JOURNAL
OF EUROPEAN ECONOMY
Vol. 24. № 1 (92). January–March 2025
Publication of West Ukrainian National University

Climate Neutrality of the Economy

Nataliia KRAUS,
Kateryna KRAUS

SYNERGISTIC EFFECTS OF FUNCTIONAL INTERACTION BETWEEN BIOGROWTH ECONOMY AND GREEN ECONOMY IN THE CONTEXT OF DIGITALIZATION AND ECOLOGIZATION

Abstract

The biogrowth economy and the green economy are integral components of the innovative development of economies and the implementation of energy saving principles. The biogrowth economy advocates for the sustainable use and rational consumption of limited resources, protects biodiversity and the biosphere of human existence, and provides individuals with ecosystem innovation and digital services. The green economy, on the other hand, focuses on reducing environmental risks and ensuring the rational use of available natural resources. This article aims to present a model for the functional interaction between the biogrowth economy and the green economy in the context of digital transformation, viewed through the lens of sustainable, inclusive, and innovative growth. The study employs the following methods: analysis – to review the literature on the

Kraus Nataliia, Doctor of Economics, Professor, Leading Researcher, Bohdan Khmelnytskyi National University of Cherkasy, Cherkasy, Ukraine. ORCID: 0000-0001-8610-3980 Email: k2205n@ukr.net
Kraus Kateryna, Candidate of Economic Sciences, Associate Professor, Senior Research Officer, Bohdan Khmelnytskyi National University of Cherkasy, Cherkasy, Ukraine. ORCID: 0000-0003-4910-8330 Email: k23k@ukr.net

economics of biogrowth and identify an effective model of the green economy; synthesis – to study the principles of building an economy in the context of sustainable development and greening; comparison – to identify the socio-economic benefits and effects of the functional interaction between the biogrowth economy and the green economy; and the schematic method – to visualize the model of functional interaction between the biogrowth economy and the green economy in the context of digital transformation. The results of the study reveal the foundational principles of the biogrowth economy and the green economy and clarify the essence of their ecological core. The socio-economic and synergistic effects resulting from their interaction are presented through the prism of greening. The biogrowth economy is described and it is shown that its important components are the reduction of carbon dioxide emissions and the mitigation of greenhouse effects, the observance of inclusiveness, barrier-freeness, social and corporate responsibility, and the compliance with ethical and environmental standards. Finally, the study emphasizes the need to increase the value component of the national eco-economy through the development of ecological franchising and ecological agritourism. The scientific novelty of the study lies in establishing the relationships between the biogrowth economy and the green economy through the lens of environmental initiatives, green innovations, and digital technologies, as well as in considering the model of the functional interaction between the biogrowth economy and the green economy in terms of sustainable, innovative, and inclusive growth. The practical value of the study is that it outlines the synergistic effects arising from the interaction between the biogrowth economy and the green economy, which lead to energy-efficient production and more economical consumption. This can be achieved by providing systematic government incentives for ecological business practices, such as «tax holidays» for green businesses, and reducing the number of taxes and tax amounts payable by businesses that gradually reduce production waste and greenhouse gas emissions and increase the use of renewable energy sources in business processes. The future prospects of the study could include the modeling of the biogrowth economy as a basis for the development of national models of innovative and digital development of the economy.

Key Words:

bioeconomy, biogrowth economy, blue economy, environmental innovations, environmental standards, global ecosystems, green economy, green growth, social benefits, technological innovations.

JEL: F15, F29, F43, O13, O33, Q00.

2 figures, 10 references.

Problem Statement

The world is undergoing rapid transformations that are changing the conditions for doing business, creating new opportunities and challenges for economic development. An integral part of transformation processes is a caring attitude towards the environment, rational use of natural potential to ensure the well-being of nations. This is possible if we maintain the sustainability of economic processes and actively use green energy-saving technologies.

The transition to a biogrowth economy and a green economy presents new opportunities for the global community and creates the preconditions for a harmonious coexistence of business and nature. This is why we believe that the green economy and the biogrowth economy interact based on several principles, in particular synergistic effects, coherence, and complementarity in innovative value chains. The principle of an effective investment policy for the research, development, data, and innovation sector in natural resource management does not go unnoticed.

