the public administration in the Czech Republic; no project dealing with this topic has been supported by national resources and there is only a small group of organizations in the Czech Republic involved in international projects focused on bioeconomy financed primarily by the funding programmes H2020, Horizon EUROPE, BBI -JU or INTERREG Danube. There are currently 33 different bioeconomy related strategies at the national level, there is no strategy solely focused on bioeconomy in the Czech Republic, and none of the strategies directly refers to the term bioeconomy. Nevertheless, **all 5 goals defined by the EU bioeconomy strategy (2018) are contained in 6 national strategic documents, while 3 of them are supra-ministerial documents**: Strategic Framework Czech Republic 2030 and The Country for the Future 2020-2027 and National concept of implementation of cohesion policy in the Czech Republic after 2020. Another 3 strategic documents copying all 5 objectives of the EU Bioeconomy Strategy were issued by the Ministry of Agriculture. When analyzing them in the framework of the objectives of the EU Bioeconomy strategy (2018) we can conclude that these strategies are covering all the objectives of the EU Bioeconomy strategy (2018).

Of course, there is an issue of synergy effects, overlapping and conflicts among strategic objectives defined by responsible governmental bodies. **It is the role of policy makers to prioritize goals and manage these conflicts.** In the presented concept paper these contradictions can only be indicated.

3 Weltzien, E., and Christinck, A. (2017). “Chapter 8 - participatory breeding: developing improved and relevant crop varieties with farmers,” in Agricultural Systems, 2nd edn, eds S. Snapp and B. Pound (Amsterdam: Academic Press), 259–301.

The Ministry of Agriculture of the Czech Republic has supported the implementation of bioeconomy and was part of the BIOEAST initiative from the very beginning. **In July 2019, the Ministry of Agriculture of the Czech Republic was the only one to prepare a Bioeconomy Concept** in the Czech Republic from the perspective of the Ministry of Agriculture **for the years 2019-2024, which considers the bioeconomy as one of its key priorities.** The Concept Paper of the Ministry of Agriculture of the Czech Republic aims to support the development of the bioeconomy to ensure sustainable management of natural resources, sustainable agriculture, forestry, water management and aquaculture, sustainable production of food and feed, and strengthening the role of primary producers and their integration into the bioeconomy value chain, as well as on the forestry side the involvement of the entire value chain of downstream sectors. At the end of August 2022, the Government of the Czech Republic approved the Strategy of Research, Development, and Innovation of the Ministry of Agriculture for the years 2023-2032, one of the key areas (or one of the three horizontal areas) is bioeconomy. Bioeconomy is embedded in the Strategic Framework Czech Republic 2030 (Ministry of Environment, 2017) [4] and the Strategic Framework Circular Czechia 2040 (Ministry of Environment, 2021) [5]. The National Energy and Climate Plan of the Czech Republic (the Ministry of Transport in the Transport Policy Czech Republic, 2020).

1.3. BIOEAST initiative and the BIOEAST HUB CZ

The engagement of the Ministry of Agriculture in bioeconomy was enhanced by membership of the BIOEAST Initative. The Ministry of Agriculture was one of the Visegrad four ministries that started to cooperate closely on bioeconomy development. As only ministerial bodies can become member of the BIOEAST Initiative, the Governance paper refers to the national bioeconomy HUBs as: entities, which want to become “supporters” of BIOEAST. The “supporters” will never become members of the governmental level Initiative. The Hub could create a stakeholder group at the national level, which will stay in touch with the BIOEAST NCP of the given member state. The objective of the HUBs will be to help the information flow at national level and to ease the participation of the national stakeholders in EU calls (BIOEAST Initiative, 2018)[6]. **BIOEAST HUB CZ** (www.bio-hub.cz) was formed in line with the BIOEAST Governance paper and with the support of the Ministry of Agriculture. The Czech Republic is the first and so far the only country in the BIOEAST macro region where the national bioeconomy BIOEAST HUB was established to support bioeconomy implementation, enhance participation in the international project cooperation, organize stakeholder according to their interest and priorities in the national thematic working groups to name but a few objectives. BIOEAST HUB CZ mobilizes stakeholders to show the interest to policy makers, enhance the inter-ministerial group formed by representatives of Ministries responsible for Agriculture, Environment, Education and Youth, Industry and Trade, and Transport.

