



## Market status of the energy, produced from animal biomass and prospects for development in Bulgaria

Nely Georgieva<sup>1\*</sup>, Petko Tsankov<sup>2</sup>, Vasil Hristov<sup>3</sup>, Kalin Kirov<sup>4</sup>

<sup>1</sup>Department of “Energetics”  
Trakia University, Faculty of Technics and technologies  
Address: Yambol, Graf Ignatiev Street, № 38  
E-mail: [nely.georgieva@trakia-uni.bg](mailto:nely.georgieva@trakia-uni.bg)

<sup>2</sup>Department of “Energetics”  
Trakia University, Faculty of Technics and technologies  
Address: Yambol, Graf Ignatiev Street, № 38  
E-mail: [ptsankov@abv.bg](mailto:ptsankov@abv.bg)

<sup>3</sup>Department of “Energetics”  
Trakia University, Faculty of Technics and technologies  
Address: Yambol, Graf Ignatiev Street, № 38  
E-mail: [vasil.hristov@trakia-uni.bg](mailto:vasil.hristov@trakia-uni.bg)

<sup>4</sup>Ecoenergy technology Ltd.  
Address: Yambol, Dimitar Blagoev Street, № 19

\*Corresponding author

**Abstract:** Bulgaria has long fulfilled its commitments to the use of renewable energy sources (RES) in the national energy mix, with the Eurostat data for 2020 showing a share of 23.3%, while the EU average is 22.1%. This places us third in terms of achieving the national energy targets for this indicator for 2020. However, if we analyze the data provided, we will find that this is mainly due to the installed photovoltaic and wind installations. Energy production from biomass ranks only fourth in the national mix, with a much smaller share compared to the potential that Bulgaria has.

The aim of this study is to identify the problems for wider use of animal biomass waste for biogas production in Bulgaria by analyzing the current regulatory framework and incentives provided for the development of biogas technologies, as well as analyzing the existing infrastructure of operating biogas plants in Bulgaria.

**Keywords:** RES, biogas technologies, animal biomass, regulatory framework for biogas production

## Introduction

In a previous study (8), an analysis of the market for energy derived from animal biomass and prospects for international development was conducted. Good practices were studied for stimulating the development of biogas technologies. It was found that in all leading countries developing these technologies, there are various incentives and measures to support the construction, operation, and purchase of energy obtained from biomass utilization facilities. Reasons for the need for this support include the large initial investments for construction, a long payback period, difficulty in providing biomass for the methanogenesis process in small livestock farms, and others. In Europe, Germany is a good example of this, applying the requirements in European directives and being a leader in biogas production from waste biomass in Europe. Germany is also the only country in Europe that has introduced standards

for quality criteria for biogas installations (15), fermentation and sampling methods, substrate assessment, data collection for materials, and fermentation tests (14).

Thanks to the global policy to stimulate the development of energy from waste biomass in the last decade, a significant increase in biogas production has been achieved, but there is still considerable untapped potential, which justifies the claim that the sector has good prospects for development in the coming years. This justifies the need for an in-depth analysis of the development of these technologies in Bulgaria.

This study analyzes the national policy on stimulating the development of biogas production from biomass, particularly based on the use of waste biomass from livestock farming, the development of these technologies in Bulgaria, and the state of energy production from animal waste.

### **Analysis of Bulgarian legislation for stimulating energy production from biomass**

From the conducted study of the Bulgarian legislation in the field of renewable energy sources, it was established that there is no specific legislation in Bulgaria aimed specifically at stimulating the use of biomass for energy production, particularly waste biomass from agriculture. The main regulatory documents in the examined area are the Energy Act (EA) and the Renewable Energy Act (5). The latter aims to promote the production and consumption of energy generated from renewable sources, laying down requirements for the development of measures and schemes to support the production and consumption of energy from renewable sources, renewable gas, biofuels, renewable energy in transport, and liquid biofuels.

In 2007, the Energy Act of the Republic of Bulgaria required all national operators to purchase all electricity generated from renewable energy sources and small hydro power plants (up to 10 MW) at preferential fixed prices through the issuance of green certificates for a period of 12 years. With the amendment of the law in 2015, these preferential prices are determined by the Bulgarian Energy and Water Regulatory Commission (EWRC) and are periodically updated. The preferential prices vary depending on the type of renewable energy source and the installed capacity.

