

THE ROLE OF BIOMASS IN THE BIOECONOMIC POLICY OF UKRAINE AND ITS LEGAL REGULATION

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ABSTRACT

The article examines the need and possibility of introducing bioeconomy in the management system of the national economy, in the context of the focus on sustainable development through the use of the most modern techniques and technologies for the use of biomass. It is determined that the key role in the development of a new direction of the country's economy is played by the agricultural sector, as the bioeconomy of agricultural systems is based on agricultural biomass and biotechnology. Optimization of agricultural biomass flows is one of the components of bioeconomy development. It is noted that, given the significant natural and economic, raw material research and production potential and state support, Ukraine has great opportunities for bioeconomy development based on the production of environmentally friendly bioenergy products through the efficient use of agricultural biomass. The legal bases of the state management of the bioeconomic development of Ukraine are stated.

Key words: bioeconomy, biotechnologies, innovations, agricultural biomass

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INTRODUCTION

The issues of formation and development of the bioeconomy have recently become one of the most relevant in the programs of a social-economic policy of countries around the world. The place and role of the bioeconomy in solving the global problems of

mankind are outlined in the strategic programs of the transition to the bioeconomic direction of national economies of the EU and other countries (German Bioeconomy Council, 2020).

The priority areas of the bioeconomy are the creation of preconditions for the economic use of natural resources, minimization of environmental risks, the

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spread of organic farming, and the use of energy-saving technologies. The development of the bioeconomy is an extremely important direction for Ukraine, which has significant relevant potential and state support.

The purpose of the study is to analyse the current state and prospects of biomass production and determine its role in the development of the bioeconomy.

THEORETICAL FOUNDATIONS

The concept of bioeconomy as a new paradigm of economic development is a field of study of domestic and foreign scientists.

Bioeconomy is a new direction of economic development, which re-uses and recycles secondary raw materials, including waste, creates conditions for multiple, cyclical use of resources, ensuring the social-economic development of the country. The use of biotechnology creates the basis for the formation of the bioeconomy as a system that creates biological resources for the production of high-tech products (Buhaichuk and Hrabchuk, 2018).

The potential for more biomass from agriculture for various biological activities can be enhanced by stimulating the development of rural areas in Central and Eastern Europe, where small semi-enterprises still predominate in some regions. In addition, double pruning can significantly increase biomass yield (Ronzon and M'Barek, 2018).

The concept of bioeconomy demonstrates how to pave the way for economic transition, which will create conditions for optimal use of renewable biological resources and enable the development of sustainable production and processing systems. This will allow for a wider range of products, using fewer resources and providing a less negative impact on ecosystems (Gołębiewski, 2016).

MATERIALS AND METHODS

Analysis and assessment of the state of development of the agricultural biomass market, as one of the important components of the bioeconomy, were aimed at studying the possibilities of implementing the bioeconomy direction of economic development in Ukraine.

The following documents and materials were used in the research process:

- Directive (EU) 2018/2001 of the European Parliament and of the Council;
- documents of the Verkhovna Rada and the Cabinet of Ministers of Ukraine on supporting the development of bioenergy potential of the agricultural sector;
- materials of the Bioenergy Association of Ukraine;
- statistical collections of the Ministry of Agrarian Policy and Food of Ukraine.

In the course of this research the method of system analysis was used, which allowed:

- to study the scientific and legal principles of bioeconomy development;
- analyse the dynamics of production and use of agricultural biomass and its energy potential;
- determine the potential of agricultural biomass available for use in the future.

RESULTS AND DISCUSSION

The modern market economy is characterized by the active use of new innovative methods of production and the expansion of its range. New knowledge and results of innovative activity have found their application in various spheres of economics and social life. Many countries around the world are creating new models of innovative development, one of which is the bioeconomy. Bioeconomy defines the economics associated with the production and processing of biological resources, based on the use of biotechnology.

Bioeconomy is an evolving paradigm in which the creation, development, and revitalization of economic systems based on the sustainable use of renewable biological resources are spreading rapidly around the world in a balanced way. Bioeconomy builds bridges between biotechnology and economics, as well as between science, industry, and society, and underpins science and innovation policies developed in many countries (Aguilar, Twardowski and Wohlgemuth 2019).