BIOEAST HUB CZ discussed the possibilities of having national statistical data of bioeconomy with the national authority - the Czech Statistical Office (CSU). The CSU representatives explained that they follow EUROSTAT directives. So far, bioeconomy as a category was not included. Therefore, when mapping the status quo of bioeconomy, the following NACE code were examined with the reference to the selection provided by JRC.

4 https://www.cr2030.cz/strategie/dokumenty-ke-stazeni/
5 https://www.mzp.cz/cz/cirkularni_cesko
6 www.bioeast.eu

The bioeconomy in the Czech Republic generated EUR 38 billion EUR (JRC, 2019) of turnover, which represented 9% of the total turnover of non-financial corporations (including agriculture) in the country. This was less than the EU average of 10% in the same year. The turnover is equivalent to 99,000 EUR per person employed in the sector, with the EU-27 average of 135,000 EUR.

1.4. Bioecononomy in numbers

The largest generators of turnover in the bioeconomy in the Czech Republic are the production of food, beverages and tobacco, agriculture and the production of wooden products, furniture and organic food, together they are accounted for approximately 80% of total turnover. The main contributor is the food sector, almost half (43%) of the total turnover in the organic economy comes from the food industry. The primary biomass production sectors are agriculture, forestry, fishing, and aquaculture, contributed to 30% of the turnover in the Czech Republic. The remaining 27% of total bioeconomy turnover came from other biotechnology-based industries (i.e., bio-based wood products and furniture, paper production, biomass-based textile production, chemical production, pharmaceuticals, plastics and rubber, liquid biofuels and bioenergy). Compared to the EU member states, the Czech Republic is the average producer of food waste with 741 kt (food waste in all stages: primary production, processing & manufacturing, retail & distribution, and consumption). The forest sector produced around 10 million tons of dry matter of woody biomass, of which around 6.5 million tons of dry matter forest biomass was used for energy, only 2.5 million tons of produced dry matter forest biomass (without any processing) went for export. The Czech Republic dispose of a rather a sophisticated policy and legal framework for waste management, in accordance with the new Waste Act (541/2020 Coll., Waste Act, effective from 1.2021), a ban on landfilling of recoverable waste will apply from 2030. This can indeed further support development of new technology for bio waste processing. Biomass from agriculture, forestry and waste seem to be the most important source of biomass in the Czech Republic. The potential of the underutilised biomass resources was examined from the bioenergy perspective in Olomoucký region[7]. The study concludes that terms of biomass potential that the biomass from agricultural land will be limited to a large extent by the need to maintain and improve soil quality in terms of biological matter content. Some pressure can be expected to at least not reduce the amount of residual straw from conventional crops ploughed into the soil. There is a need to further exploit the use of waste biomass from agriculture, forestry, wood processing industry. At the same time the use of municipal waste and biological waste from households and the development of perennial energy crops can be expected precisely in relation to the requirements of soil and landscape protection to reduce the risk of soil and wind erosion, for increasing the absorption capacity of the landscape, etc., in addition to cooling the landscape.

The production lines have been built based on fresh water for many centuries in the BIOEAST macro-region. Fresh water is a substantial input to their development and growth, therefore the current crisis (safety, climate, energy, food) create a pressure on sustainable management of fresh water. Drought, lack of groundwater, floods are emerging problems of the Czech Republic; the Ministry of Agriculture of the Czech Republic initiated the Thematic Working Group Fresh Water Based Bioeconomy to tackle the issue on the macro regional level. The Thematic Working Group Fresh Water Based Bioeconomy is coordinated by the BIOEAST

7 https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwi-2YSlyYP7AhXJ_KQKHRc1BhEQFnoECA8QAQ&url=https%3A%2F%2Fwww.olkraj.cz%2Fdownload.html%3Fid%3D78719&usg=AOvVaw1XpGH_5gR7vqq7V17-Nzp7

HUB CZ. The Ministry of Agriculture supports the implementation of the European Missions Restore our Ocean and Waters by 2030.