With the amendments to the Energy Act (promulgated in State Gazette, issue 9, dated February 2, 2021), the next stage of liberalization of the electricity market has been initiated. Accordingly, the public supplier and final suppliers are obliged to purchase the entire quantity of electricity produced from renewable energy sources (RES) and high-efficiency cogeneration of electricity and heat (HECHP) with a total installed capacity of up to 500 kW, and are required to purchase the entire amount of electricity produced from different segments of the organized power exchange market. The "Security of the Power System" Fund is obliged to compensate producers with a total installed electrical capacity of up to and above 500 kW for the entire amount of electricity produced from HECHP, registered with a monthly certificate of origin, with some exceptions as described in the law and determined by a decision of the EWRC for determining a preferential price.

Another strategic document of national significance adopted in 2020 is the "Integrated National Plan in the Field of Energy and Climate of the Republic of Bulgaria 2021-2030"(4). According to this plan, an increase in the share of RES by 27% is envisaged for the period 2021-2030, with the share of biomass in gross energy consumption expected to increase from 14.37 TWh to

nearly 21 TWh or represent 10% of gross final energy consumption. Investments in decentralized power generation for combined heat and power production (cogeneration) from biomass in the form of 220 MW of new generating capacity are also envisaged. However, this is considered highly unrealistic (1) by specialists, and they proposed a specific financial instrument to be directed towards building medium-sized power plants for centralized heat supply from RES in rural areas and small towns.

In the National Recovery and Sustainability Plan of the Republic of Bulgaria (2), presented in Brussels at the end of 2021 and approved by the European Commission on 3 May 2022, the largest funding is allocated to the "Green Bulgaria" pillar, which includes components of low-carbon economy, biodiversity, and sustainable agriculture. The planned reforms and investments in biotechnologies are formulated indirectly through measures to stimulate the production of electricity from renewable energy sources, support schemes for pilot projects for the production of green hydrogen and biogas, and improvements in energy efficiency. However, these goals are not clearly connected to a unified policy for the development of biogas technologies. Unclear definition of the objectives and indicators will make their implementation and evaluation of results difficult.

An important regulatory document adopted by the European Parliament is the European Renewable Energy Directive (2018/2001/EC) (3), which aims to encourage greater production of electricity from renewable sources, expressed as a share of total consumption, and to ensure that the origin of energy from renewable sources can be proven according to objective, transparent and non-discriminatory criteria, for which guarantees are issued. Guarantees of origin aim to show the end customer that a given share or quantity of energy is produced from renewable sources. For the purposes of the Renewable Energy Sources Directive, energy from renewable sources is defined: "energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases".

In 2017, the Regulation on the issuance, transfer, and revocation of certificates of origin for electricity was adopted in Bulgaria to synchronize Bulgarian legislation with European legislation. According to this regulation (9), the Sustainable Energy Development Agency (SEDA) maintains a register of biogas installations for the production of electricity from the listed types of renewable sources (10), including biomass waste. However, there is no information available in this register for those installations that produce only thermal energy. This creates the potential for inaccurate information regarding the actual number of functioning biogas installations in Bulgaria and the amount of energy produced from biomass as companies that produce energy from biomass for their own use, both for electricity and thermal energy are not included in this register of SEDA.

During the current survey of operational biogas plants in Bulgaria, it was found that almost all large meat and dairy companies have such plants and use them to cover their own energy needs, but they are not listed in the SEDA register, as by not selling electricity.

Information on biogas plants generating entirely only heat energy was found in the document "Comprehensive assessment of the potential for highly efficient combined heat and power and efficient district heating and cooling systems" (6) developed by the Ministry of Energy in accordance with the requirements of Directive 2009/28/EC and proposed for discussion on 31 August 2021. The document presents information on the net installed capacity and energy

produced by combined heat and power plants and installations using heat recovered from chemical or other heating and cooling processes in Bulgaria, which in 2019 amounted to 5441 MW and net production of transmitted heat energy in the network of 7376 GWh. However, the information presented does not allow differentiation of energy produced from waste biomass to estimate its share.