The biogrowth economy should primarily advocate for the sustainable use of limited resources and their rational consumption, protect biodiversity and improve the quality of human bio-environment, and provide individuals with ecosystem innovation and digital services. The policy of green national development should provide comprehensive and valuable information for a conscious understanding of the clear contributions of scientific and technological progress, technological innovations, the development of Industry 5.0 based on smart ecosystem principles, and high-quality ecological digital management and e-regulation based on transparency, openness, accessibility, inclusiveness, and barrier-freeness.

Literature Review

The names of Kallis (Schneider et al., 2010), Castro and Lechthaler (2022) and Schmidt et al. (2012) are associated with research on the general aspects of biogrowth economy formation. Researchers such as Booth (2020), Chatzoudes et al. (2024), Liu et al. (2024) and others focus on the development of a national green economy model. At the same time, Nihal et al. (2024) and Kraus et al. (2021) consider the consequences of the interaction between these two types of economies for countries and society, taking into account innovative changes and the emergence of digital models of ecological business. However, many issues, such as the model of the functional interaction between the biogrowth economy and the green economy within the digitalized global world-system, remain insufficiently disclosed and described. Moreover, there is no clear understanding of the synergistic effects resulting from the development of these economies through the lens of greening.

Chatzoudes et al. (2024) studied the practice of applying green logistics from the perspectives of operational, financial, and market efficiency, and social reputation. In our opinion, the scientific results presented by Liu et al. (2024) are highly valuable, as they managed to trace dynamic changes in the sector of high-quality maritime economic development of the country from the perspective of green growth and introduced an original strategy for environmental improvement.

Raisova and Durcova (2014) compared economic growth across EU countries, analyzing the relationship between the Cobb-Douglas production function and productivity. They concluded that economic growth in most countries is characterized by extensive growth, which is achieved through both extensive and intensive factors of production.

Considering the above, we find it necessary to propose the obvious socio-economic benefits and effects of the functional interaction between the biogrowth economy and the green economy through the lens of ecologization, to identify the characteristic features of the interconnections between these economies, and to present the actualization of their interdependence. We also consider it appropriate to describe both the ecological core of the biogrowth economy and the ecological core of the green economy.

The purpose of this article is to present a model of the functional interaction between the biogrowth economy and the green economy in the context of digital transformation through the lens of sustainable, inclusive, and innovative growth, as well as to define organizational and economic principles for «smart» consumption, digitized production, and efficient use of limited resources.

Methodology

The following scientific methods were used in the study: analysis – to review the available scientific literature on biogrowth economics and to search for an effective model of a green economy based on innovations and digital models of ecological business; synthesis – to study the principles underlying these two types of economies in the context of sustainable development and greening; comparison – to identify the socio-economic benefits and effects of the functional interaction between the biogrowth economy and the green economy through the lens of greening; schematic method – to visually present a model that illustrates the functional interaction between the biogrowth and green economies in the conditions of digital transformation.

The hypotheses we propose are as follows:

- The consistency of interests in the functional interaction between the development of the biogrowth economy and the green economy, based on the ecological core, towards sustainable innovative and digital growth;
- The strengthening of synergistic effects from the interaction of the biogrowth economy and the green economy as a result of the biodigital renewal of the economy and changes in environmental production and consumption standards.

Research Results

According to the key findings of the *Future Possibilities Index 2024* (Horizon Group & Vantage Research, 2024), Germany is leading in the biogrowth economy, while the United Kingdom is in the lead in the circular economy. By 2030, the total value of the biogrowth economy is expected to exceed $1 trillion, while the circular economy is projected to reach $4.5 trillion.

Japan and France rank 2nd and 3rd globally in the development of the biogrowth economy, thanks to the large number of patented innovations in this field. China and the United States rank 2nd and 3rd in the development of the circular economy, with businesses characterized by a closed production cycle (Horizon Group & Vantage Research, 2024).

We partially share the opinion of foreign scientists Castro and Lechthaler (2022) that the biogrowth economy is closely linked to the development of technological innovations and depends on constant changes in the environment, and

that «inclusive models of efficient land use are able to predict solutions and identify benefits.» Monitoring changes in forest area allows us to understand the demand for wood resources and the ecological consequences of disturbances, such as natural disasters, on ecosystems. Countries with less forest cover are usually more sensitive to the effects of climate change (Nihal et al., 2024). Schmidt et al. (2012) also note that «the full potential of the integrated bioeconomy needs to be developed to a greater extent through links to public goods and a more visible role for farmers.»

