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Editorial

Bioeconomy for Resilient Post-COVID Economies

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1. Introduction

In the creation of this Special Issue, the editors identified circular bioeconomy, i.e., sustainable optimization of the value of biomass through its cascading use [1], as the key engine of the future economic growth of post-COVID economic recovery. The cascading use of biomass is one of the key principles of sustainable bioeconomy [2]. It provides for the energy- and material-efficient use of biomass, as well as a larger number of short chain transactions between economic entities. The multiplicative impact on the national economy is reflected in a greater accumulation of revenues (and consequently investments, income, as well as tax revenues) and in a larger employment. As bioeconomy stakeholders are most often located in rural areas, the growth of bioeconomy is also beneficial for the economic convergence between urban and rural areas. Furthermore, the bioeconomy contributes to the circular economy, more specifically to the sustainable carbon cycles of biomass production and processing, as it promotes the sustainable and efficient exploitation of renewable resources in closed material and energy loops substituting for fossil-based products.

More specifically, the call for papers outlined the transition to the biomass-based economy, which marks a new paradigm in the organization of business processes. By-products and residues are thus becoming raw materials in the existing optimized or new value chains. This transition is enabled by new knowledge and technologies for converting biomass into different products, interconnected in cascade and circular (in terms of energy and material) production cycles. Such organization of business processes brings numerous economic, social, and environmental benefits. The constantly improving efficiency of biorefining techniques and the inclusion of the resulting platform chemicals for bio-based materials allow entry into new value chains (e.g., health, smart packaging) and the achievement of significantly higher added value than the current methods of biomass processing. The transition to a circular bioeconomy needs to be environmentally sound, socially accepted, and cost competitive. None of these three dimensions should be independently maximized, and optimal compromises should be sought instead.

The European policymakers recognized the above challenges. Europe aims to be the first climate-neutral continent by becoming a modern, resource-efficient economy, thus the European Green Deal puts biomass in a central role. All EU strategies proposed under this priority are counting on sustainable biomass valorization. Moreover, the recovery plan in the post-COVID-19 period is meant to support transformative growth for the economies to attain resilience. The consecutive shocks to the European economy (ex. migration, COVID, energy crises) give the issue of bioeconomy a new dimension:

- In the wake of aggravated conditions in the commodity markets (natural resources, agricultural commodities, fossil fuels), the strategic importance of sufficient biomass mobilization, on the other hand,

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- the efficient and sustainable use of it amplified the importance of biomass as a sustainable resource for renewable carbon, implicitly as an energy source, contributing to de-fossilization of the economies.

The central and eastern European (CEE) initiative for knowledge-based agriculture, aquaculture, and forestry in bioeconomy, the so-called BIOEAST initiative, set the vision to develop sustainable circular bioeconomies [3]. The intergovernmental cooperation between 11 CEE countries aims to help the ministries in forming policies and building networks to cooperate better at the national, macro-regional, and European level. Implicitly, this is in order to help the countries better valorize their natural resources and to reach the climate and environmental targets set at the EU level.

Nine papers included in this Special Issue contribute to the debate on the bioeconomy transition in the post-COVID-19 setting. They reveal pathways and challenges associated with this transition. The first group of papers [4–6] is assessing the potentials and relative significance of bioeconomy in the post-COVID economic recovery. This is followed by a group of four papers [7–10] that are assessing technical or economic feasibility of knowledge-intensive biobased applications at the industrial, or regional, scale. The Special Issue is rounded off with two contributions [11,12] that draw attention to the (often overlooked) role of biotechnology and the commercialization-oriented innovation in the mainstreaming of the economy. Contributions in this Special Issue have a clear territorial focus, as seven of them address specific challenges in the region of central and eastern Europe (CEE), which is often considered as the lagging region of Europe in terms of bioeconomy deployment. Below, we are briefly introducing the papers of this Special Issue, both in terms of the issues addressed (Sections 2–4) and territorial implications (Section 5).

2. Economic Feasibility, Contribution of Bioeconomy to Post-COVID Recovery

The energy industry is undoubtedly an engine of economic growth, as its products serve as inputs into nearly every good and service provided on the market. The COVID crisis challenged the stability of the energy system, with a knock-on effect of energy price volatility on the whole economy. This motivated Czech et al. [4] to check possible differences in volatility between the conventional and alternative energy sources (of which an important part is biomass). The results of the comparative econometric analysis of global price trends between the energy from fossil fuels and their renewable alternatives suggest that the latter are less susceptible to external shocks (such as COVID) and therefore improve the stability of the economic system.