Agriculture plays the role of the core of the bioeconomy, as it is the main raw material base. Bioeconomy is based on biomass and biotechnology

where the main components are renewable sources of biomass, in particular of agricultural origin.

The EU Directive defines biomass as a biodegradable fraction of products, waste, or residues of biological origin from agriculture, including plant and animal substances, forestry and related industries, including fisheries and aquaculture, and a biodegradable fraction of waste, including and municipal waste of biological origin. Agricultural biomass means biomass produced from agriculture (Directive (EU) 2018/2001).

The European Union's bioeconomy strategy, developed in 2012, placed a strong emphasis on investment in research, innovation, and skills. Optimization of biomass flows is one of the components of bioeconomy development (Ronzon and M'Barek, 2018).

Given that the agro-industrial resource is becoming a leading strategic bioresource, biomass from products produced in the agricultural sector can give Ukraine new opportunities for sustainable development through the production of cheap, environmen-

tally friendly bioenergy products through efficient use of agricultural biomass.

To stimulate the production and use of biological fuels, the development of the national fuel market in Ukraine based on biomass as a renewable raw material for the production of biological fuels, the legal, social, economic, environmental, and organizational principles of production and use of alternative fuels stimulating an increase in the share of their use to 20% of total fuel consumption in Ukraine by 2020 (Zakon Ukrayiny vid 28 chervnya 2015 r. No 1391-VI).

The analysis for the period 2015–2019 shows that the economic potential of agricultural biomass available for energy production is characterized by an upward trend. According to the Bioenergy Association of Ukraine, in 2015 the energy potential from agricultural biomass was 8.12 million tons of oil equivalent (toe) or 40% of the total biomass potential, in 2018 it was already 10.15 million tons of oil equivalent, which was equal to 44% (Table 1).

Table 1. Energy potential of agricultural biomass for 2015–2019

Type of biomass	Theoretical potential (M tons)	Potential is available for energy (M toe)	Theoretical potential (M tons)	Potential is available for energy (M toe)	Theoretical potential (M tons)	Potential is available for energy (M toe)	Theoretical potential (M tons)	Potential is available for energy (M toe)	Theoretical potential (M tons)	Potential is available for energy (M toe)
	2015 ^a		2016 ^b		2017 ^c		2018 ^d		2019 ^e	
Straw of cereals	35.1	3.65	36.1	3.75	35.6	3.65	32.8	3.36	37.5	3.84
Rapeseed straw	3.1	0.43	2.1	0.29	3.9	0.54	4.9	0.68	5.9	0.81
By-products of corn production on grain (stalks, cores)	30.3	2.32	36.5	2.79	32.1	2.45	46.5	3.56	46.6	3.57
By-products of sunflower production (stems, baskets)	21.2	1.22	25.9	1.48	23.2	1.33	26.9	1.54	29.0	1.66
Secondary agricultural waste (sunflower husk, pulp)	1.9	0.5	2.0	0.71	2.4	0.99	2.4	1.01	2.6	1.08
Total agricultural biomass	91.6	8.12	102.6	9.02	97.2	8.96	113.5	10.15	121.6	10.96
Total biomass potential		20.19		21.0		20.91		23		23.63
The share of agricultural biomass in total potentials (%)		40		43		43		44		46

Source: formed by the authors based on ^aGeletukha, Dragnev and Kucheruk (2017); ^bVinikaytis and Geletukha (2018); ^cGeletukha, Zhelezna and Dragnev (2019); ^dUABIO (2018); ^eUABIO (2020a, b), Zhelezna (2020).

Analysis of the use of agricultural biomass for energy purposes showed that the current level of use of energy potential of biomass in the country is very low – from 0 to 2–3% depending on the specific species, and only sunflower husk showed 73.1% (Table 2).

Structural analysis of the energy potential of biomass revealed that the most frequent raw material used is sunflower husk and the least frequent are cereals and rapeseed straw. Therefore, a beneficial long-term decision would be the intensification of energy production of this type of biomass. The highest percent of biomass potential exploitation was gained by burning the straw bales (Table 3).

The main form of energy from biomass is thermal

energy, which is used for energy purposes by producing thermal energy for heating and hot water supply. During 2014–2018, the share of thermal energy from biomass was within 97% of all renewable thermal energy.