We propose to define the «biogrowth economy» as an institutionalized and qualitatively structured economy for the creation of biomaterials that can decompose rapidly and do not pollute the environment. The goal of its progressive development can be seen as the breeding and selection of new species and types of agricultural crops with traits such as frost resistance, drought resistance, saturation with minerals, and nutritional properties, i.e., characterized by new nutritional quality.

The products of the biogrowth economy are efficient fuels and building materials of new quality. Scientific and technological progress, along with innovations in synthetic biology and biomaterials, are laying the foundations for the emergence of new medicines for medical treatment and advanced cosmetics for human restoration and rejuvenation in the beauty industry.

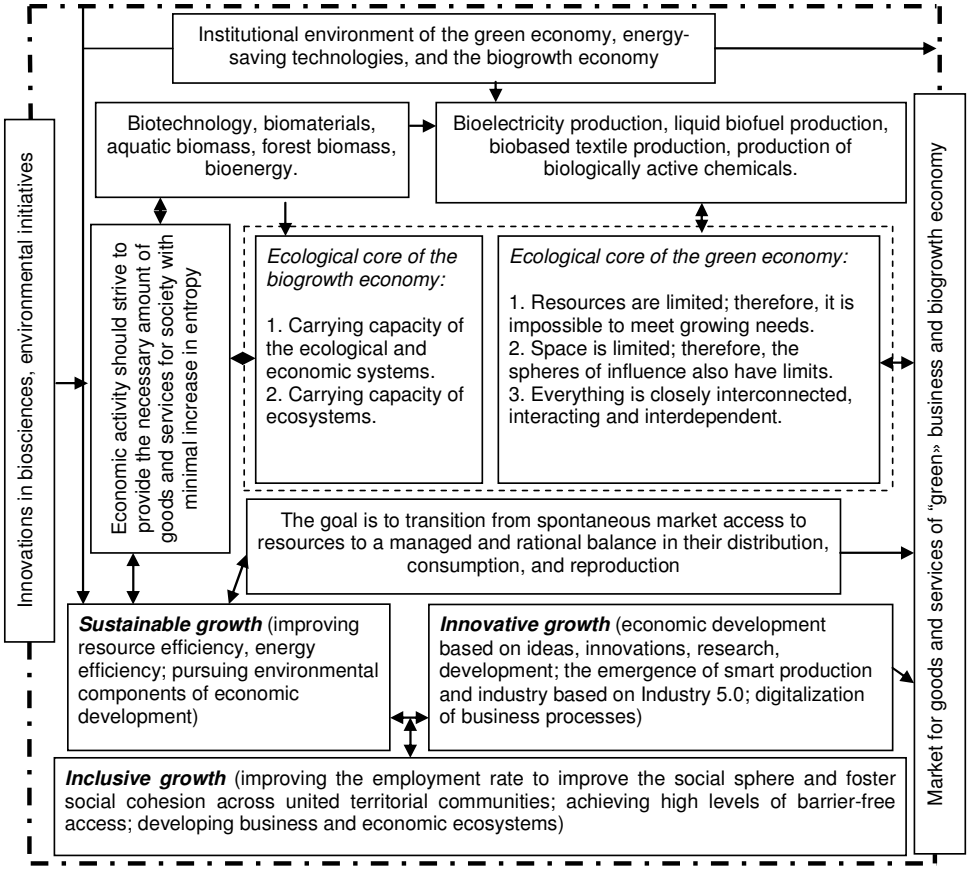
We are convinced that the quality of biogrowth economy management is affected by the lack of accurate and verified information, insufficient knowledge of the services provided by the economic ecosystem, unpredictable risks arising from the functioning of the institutional system, and negative externalities from economic convergence. We have tried to visualize a model of the functional interaction between the biogrowth economy and the green economy in the context of digital transformation, as shown in Figure 1.

When describing Figure 1, it is important to note that the ecological core serves as a foundation for the high-quality interaction between the biogrowth economy and the green economy. Biotechnologies make digital transformation of the biogrowth economy flexible, fast, and effective. The growth of green businesses is achieved through digital development tools that form a new virtual and mixed reality.

Among the digitalization tools used in the biogrowth economy and in green businesses, the following are worth mentioning: GPS tracking, logbooks, automated animal herd management systems, automated irrigation systems, information systems for sowing planning and effective harvest management, drones for economic purposes, programs and applications in horticulture, artificial intelligence, digital terrain models and digital thematic maps, cyber-physical systems, Big Data, Internet services, Internet of Things, cloud computing, energy-efficient and resource-saving technologies, digital twins, and industrial Internet of Things.