The analysis of the regulatory framework in Bulgaria shows that at the national level, the incentivization of energy production from renewable sources, including biomass, is carried out through preferential prices and bonuses for electricity produced from renewable sources, which should be implemented until 2025. According to the conducted study of the regulatory framework, there is no state support for stimulating the production of heat energy from biomass, both for own consumption and for trade.

With its decision of July 1, 2022, the Energy and water regulatory commission (EWRC) removed a large part of the planned bonuses due to the energy crisis, which not only in Bulgaria, but also on a European scale leads to a continuous increase in energy prices. This raises the legitimate question of how this will affect renewable energy producers, according to industry experts who predict that reduced support for renewable energy production will lead to an increase in consumption of traditional fuels from the end of 2022.

## Analysis of functioning biogas installations in Bulgaria

### *Analysis of installed capacities for biogas production in Bulgaria*

The study conducted to gather information on the number of installed and functioning biogas installations in Bulgaria revealed that there is no comprehensive register offering such statistical information. The only register providing such information is available at the SEDA, but it only contains information on biogas installations producing electricity and requiring guarantees of origin for renewable energy, in accordance with the current national legislation and the obligations under the Renewable Energy Directive.

According to the data in the register on installed capacities of different renewable energy sources (RES) as of this year, biomass ranks fourth with a relative share below 1% (Fig. 1).

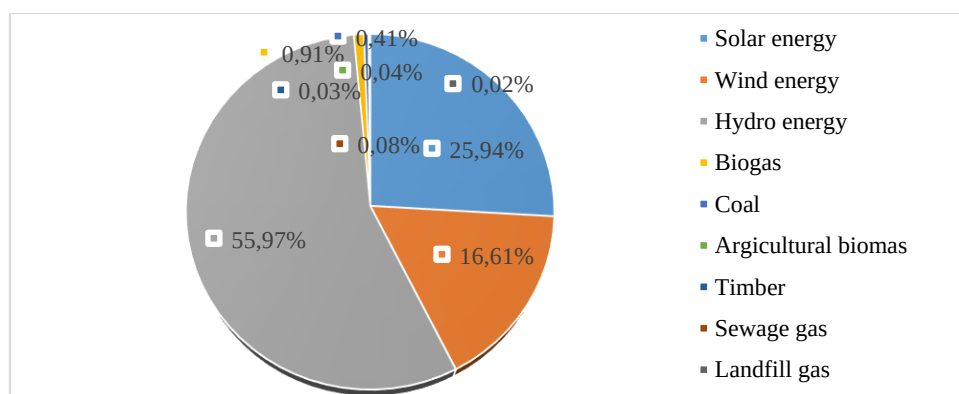


Fig. 1 Percentage ratio of installed RES capacities by type of RES in Bulgaria as of June 2022; source: SEDA

According to the published information in the registers, it was found that the first operational biogas installation had been put into operation in 2007 (Fig. 2) and it was the "Nadezhda" biogas

plant, located in the municipality of Laskovets, Veliko Tarnovo region, owned by "Water Supply and Sewerage, Yovkovtsi - Ltd."

According to the published information in the registers, it was found that the largest number of built and put into operation installations was during the period 2011-2015. According to the authors, this is due to the European funding provided for the development of rural regions during this period, through which the construction of such biogas installations as a tool for utilizing waste biomass from agriculture and livestock is supported. The construction of such facilities involves providing large initial investments, and the predicted payback period for these investments is no less than 10 years (13). This also explains the fact that after this period, with no secured financial assistance, the number of built installations up to 2022 is only three.