The Czech Republic, within the framework of its strategic documents in the field of energy and to meet its climate-energy commitments arising from its membership of the European Union, is significantly committed to further development in the use of bioenergy. This term refers to all forms of biomass that can be converted into further usable forms of energy (heat, electricity, fuels) by direct combustion or biochemical and other processes. According to the Czech Republic's National Energy and Climate Plan, bioenergy use should increase by almost 30% or by about 47 million tonnes in absolute terms between 2016 and 2030. This represents more than 60% of the total expected increase in renewable energy over the next decade, so that the country will be able to meet the main objective of the national plan, which is to achieve 22% of the share of renewable energy in the country's gross final energy consumption by 2030 (while it is currently at 15.15% in 2018)[8]. The Czech Republic has historically been one of the top European countries in the use of hydropower. The total technically exploitable potential of hydropower can be estimated with several difficulties, the Ministry of Industry and Trade estimates the annual potential at 2535 GWh (MPO. Development of Supported Energy Sources until 2030) . In 2021, there were in Czech Republic realized 9,321 new installations with total capacity 62 MWp. For comparison, in 2020 were installed 6,293 PV plants with total capacity 51.4 MWp. Average PV plant size was 6.7 kWp in 2021 (in 2020 it was 8.3 kWp). In 2012, 416 GWh of electricity was generated in the Czech Republic in wind power plants, which represents a saving of more than 407,000 tonnes of lignite (almost 8,000 wagons of coal), more than 500,000 tonnes of C02 and several thousand tonnes of sulphur and nitrogen oxides. The wind power plants cover 8% of electricity consumption in the EU, while in the Czech Republic it is only 0.6%. The production of biogas, i.e. agricultural biogas plants and organic waste biogas plants are widely spread in the Czech Republic and have a strong and stable position for the biogas and electric energy production.

The current, consumer-oriented society is forced to find solutions for the increasing amounts of waste. Approximately one fifth of all waste production in the Czech Republic belongs to biodegradable waste. The capacity for processing biodegradable waste in the Czech Republic is sufficient and the amount of this waste is expected to increase. Approximately 500 larger composting plants with a total capacity of over 2 million tonnes per year are available for the preparation of valuable compost.

1.5. Innovations as key factor of bioeconomy implementation

Bioeconomy is considered an early-stage industry which it needs innovation to support its implementation. Agricultural and biological sciences and biochemistry, genetics and molecular biology sciences are rather developed in the Czech Republic (represented more than one-tenth of all Czech Republic's citable publications each), meanwhile, other bioeconomy related sciences areas were much less developed. The research sector in the Czech Republic is represented by research institutes (20), universities (6) and the Czech Academy of Science. The research organizations oriented to the applied research that are also actively involved in the technology transfer are represented by the Association of Research Organizations (www.avo.cz, hereinafter referred as AVO, member of the BIOEAST HUB CZ[9]) that supports the engagement and involvement of SMEs and large entrepreneurs.

8 Studie potenciálu dosud nevyužívaných zdrojů biomasy na území Olomouckého kraje, 2020, SEVEn Energy s.r.o., Praha, dostupné https://www.olkraj.cz/download.html?id=78719
9 www.mpo.cz

R&D is a key factor in technological progress as such it is one of the many possible inputs in the innovation processes. In the Czech Republic, the business activity in R&D is relatively low compared to the EU countries-innovation leaders. Business-science collaboration is moderate and sophisticated innovation demand is low. Cooperation between innovative enterprises and research organizations is underdeveloped in the RDI system[10]. Low interaction between research organizations and the business sector is observed. The demand for research cooperation on the part of the business sector is slightly growing[11].

According to the CSO data, 66.6 billion CZK were invested in R&D in the private business sector in 2019, which is almost twice as much as in universities and departments of the Academy of Sciences of the Czech Republic. Private sources accounted for 92% of the total expenditure on corporate R&D, in absolute terms it were 61.1 billion CZK. Another 5.4 billion CZK were obtained by private companies for research and development through direct support from public sources (including 3.7 billion CZK in direct subsidies from the state budget of the Czech Republic and 1.7 billion CZK from EU sources).