Figure 1

A model of functional interaction between the biogrowth economy and the green economy in the context of digital transformation



Source: authors'own elaboration.

When analyzing the interaction model, it is worth noting that the new quality of organization of the green economy functioning and «sustainable resource management enhances natural processes by either avoiding or slowing down degradation processes» (Castro & Lechthaler, 2022). Regulatory pressure on the environment is the strongest driver of green logistics, emphasizing the importance of compliance with regulatory requirements in the development of sustainable practices (Chatzoudes et al., 2024). «The overwhelming share of CO^2 emissions

comes from the energy sector due to the combustion of fossil fuels, which is the main source of energy» (Nihal et al., 2024).

The term «green economy» refers to a type of economy that addresses environmental issues at both macro and micro levels, in particular eco-security. This economy aims to improve the well-being of the population through the rational and economical use of natural resources within the country's existing ecosystem. The modern development of the green economy is implemented through breakthrough innovations, progressive green technologies, and digital tools such as applications and programs.

The challenge of the green economy is not so much to achieve zero growth, but to realize such a green economy model, in which energy and material flows, as well as waste emissions, are limited to sustainable levels that are consistent with supporting a healthy global ecosystem (Booth, 2020). «Green growth involves the development of more environmentally friendly industries, but does not necessarily replace existing problematic industries… In fact, the positive impact of environmentally friendly goods and services can be offset by increased production and consumption, as revenues from more environmentally efficient technologies are used consume more in other developing countries» (Schneider et al., 2010).

The biogrowth economy includes new-generation biorefinery, biomaterials, plant tissue culture, synthetic biology, and plant-based foods. The biogrowth economy market recognizes the transformative potential of harnessing nature's capabilities for sustainable industrial and agricultural practices (Horizon Group & Vantage Research, 2024).

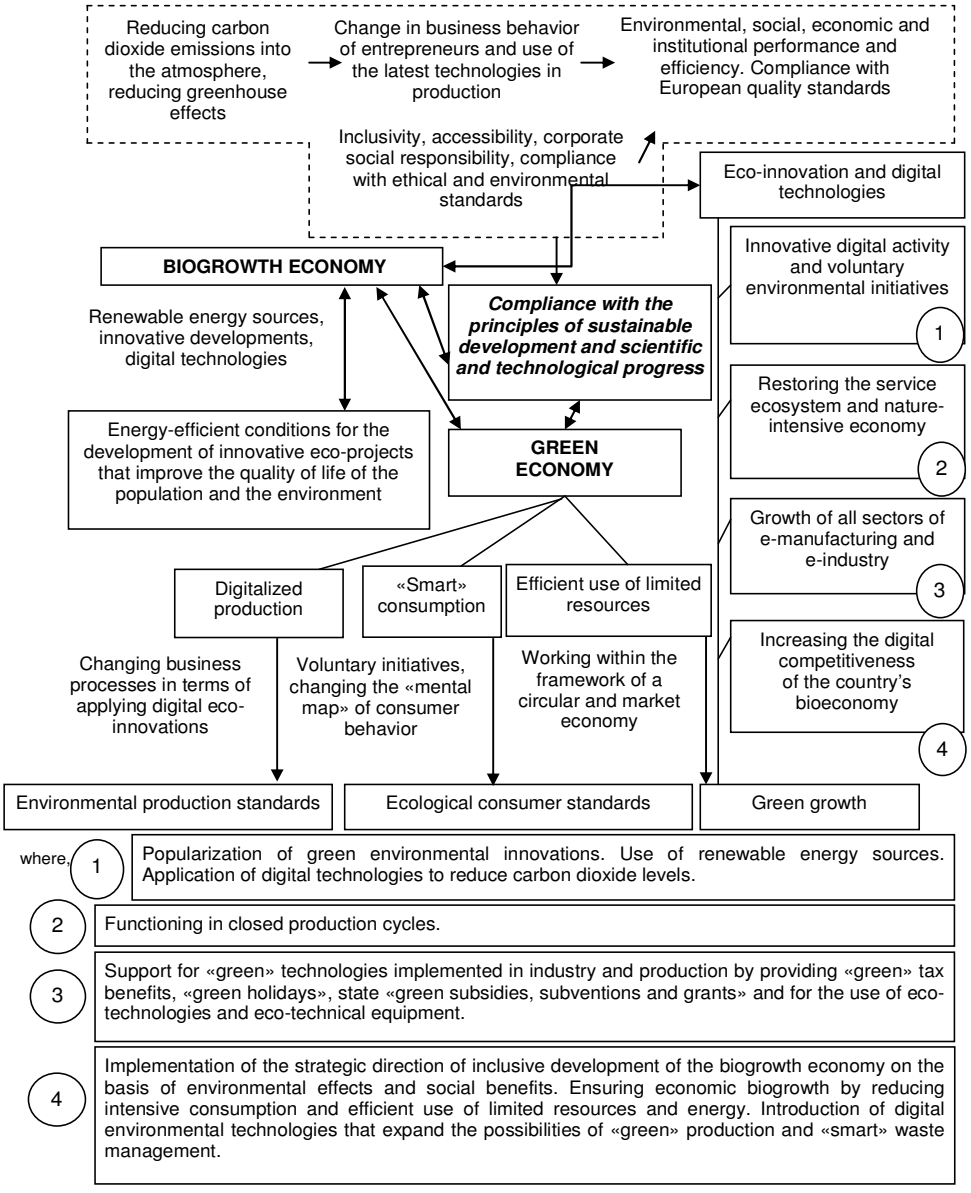
The bioeconomy is focused on public goods. The biogrowth economy promotes the application of agroecological methods in business processes, such as organic and low-input systems in agriculture. This economy advocates the provision of ecosystem services based on the use of social innovations in multi-stakeholder collective practices and the co-production of knowledge (Schmidt et al., 2012).