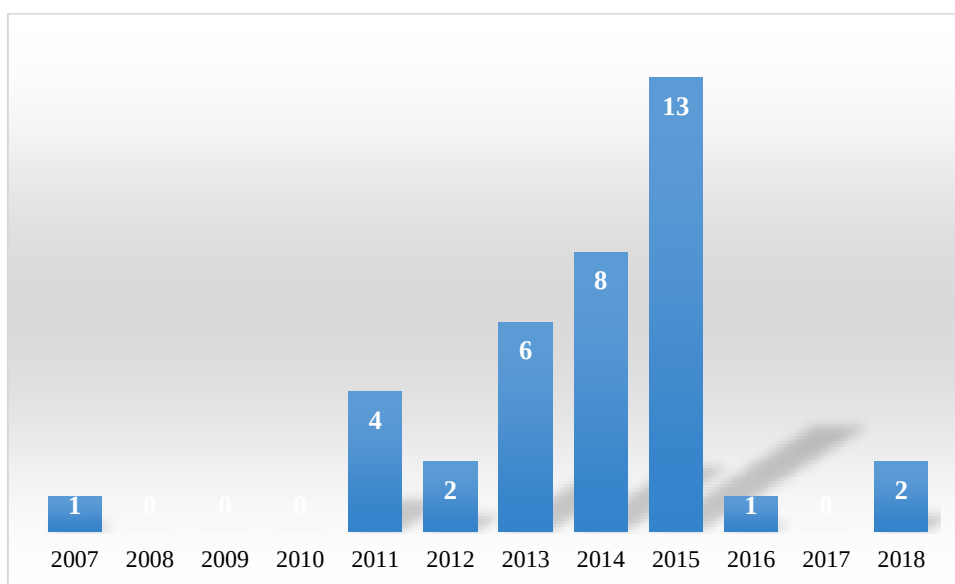


Fig. 2 Number of biogas installations in Bulgaria put into operation by year; source: SEDA

According to the analysis based on the SEDA register, the total number of biogas plants built in Bulgaria is 38, and by 2022 there are 31 operating, located in 15 regions (Fig. 3). The total installed capacity is 39,896 MW. The largest number of installations are in the South Central region (Fig. 4) – a total of 14, with a total installed capacity of 21,564 MW.

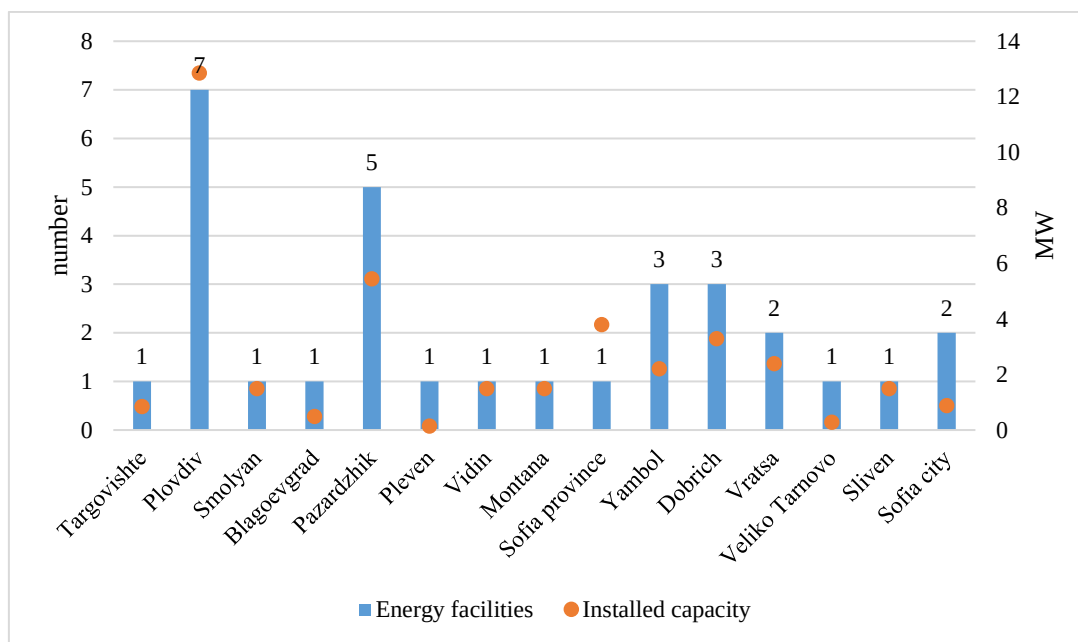


Fig. 3 Number of operating biogas installations in Bulgaria and installed capacity as of June 2022; source: SEDA

In Plovdiv region, there are 7 constructed and operating biogas plants with a total capacity of 12.863 MW, which places it first in Bulgaria in terms of the number of active facilities and the highest installed capacity.