Electricity from biomass is used to provide consumers with electricity. It is mainly produced at thermal power plants and biogas complexes. As of 2018, wood biomass, agricultural waste, and livestock waste were used as raw materials for the production of electricity from biomass in Ukraine. The share of electricity from biomass was about 2.2% of total renewable electricity and about 2% of the total final energy consumption of the country in 2018. The market for electricity from biomass produced by thermal power plants is the wholesale electricity market. That is, the entire amount

Table 2. The state of use of the energy potential of agricultural biomass

Type of biomass	Potential available for energy (thous. tons)			Volume already used for energy needs						Share of total potential use (%)		
				thous. tons	thous. toe	thous. tons	thous. toe	thous. tons	thous. toe			
	2015 ^a	2017 ^b	2019 ^c	2015 ^a		2017 ^b	2019 ^c		2015 ^a	2017 ^b	2019 ^c	
Cereal / rapeseed straw	10 540	12 258	13 604	256	95	371	130	455	157	2.4	3.0	3.3
Stems, corn cobs	12 120	12 828	18 660	3.7	1.2	15	5.0	15	5.0	0.0	0.1	0.1
Stems, baskets of sunflower	8 480	9 299	11 590	0	0	0	0	0	0	0	0	0
Sunflower husk	1 410	2 374	2 585	1 166	462	1 500	626	1 890	789	82.7	63.2	73.1

Source: formed by the authors on the basis of ^aAntonenko et al. (2017); ^bGeletukha, Zhelezna and Dragnev (2019), ^cZhelezna (2020).

Table 3. Structure of biomass energy potential exploitation for 2017 and 2019

Type of biomass and exploitation vector	Energy potential of biomass (thous. tons)		Already used for energy exploitation (thous. tons)		Energy potential used (%)	
	2017 ^a	2019 ^b	2017 ^a	2019 ^b	2017 ^a	2019 ^b
Cereal/rapeseed straw:	12 258	13 604	371	455	3.0	3.3
burning (bales)	–	–	200	350	1.6	2.6
production and burning of granules/briquettes	–	–	155	100	1.3	0.7
production and export of granules	–	–	0.97	4.9	0.01	0.0
production and burning of briquettes	–	–	15	–	0.1	–
Sunflower husk:	2 374	2 585	1 500	1 890	63.2	73.1
burning (bales)	–	–	650	1 280	27.4	49.5
production and burning of granules/briquettes	–	–	300	400	12.6	15.5
production and burning of briquettes	–	–	450	210	19.0	8.1

Source: the authors' interpretation based on ^aGeletukha, Zhelezna and Dragnev (2019), ^bZhelezna (2020).

of electricity produced from biomass, except for the own needs of thermal power plants, must be purchased by the state enterprise 'Energorynok'.

Biomass can also be used to make a variety of fuels for use in heating systems. Fuel made from biomass is a biofuel. It can be used as a fuel or a component of other fuels. Biofuels can be solid (granules, briquettes, etc.), gaseous (generator gas of gasification processes, biogas in the process of fermentation, etc.), and liquid (combustible liquids and oils in the process of pyrolysis, liquid motor biofuels in the process of hydrolysis or fermentation, etc.). All of these fuels are biological fuels. In the studied period, solid biofuel has a stable upward trend and its production in 2018 compared to 2014 increased by 54.2%. Biogas production increased 3.3 times compared to 2015 (Table 4).

The processes of transition of the national economics to bioeconomy principles should be based on the restoration of the biological value of natural resources, their rational use, the introduction of new technologies and innovations, and the use of the energy potential of agricultural biomass (Martusenko, 2017).

The amendments to the State Targeted Economic Program for Energy Efficiency and Development of Energy Production from Renewable Energy Sources and Alternative Fuels for 2010–2020 approved the amount and sources of funding in the amount of 346.73 billion UAH, including 8.42 billion UAH at the expense of state budget, 15 billion from local

budgets and 323.31 billion UAH from other sources (Kabinet Ministriv Ukrayiny Postanova vid 19 chervnya 2019 r. No 556).

Reliable assessment of the potential of agricultural biomass is an important indicator of creating conditions for the implementation of bioeconomic standards in the economics of Ukraine.