In 2020, a total of 113.4 CZK billion were spent on R&D in the Czech Republic, of which 69,113 million CZK were spent in enterprises from private sources. Foreign-controlled companies, whose R&D spending is growing fastest, are the main contributors to the growth of R&D spending in the business sector. In 2020, enterprises with more than 250 employees spent 50 406 million CZK (72.9%), medium-sized enterprises contributed 11 846 million CZK (17.1%) and small enterprises 6 861 million CZK (9.9%). Private enterprises with more than 250 employees invested 38 852 million CZK in 2020.

Comparing all types of innovation activities, the Czech Republic comes fourth place among BIOEAST countries. Average proportion of enterprises undertaking innovation activities of the main fully and partly bio-based industries is 50.6%, following Estonia (62%), Lithuania (59.4%) and Croatia (53.3%). Considering the proportion of enterprises undertaking innovation activities, the Czech Republic takes leadership only in the manufacture of gas, distribution of gaseous fuels. This country is among the leaders in the manufacture of chemicals (71.3%) following Estonia (72%).

AVO provided the methodology of research and development performance measurement, this methodology is a basis for the national evaluation used by policy makers (primarily the Ministry of Agriculture and Ministry of Industry and Trade). AVO also promoted the indirect tax support for the research and development activities in the Czech Republic. AVO has been coordinated several national projects that support technology transfer, application of research results in SMEs and methodology for SMEs how to use the potential of bioeconomy innovation. These projects delivered both practical guidelines that are also showing practical examples for SMEs and new software e-map that enables SMEs to search for an appropriate research infrastructure (e.g. machinery, laboratory, greenhouses) or to get in touch with an expert team disposing of specific knowledge.

1.6. Stakeholders' Expectations

BIOEAST HUB CZ conducted several surveys to map stakeholders' expectations and opinions towards bioeconomy transformation, i.e. priorities in bioeconomy innovations - mapping of bi-

10 National Research, Development and Innovation Policy of the Czech Republic 2016–2020. Office of the Government of the Czech Republic, 2016.
11 National Research and Innovation Strategy for Smart Specialisation of the Czech Republic. Office of the Government of the Czech Republic, 2016.

oeconomy innovation priorities and the focus of bioeconomy in the Czech Republic, preferences of strategic goals defined by public administration - perception of bioeconomy as part of national strategic documents, preferences of sustainable development goals defined by UN - Prioritization of UN SDGs and EU Bioeconomy Strategy objectives, understanding of bioeconomy potential – An analysis of bioeconomy development potential in the Czech Republic. Likewise, the pathways how to enhance bioeconomy implementation in the Czech Republic, bioeconomy drivers and limits were also consulted with stakeholders in a series of surreys organised by the BIOEAST HUB CZ.

The above outlined surveys indicated that stakeholders:

- **consider highly important to protect, restore and promote the sustainable use** of terrestrial ecosystems, sustainable forest management, promote sustainable agriculture, new breading techniques and food security, manage natural resources sustainably, building resilient infrastructure, promoting inclusive and sustainable industrialisation and promoting innovation and reducing dependence on non-renewable resources;
- **emphasise the need to mitigate the effects of drought** in connection with climate change, adapt the landscape to these changes and comprehensively care for and protect primary resources, improve their management;
- **see environment, food industry, waste, agricultural and food technology with the automotive, aircraft and spacecraft industry, railway, and rail vehicles as the most priority sectors**, prominent position in the biogas production and composting technologies; consider the need to support the transition from cost-oriented competitiveness towards knowledge-based competitiveness;
- **consider it essential to support cooperation between research organizations and the application sphere**, further development of the national BIOEAST HUB CZ for the implementation of bioeconomy in the bottom-up approach;
- **clarify the need to support for environmentally friendly technologies and technologies** and products that increase the overall efficiency of the use of primary resources and energy efficiency; develop bioeconomy education as it is of crucial importance to influence changes towards sustainable development, more specifically to provide sufficient competence for industry, services, and public administration;
- **perceive the potential of bioeconomy in the Czech Republic to replace fossil fuels with renewables, modernize primary sector**; improve resource efficiency, develop industrial applications and biotechnology, comprehensive approaches to value chains, consumption, and ecosystem services;
- name the following sectors to have the greatest potential for bioeconomy: biotechnology **and breeding, composting and biogas, education in bioeconomy.**