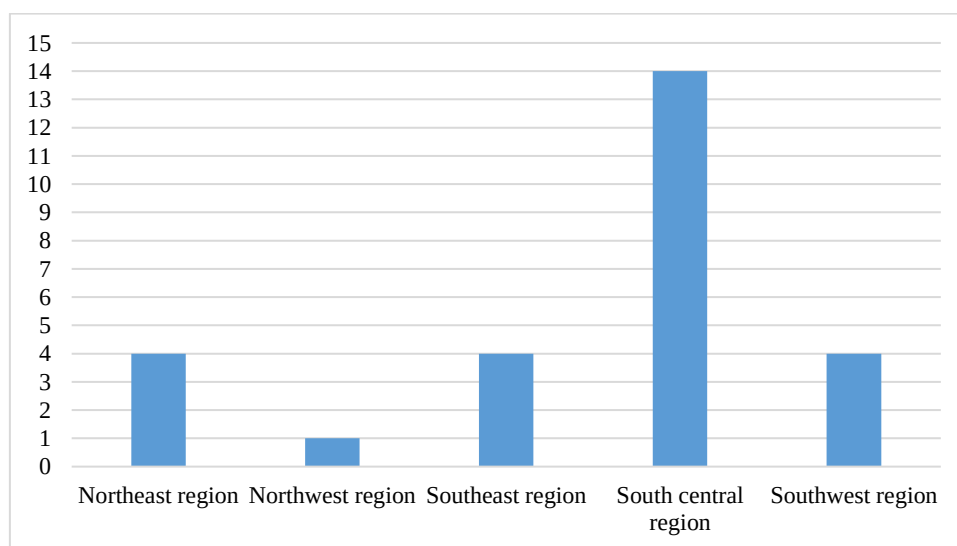


Fig. 4 Number of installed biogas installations by regions; source: SEDA

In Bulgaria, there are only three larger biogas plants (Fig. 5), with the largest being the Bio-CHP "Green Forest Project - Kostievo" with an installed capacity of 4.99 MW, which was commissioned in 2013. Facilities with medium capacity, ranging from 500 kW to 1.5 MW are predominant - 18 in total.

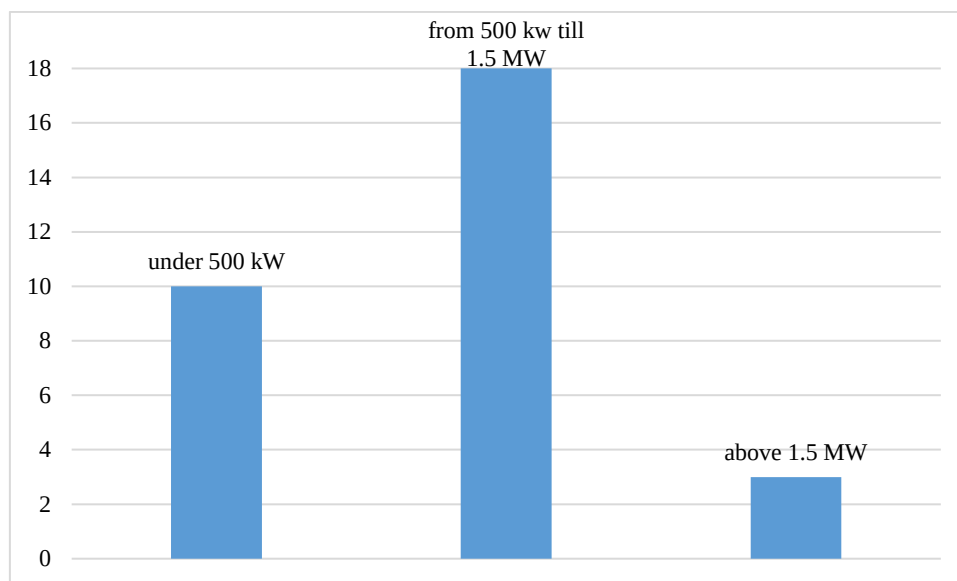


Fig. 5 Structure of active biogas installations in Bulgaria by installed capacity; source: SEDA

In the annual report of the EWRC for 2021, it is concluded that based on the forecast data in the plan of "Electricity System Operator" EAD (ESO) and the stated investment interest in building renewable sources connected to the electricity transmission and distribution networks, new capacities to be installed in 2022 in a total amount of 137 MW. For biogas power plants, the new installations with a total capacity of 4 MW (12) are expected to increase the existing biogas capacity in Bulgaria by 10%.