Dynamics of agricultural biomass volume and the prospect thereof have been composed based on statistical data and growth rate factor (K_B):

$$K_B = \frac{B_1 - B_0}{B_0},$$

where:

K_B – growth rate factor,

B_0 – statistical indicator of previous year,

B_1 – statistical indicator of current year.

By substituting the variables with data that correspond to a certain period (Table 1) we receive the indicators that demonstrate growth or decrease of agricultural biomass volume (Table 5).

Volumes of agricultural biomass production for the future were determined using the technique of calculating the materials of previous studies of the authors (Kucher and Prokopchuk, 2019) and statistical data (State Statistics Service of Ukraine, 2019b). Based on the obtained results, the average growth rate of crop biomass for the study period 2015–2018 is 0.08 or 8%. According to the

Table 4. Dynamics of energy production and biofuels from biomass for 2014–2018

Indicator	2014	2015	2016	2017	2018
Heat energy					
Produced (thous. toe)	1 407	1 533	2 170	2 429	2 676
Share of thermal energy from biomass from all renewable thermal energy (%)	96.5	96.6	97.4	97.5	97.6
Electricity					
Produced (thous. toe)	11.0	12.0	12.0	18.0	25.0
Share of electricity from biomass from all renewable electricity (%)	1.1	1.2	1.1	1.7	2.2
Biofuels					
Solid biofuels (kJ)	99 773	108 081	138 667	147 400	153 886
Liquid biofuel (thous. tons)	26	16	6	21	4
Biogas (kJ)	–	600	1 267	1 601	1 995

Source: systematized by the authors according to the official data of the State Statistics Service of Ukraine (2016, 2018, 2019a).

Table 5. Growth rate factor of agricultural biomass growth

Year	Variable	Theoretical capacity (million tons)	Growth rate factor	Average growth rate factor
2015	B_0	91.6	–	$(K_{B1} + K_{B2} + K_{B3}) / 3 = 0.08$
2016	B_1	102.6	$K_{B1} = (102.6 - 91.6) \div 91.6 = 0.12$	
2017	B_2	97.2	$K_{B2} = (97.2 - 102.6) \div 102.6 = -0.05$	
2018	B_3	113.5	$K_{B3} = (113.5 - 97.2) \div 97.2 = 0.17$	

Source: own calculations based on Table 1.

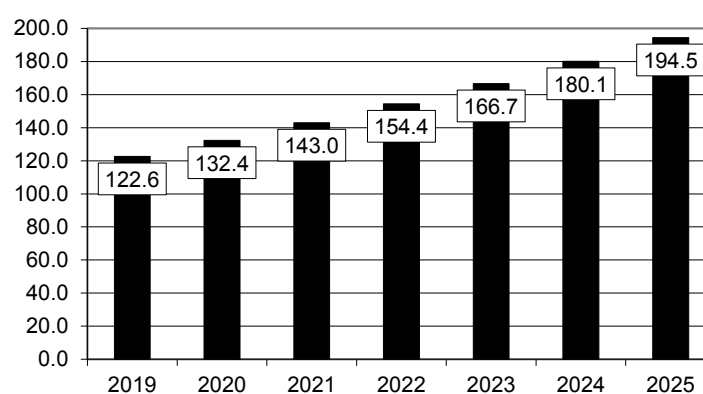


Figure 1. Potential of agricultural biomass available for use (million tons)

Source: own calculations.

results obtained in 2025, the amount of biomass for use in bioenergy may be about 194.5 million tons (Fig. 1).

CONCLUSIONS

The results of the study suggest that Ukraine has significant natural and economic, research and production, raw material potential, and legal support of the state for the development of the bioeconomy through the development of innovative technologies.

In the context of the above, for the implementation of the bioeconomic format of Ukraine's economic development, it is first necessary:

- create conditions for increasing agricultural biomass production through the development of innovative technologies;
- concentrate the efforts of scientists and practitioners on the development of basic technologies and approaches to the organization of this process;

- provide support for the development of the bioeconomy at the state level;
- based on the analysis of the components of the bioeconomy that determine its implementation, develop a concept and national strategy for the development of the bioeconomy.

Further research will focus on the experience of countries that use innovative biotechnology in agricultural production and their strategic programs for the development of the bioeconomy.

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