1.7. Promising opportunities to implement bioeconomy

Crop breeding in the face of a rapidly changing climate and a growing human population continues to be a major challenge for researchers worldwide; the pace at which current crop breeding programs are proceeding is essentially insufficient to meet food demand. There is an urgent need to cultivate crops to be climate resilient, to achieve sustainable yields and to provide adequate nutrition. The speed of breeding processes is largely limited due to the long generation time that crops necessarily require during the breeding process (Sharma

et al., 2021)[12]. A SWOT analysis of the sector was carried out in the form of interviews with experts of these field provided by the BIOEAST HUB CZ in close cooperation with the Czech Technological Platform Plants for the Future (member of the BIOEAST HUB CZ).

The case studies were provided: biogas production, composting and bioeconomy education activities of the BIOEAST HUB CZ.

The first case studies provide examples of how, energy or fertilizer production can be realized through more efficient use of renewable resources and recycling of raw materials. The case study shows the possibilities of creating a new value chain - the collection of animal residues and their use as a source of biogas. The new value chain offers opportunities for logistics companies as well as IT companies (creating, for example, map portals and communication platforms for all participants in the value chain).

The second case study shows how increasingly expensive nitrogen fertilizers can be replaced by compost. In addition, it can also demonstrate the role of public administration (here represented by the region) in supporting bioeconomy and creating new opportunities for businesses. Opportunities may arise for companies focused on logistics, IT, but also on the supply of sludge treatment equipment and project activities.

The third case study is focused on the bioeconomy education, more precisely of how important for the bioeconomy implementation. The **Foresight Report highlighted the structure problems in the BIOEAST macro-region, the lack of human resources in higher education and research** is one of the main bottlenecks to accomplishing the goals of the European Green Deal.

To efficiently support the expansion of the sustainable circular bioeconomy, educational and vocational training programs are required. In addition to technical skills, strong interdisciplinary competences, systems thinking and the ability to understand the subject matter of all stakeholders in the value chains are of increasing importance.

The Thematic Study states that the BIOEAST macro region is rich in biomass resources availability to ensure a knowledge-based transformation towards a biobased economy, new transdisciplinary curricula should be developed, and existing ones should be adjusted to existing needs of the agricultural practice, industry, and policy makers, as well as the foreseen needs for the upcoming decades. The BIOEAST region is lagging in the practice of lifelong learning. The high schools are still not sufficiently addressing the needs of the bioeconomy and the topics related to bioeconomy are only addressed in the scope of the “general” subjects, such as biology. A low number of educational agencies with programs in bioeconomy was depicted as another key issue.

The macro regional BIOEAST Thematic Working Group Bioeconomy Education (TWG BE EDU) was established in 2020 and is coordinated by the BIOEAST HUB CZ. BIOEAST TWG BE EDU has participated in several EU events:

- EBU – Scientific Forum (Session Education);
- BIOEAST Foresight Conference (September 2021);
- IFIB-2021 (Panel Discussion on BE), Bioeconomy Education Seminar (ICA-Community of Practice); TWG Leaders are involved in the study Promoting Education;
- Training and Skills across the Bioeconomy Deloitte, empirica and Fondazione Giacomo Brodolini (FGB) study developed for the EU Commission;

12 Sharma, S., et al. (2021) Speed Breeding Opportunities and Challenges for Crop Improvement https://doi.org/10.1007/s00344-021-10551-

- Transition2Bio & BIOEASTsUP & GODANUBIO webinar / 6 April 2022;
- EC Workshop on Promoting Education, Training and Skills across the Bioeconomy / 26 April 2022;
- Foresight workshop on the future skill needs for BE 2030 and 2050 / 29 April 2022;
- ICA-CoP (European Community of Practice on Bioeconomy Education) supported by the European Commission, several key issues were raised such as Interdisciplinarity on Bioeconomy Education, Sustainability Issues, Vocational Training, Institutionalisation of the BE on European Scale; parallel a workshop on Sustainable Entrepreneurship Education took place too;
- Project2Project (co organised by the BIOEASTsUP project) side event of the High Level Bioeconomy Conference 5th October 2022; several issues were raised and discussed among the participants: specific skills are important for BioIndustry and particularly in the frames of the vocational training.that should be tailored-made and on a case by case basis; BIOBec BBI-JU is an excellent example and similar approached should be adopted in other cases also.