### *Analysis of the quantities of produced biogas from animal waste biomass in Bulgaria*

Regarding the energy produced from biomass, according to the data of the National Statistical Institute (NSI) for 2020 (7), an analysis was made of the energy produced from renewable energy sources, in particular the quantities of biogas produced (Fig. 6).

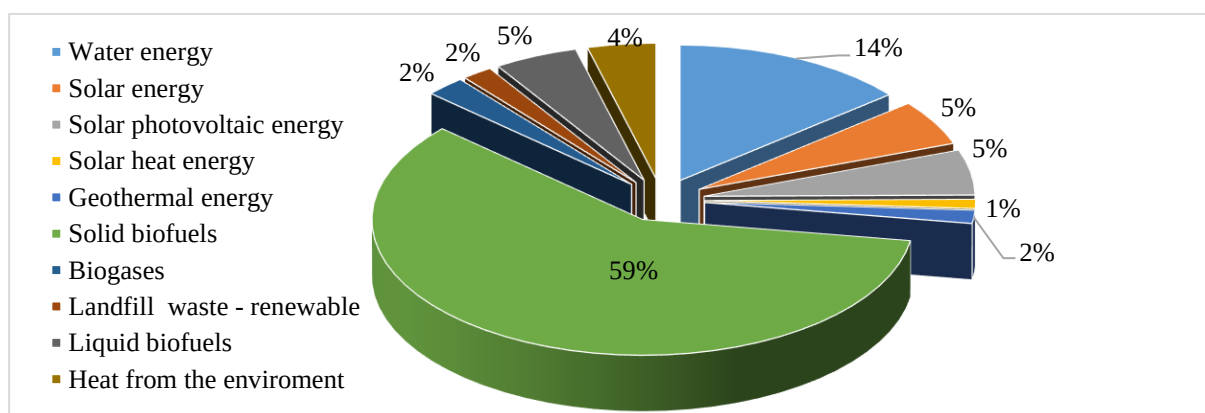


Fig. 6 Average share of different renewable energy sources in the produced amount of renewable energy for the period 2016-2020; source: NSI

The information provided suggests that the largest share of renewable energy production in Bulgaria comes from solid biofuels - on average 59% of the total renewable energy produced during the period 2016-2020. These fuels include wood for heating and do not represent waste biomass from agriculture and livestock farming. To confirm this, on 14.09.2022 the EU adopted an amendment to Directive (EU) 2018/2001 of the European Parliament and of the Council, Regulation (EU) 2018/1999 of the European Parliament and of the Council, and Directive 98/70/EC of the European Parliament and of the Council on the promotion of energy from renewable sources and repealing Directive (EU) 2015/652 of the Council, which specifies that primary biomass obtained from roundwood is not considered renewable energy.

As can be seen from the presented information, there is no separate indicator showing the amount of biomass of plant or animal origin used for energy production, which would facilitate the assessment of this source of renewable energy.

According to an analysis based on electronic certificates of origin for renewable energy production issued in 2020 by the State EWRC, energy from biomass accounts for only 0.08% (11) of the total energy produced from RES, and according to the data of ESO for the same year, the electric energy produced from biomass is 349,532MWh, which is 0.9% of the total amount of electricity produced from RES (12).

According to the data published by National Statistical Institute for the period 2016-2020, the production of biogas remained almost constant, representing on average 2% of the total renewable energy produced for this period. The largest amount of biogas was produced in 2016, with an absolute and relative value of 697.8 MWh and 3% of the total renewable energy produced (Fig. 7).

From the conducted study, it was found that the statistical data on the quantities of produced biogas do not take into account the amounts obtained from waste biomass, unlike, for example, the quantities of biogas produced from wastewater.