We understand the bioeconomy as a type of economy in which the production and industrial sectors are primarily driven by the application of innovative and digital bio-, nano- and information technologies of the latest generation at the molecular and genetic levels, improving the quality and efficiency of production and refinement of bioresources. The development of this type of economy is closely linked to innovation, scientific and technological progress, and the digitized production of non-food products based on large-scale application of bioresources, biotechnology, and biotechnological products. Renewed bioresources are used to produce valuable food products, fiber, cellulose, high-quality health products, and energy. The bioeconomy produces energy and goods based on renewable natural resources.

The authors' original scientific perspective on the synergistic effects arising from the functional interaction between the biogrowth economy and the green economy, viewed through the lens of greening, is visually presented in Figure 2.

Figure 2

Synergistic effects of functional interaction between the biogrowth economy and the green economy through the prism of greening



Source: authors' own elaboration.

The inclusion of digital technologies in each of the economies shown in Figure 2 aims to reduce the environmental hazards at enterprises in different sectors of the economy. In addition, the digitalization of business processes and business models in the biogrowth and green economies allows for the conservation of already limited resources, while at the same time imparting a new quality to the goods and services in these economies, thereby satisfying the geometrically growing desires and needs of consumers.

As we present the content of Figure 2, it is important to note that we view the synergistic effects arising from the simultaneous functioning of the biogrowth and green economies as being manifested in the establishment of sustainable resource management, in particular in environmentally sustainable production and application of resource-saving digital technologies. Increased productivity and efficiency within these economies are achieved through automation, innovation, digitalization of production and industrial processes, the transition to environmental production standards, corporate social responsibility, and the use of eco-innovations in production and industry.

Optimization of resource management and balanced use of resources within the framework of the green economy can be achieved through digitized production and efficient and thoughtful use of limited resources. The quality of products and energy produced by the biogrowth economy can be enhanced by applying digital technologies to improve the quality and ensure the eco-friendliness of products, reduce the cost of pesticides, effectively manage fresh water reserves, and use renewable energy sources.

It is also worth recalling that «oceans cover 97% of the world's water resources, constituting the largest biologically diverse ecosystem on the planet, which is considered a powerful economic force, called the «blue» economy, which includes the complex interaction of commercial and scientific activities. The «blue» economy can create numerous economic and social opportunities. However, it is threatened by the negative impact of some human activities on the marine ecosystem. This fact worsens the state of life in the ocean, undermining biodiversity, accelerating global warming and destroying global fisheries» (Horizon Group & Vantage Research, 2024). Advances in biomaterials, plant breeding, and synthetic biology are expected to lead to new types of food, biodegradable materials, sustainable crops, biofuels derived from agricultural waste, and animal protein substitutes (Horizon Group & Vantage Research, 2024).

The biogrowth economy aims to expand the practical aspect of sustainable intensification in primary production, the effective full closed cycle of biomass utilization, and the formation of waste-free production (see Figure 2).