Kulišić et al. [5] further investigate how biomass supply for bioenergy could contribute to the post-COVID recovery in three dimensions: boosting economic growth, creating jobs, and building more resilient and cleaner energy systems. The results of an extensive qualitative analysis suggest that the paramount impact of a stronger mobilization of biomass supply chains would be on economic growth, followed by a contribution to the resilient and cleaner energy systems, and job creation. Due to the investment-demanding adaptation, the effects would be more visible in the long run.

A comparison of the bioeconomy potential at the two territorial levels, national and regional level, opens a relevant point for the future bioeconomy strategy setting. As illustrated on the case of a Polish region Lubelskie [6], there are notable differences between the bio-based sectors' potential and their subsequent impact on the economy at the regional and national level. Relevant strategies and instruments should take this into account.

3. Mobilization of Material Sources and Knowledge for Sustainable Bioeconomy on Micro Settings

The first two research papers in this section test the potential and subsequent feasibility of biomass sources for sustainable bioenergy, focusing at the regional level; the following two papers analyze the knowledge-driven perspectives of bioeconomy development in the context of exploiting biogenic resources.

Bioenergy production from animal waste can be a key driver to developing a bioeconomy sector also offering economic profitability and recovery to farmers, especially needed in the post-COVID period. To this end, manure production, its nutrient content, and bioenergy potential were estimated by Sefeedpari et al. [7], along with their spatial distribution in the Lubelskie province, Poland, based on farm-level data. Material balance equations were used to calculate the theoretical potential of livestock manure and bioenergy for different use scenarios and aggregated at the municipality level. According to the estimated potential and the environmental cost effectiveness of AD, new plants will recycle manure through bioenergy production, and subsequently, the digestate can be applied as organic fertilizer, closing the nutrients cycle, minimizing both GHG emissions and fertilization expenses.

Rozakis et al. [8] exploit detailed resource availability analyses, including evidence provided by previous research works, such as Ref. [7], in search of optimal scale specific configurations for regional biomass utilization. Massive biogas development is expected to contribute to the National Recovery and Resilience plan to overcome the COVID-19 shock. The estimation of the immense agricultural biogas potential in economic terms can assist in refining policies with effective incentives for sector development. In this paper, these statements are quantified by modeling biogas chain from dedicated crops and livestock waste by means of coupling the farming models to the biogas industry in a partial equilibrium framework. This allows for a comprehensive investigation of alternative measures in technology, size, spatial distribution, and land use change.

The economic benefits of transitioning to alternative biofuel from wood waste are subject of research presented in Štofova et al. [9] in cooperation with the Vojany black coal power plant, the largest user of solid recovered fuel in Slovakia and beyond. For this purpose, a non-parametric data envelopment analysis method was used to confirm the most economically efficient types of fuels used in the combustion process. The transition to 100% combustion of solid recovered fuel creates the potential for sustainable electricity generation and compliance with the current emission values of basic pollutants and new stricter limits binding the EU from August 2021.

The SARS-CoV-2 pandemic has resulted in the need for objects of a different kind, mostly related to hygiene and prevention. They represent an expense that amounts to billions worldwide and, at the same time, revenues for the industry. Knowledge bio-based technology searches its place in this business. Ochiowak et al. [10] tested solutions to respond to special hygienic demand due to pandemic conditions for increased surface disinfection. Among biocides, UV-C radiation, or ozonation, the former are the most commonly used and can be deposited on the surface with the use of various devices, including foggers. The conditions to maximize the efficiency of disinfection are detailed in this paper in the context of fighting the virus in hard-to-reach places where battery devices can be used.

4. Strategies, Public Policies, and Instruments Promoting the Transition to Circular Bioeconomy

Two papers in this Special Issue are dealing with the question of appropriate transition pathways, policies, and instruments to unlock the bioeconomy potential. In his review paper, Philp [10] puts a strong emphasis on the role that biotechnology can play in bridging the schism between the conventional and emerging new bioeconomy sectors. This explains the fact that some countries, including some of the largest economies, are clearly following a biotechnology model. A grand challenge (observed in particular in Europe) remains the public acceptance of biotechnologies, especially in the agriculture and food sectors, which are proving to be particularly sensitive.

Lovec and Juvančič [11] argue that the current set of policy instruments for mainstreaming the circular bioeconomy, which is based on (publicly supported) R&D, innovation adoption, and technology transfer (science–technology–innovation model; STI), may not be sufficient in the "early" stages of transition. The policy mix should acknowledge the impor-

tance of improved productivity of the primary sectors and the commercialization-oriented innovation (the do–use–interact model; DUI). The latter usually entails integration into larger international value chains.