BIOEAST HUB CZ initiated the establishment of the BIOEAST Network of Central and Eastern European Universities – BIOEAST University Network.

1.8. Limitations

The key limitation of this concept paper is the validity of the questionnaire surveys. One of the key findings for the bioeconomy development is the need for more awareness raising and promotion. The survey provided during the BIOEASTsUP project naturally attracted only stakeholders who work in bioeconomy - it is still a relatively small group of experts and organizations in the national perspective. The surveys were also provided during and after the COVID-19 pandemic but before the war in Ukraine. Therefore, it is highly probable that the results might differ in case such a survey would be replicated. Nevertheless, we believe that this concept paper summarizes key information and provides inspirations that are necessary for the development of the national bioeconomy strategy.

1.9. Exploitation of the concept paper

The National Concept Papers are together with the BIOEAST SRIA key results of the BIOEASTsUP project. They are incorporating key results and conclusions of the BIOEASTsUP project. National Bioeconomy Strategic **Concept Papers are designed to serve as a basis for the further development and implementation of national bioeconomy strategies and action plans** in the BIOEAST countries. The development of National Concept Papers launched several key processes in the BIOEAST macro-region, i.e. stakeholder involvement and engagement in discussion, facilitating the interministerial dialog and national thematic working groups.

This document is considered as on open one, BIOEAST HUB CZ is committed to further advance upon what has been done, focused on the above-mentioned challenges and continue improving this background material (i.e. market signals of bio-based industry, market acceptance and public incentives for bio based products, (non) existence of private funding, flagship projects and their life cycle analysis) for policy makers to support the development of national bioeconomy strategies, action plans and public funding instruments.

2. References

Literature

- Noleppa, S., and Cartsburg, M. (2021). The socio-economic and environmental values of plant breeding in the EU and for selected EU member states. HFFA Research
- Razzaq, A., Kaur, P, Akhter, N, Wani, S.H., Saleem, F. (2021) Next-Generation Breeding Strategies for Climate-Ready Crops doi: 10.3389/fpls.2021.620420
- Sharma, S., et al. (2021) Speed Breeding Opportunities and Challenges for Crop Improvement https://doi.org/10.1007/s00344-021-10551-
- Weltzien, E., and Christinck, A. (2017). “Chapter 8 - participatory breeding: developing improved and relevant crop varieties with farmers,” in Agricultural Systems, 2nd edn, eds S. Snapp and B. Pound (Amsterdam: Academic Press), 259–301.

Electronic sources

- Life and biological sciences and technologies as engines for bio-based innovation (EU, 2021) https://op.europa.eu/en/publication-detail/-/publication/df6b2239-9b3e-11eb-b85c-01aa75ed71a1/language-en
- https://www.cr2030.cz/strategie/dokumenty-ke-stazeni/
- https://www.mzp.cz/cz/cirkularni_cesko
- https://eagri.cz/public/web/mze/poradenstvi-a-vyzkum/vyzkum-a-vyvoj/koncepce-a-strategie/
- www.bioeast.eu
- https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwi-2YS-lyYP7AhXJ_KQKHRc1BhEQFnoECA8QAQ&url=https%3A%2F%2Fwww.olkraj.cz%2Fdownload.html%3Fid%3D78719&usg=AOvVaw1XpGH_5gR7vqg7V17-Nzp7
- Studie potenciálu dosud nevyužívaných zdrojů biomasy na území Olomouckého kraje, 2020, SEVEn Energy s.r.o., Praha, dostupné https://www.olkraj.cz/download.html?id=78719
- www.mpo.cz
- National Research, Development and Innovation Policy of the Czech Republic 2016–2020. Office of the Government of the Czech Republic, 2016.