The green economy would benefit more if society made more efficient use of its resources – limited as they are. It is worth emphasizing the expansion of opportunities for the green economy brought about by the sharing economy.

It makes sense to increase the value component of the national eco-economy through the development of ecological franchising and ecological agritourism. This can be achieved by the state providing consistent incentives for ecological business through «tax holidays» for green businesses and reducing the number and the amount of taxes to be paid by business entities that gradually cut production waste and greenhouse gas emissions, use renewable energy sources in business processes, and digitize them. The government should expand access to the market for new agricultural technologies and biomaterial products for all interested entrepreneurs.

Conclusions

In conclusion, it should be noted that the synergistic effects arising from the interaction between the biogrowth economy and the green economy contribute to more energy-efficient production and more economical consumption, which can eventually improve the quality of life and promote societal well-being in terms of explicit environmental conditions of coexistence of man and industry. Ultimately, the processes of systemic and comprehensive modernization of production, digital transformation of business processes, and institutional changes are designed to promote the sustainability of environmental and social changes in the economy.

Further scientific research should be conducted on modeling the biogrowth economy in order to develop effective national models for the innovative and digital development of the economy based on this knowledge. It is worth calculating the impact of factors on changes in the biogrowth economy through the lens of spatial coordinates and time constraints. Obviously, this task is extremely complex, but accurate and comprehensive econometric modeling could contribute to the creation of new tools for the development of the green economy and help determine the range of alternative management decisions at the government level to ensure a new quality of development for the national biogrowth economy in the post-war period.

References

Booth, D. (2020). Achieving a post-growth green economy. *The Journal of Population and Sustainability, 5*(1). 57–75. https://doi.org/10.3197/jps.2020.5.1.57

Castro, L.-M., & Lechthaler, F. (2022). The contribution of bio-economic assessments to better informed land-use decision making: An overview. *Ecological Engineering, 174*, 106449. https://doi.org/10.1016/j.ecoleng.2021.106449

Chatzoudes, D., Kadlubek, M., & Maditinos, D. (2024). Green logistics practices: The antecedents and effects for supply chain management in the modern era. *Equilibrium. Quarterly Journal of Economics and Economic Policy, 19*(3), 991–1034. https://doi.org/10.24136/eq.2864

Horizon Group & Vantage Research. (2024). *Future Possibilities Index 2024*. https://www.vantageresearchgroup.com/reports/FPI%202024%20report%20FINAL.pdf

Kraus, N. M., Kraus, K. M., & Osetskyi, V. L. (2021). Green business in blue economy: Quality management and development of innovative products. In: S. K. Ghosh, K. Ghosh, S. Das, P. K. Dan, & A. Kundu (Eds.), *Advances in Thermal Engineering, Manufacturing, and Production Management (ICTEMA 2020)* (pp. 383-394). Lecture Notes in Mechanical Engineering. Springer. https://doi.org/10.1007/978-981-16-2347-9_33

Liu, P., Zhu, B., Yang, M., & De Baets, B. (2024). High-quality marine economic development in China from the perspective of green total factor productivity growth: dynamic changes and improvement strategies. *Technological and Economic Development of Economy, 30*(6), 1572–1597. https://doi.org/10.3846/tede.2024.22018

Nihal, A., Areche, F., Araujo, V., & Ober, J. (2024). Synergistic evaluation of energy security and environmental sustainability in BRICS geopolitical entities: An integrated index framework. *Equilibrium. Quarterly Journal of Economics and Economic Policy, 19*(3), 793–839. https://doi.org/10.24136/eq.3088

Raisova, M., & Durcova, J. (2014). Economic growth – supply and demand perspective. *Procedia Economics and Finance,* 15, 184-191. https://doi.org/10.1016/S2212-5671(14)00476-6

Schmidt, O., Padel, S., & Levidow, L. (2012). The bio-economy concept and knowledge base in a public goods and farmer perspective. *Bio-Based and Applied Economics, 1*(1), 47–63. https://doi.org/10.13128/BAE-10770

Schneider, F., Kallis, G., & Martinez-Alier, J. (2010). Crisis or opportunity? Economic degrowth for social equity and ecological sustainability. Introduction to this special issue. *Journal of Cleaner Production,* 18(6), 511–518. https://doi.org/10.1016/j.jclepro.2010.01.014

Received: January 4, 2025.
Reviewed: January 22, 2025.
Accepted: January 27, 2025.