5. Regional Differences and Mobilization of Stakeholders for Sustainable Biomass Valorization

The European bioeconomy development is strongly linked with rural development. The Common Agricultural Policy (CAP) tackles it as a key specific objective. On the other hand, the different national policies in energy, food security, etc., undoubtedly give specific territorial focus to the biomass-based economies. Enforcing the regional focus of the bioeconomy was also recognized in the 2018 EU Bioeconomy Strategy and action plan. "Deploy local Bioeconomies rapidly across the whole of Europe" is recognized as one of the three cornerstones of the EU Bioeconomy Action plan.

This publication aims to contribute to this regional approach in the context of the central and eastern European (CEE) countries in the tracking of past conferences and previous efforts [12]. The editors agree with the Commission approach, which recognized the missing position of the CEE countries as a specific problem. The EU's updated bioeconomy strategy stated that "…low bioeconomy added value in the CEE is at odds with their high, and, compared to other European regions, yet underutilized biomass potential" [13,14].

The BIOEAST macro regional initiative that has been going on since 2016 aims to help build up knowledge-based agriculture, aquaculture, and forestry in the bioeconomy by contributing to the national-level bioeconomy strategy and action plan development. The Commission in the above-named strategy recognized the role of the intergovernmental initiative in bringing into the attention of national policy makers the importance and urgency of bioeconomy, and the member states also emphasized this role in two Council Conclusions: one on bioeconomy, the other on the Farm to Fork Strategy. Despite all, the uptake of bioeconomy as a cross-cutting sector is not obvious in the CEE countries. The growth of bioeconomy is still heavily dependent on research and innovation investments, which puts on the edge the different rural and regional development policies, and consequently, the funds that could support the overarching deployment. The "bio-economization" of local and regional levels needs further steps in terms of stakeholder engagement by bringing closer to the local level the adoption of new technologies and new biorefining concepts. The smart specialization strategies and regional operational programs need to take up special focus on sustainable biomass, including bio-waste valorization. Beside the European research and innovation funds and CAP, the cohesion and structural funds should also focus their programs. The "bio-economization" of the latter could bring local engagement, bringing value into the rural and local development.

The five-year cooperation of the eleven BIOEAST countries enforced the policy-level recognition of bioeconomy, not only at agricultural-ministries level, but also with other ministries. The growing number of ministerial-level thematic working groups accomplishes one of the main objectives of the initiative to build up networks at policy and scientific levels. Today, seven thematic working groups are elaborating on agroecology, food systems, forestry, fresh-water-based bioeconomy, education, bioenergy, and high-value-added bio-chemicals. The key objectives helping the countries develop their own bioeconomy strategies and action plans, as well as research and innovation agenda, are helpful in providing the countries with impact assessment concept papers, with country-specific national analyses. Moreover, the special focus on macro regional strategic research and innovation agenda contributes to the assessment of needs and gaps connected to European priorities.

Bioeconomy in the CEE countries could play a special role in focusing green investments. The processing sectors, including food and feed, still lag behind; based on the EU Innovation Scoreboard, the countries' economies are between the low or moderate innovators, and substantial progress depends on their modernization. Additionally, global challenges do require new priorities on modernization, which is implemented with the help of new funding mechanisms (EU Recovery and Resilience Fund/EU Next Genera-

tion Fund). The new projects in these countries could provide unique opportunities for progress if the countries focus their investments. The implementation of a circular and sustainable bioeconomy can be used as one of the industry transformation drivers similar to renewable energy, electric mobility, or Industry 4.0. Supported also by the BIOEAST Foresight report's conclusions, biotechnology could be a key enabling technology in this macro region. Bioeconomy could create viable rural areas if special focus is set on national operational programs and national research and innovation strategies for bioeconomy.

6. Conclusions

The current publication puts an emphasis on the deployment of the bioeconomy potentials in the countries of Central and Eastern Europe (CEE). The papers presented in the Special Issue unveil various associated challenges; sustainability is investigated at the firm, sector, and regional level, and impacts on the economy are assessed. As a next step, the CEE countries stakeholder engagement and awareness raising should occur via specialized clusters, technology platforms, and innovation hubs. Last but not least, alternative business models and transition pathways appropriate for the CEE countries are analyzed, suggesting synergies among endogenous drivers and external forces pushing for bio-based activities' take-off.

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