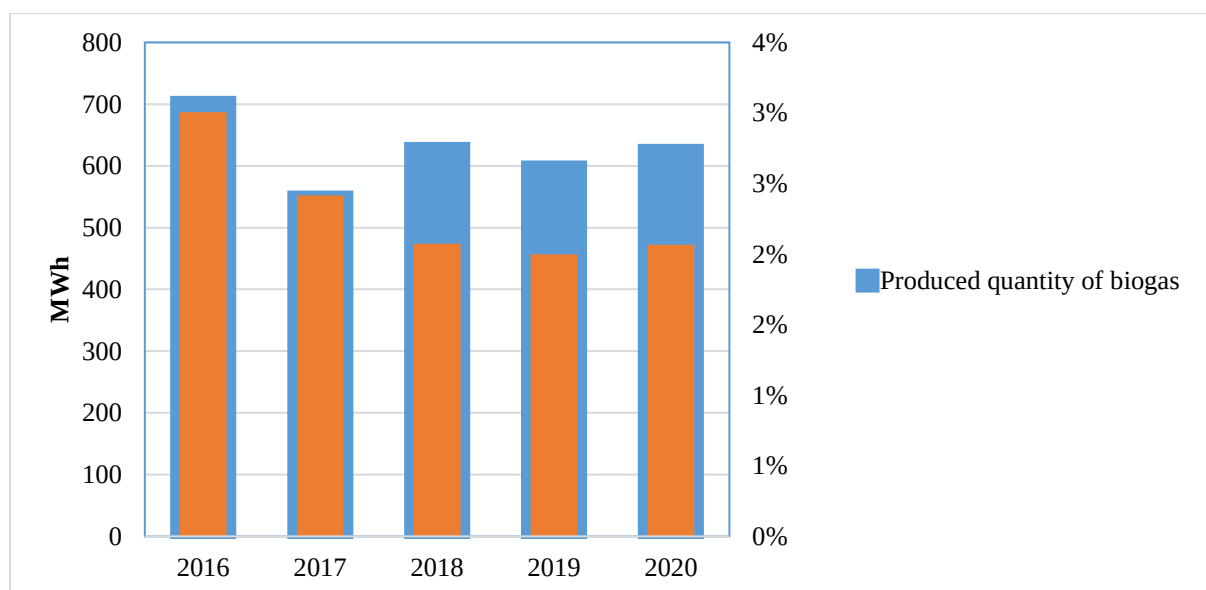


Fig. 7 Produced amounts of biogas for the period 2016-2020; source: NSI

## Conclusion

Based on the conducted study of the national policy for stimulating the development of biogas production from biomass, particularly through the use of livestock waste, and the state of these technologies in Bulgaria, the following conclusions can be formulated regarding the state of production:

- The installed capacity and energy produced from biogas have an insignificant share in Bulgaria's energy mix, with significant amounts of unused biomass waste. It is necessary to take regulatory measures to stimulate biogas energy as an opportunity to utilize the untapped potential, such as financial support for the construction of biogas installations and energy production;
- In Bulgaria, unlike many countries in the world, there is no special regulatory framework to stimulate the use of waste biomass and energy production from it. Good practices from Germany and other countries with national policies for the development of biogas technologies can be utilized. The adoption of national methodologies for assessing the characteristics of input materials, parameters of the methane generation process, and requirements for the operation of biogas installations would have a positive impact on the development of the biogas sector;
- Significant initial investments are required for the construction of installations for biogas production from waste biomass. Most of the existing biogas installations were built with financial assistance from the EU during the period 2011-2015. Financial instruments need to be found to stimulate the construction of new capacities. One possible solution is to use funds from the Recovery Plan to encourage agricultural producers to build biogas installations for the utilization of waste biomass from their production;
- According to Regulation No. 7, SEDA maintains a register of biogas installations that work for cogeneration. It would be beneficial to establish a link between the register of livestock companies to identify available waste biomass and the register for the utilization of waste biomass for the production of thermal and electrical energy, including for own use. This will enable the identification of unused waste biomass and optimization of the financial resources required for the construction of new utilization capacities;
- The policy of reducing premiums for electricity production from RES, particularly from waste biomass, needs to be reconsidered, as this will lead to a drain from this share of the energy sector.

## Acknowledgements

*"The research leading to these results has received funding from the Ministry of education and science under the National science program INTELLIGENT ANIMAL HUSBANDRY, grant agreement n°D01-62/18.03.2021"*

## References

1. Center for the Study of Democracy, Lost in Transition: Bulgaria and the European Green Deal, Policy Brief No. 92, May 2020. Policy Brief No. 92, March 2020. Supported by Federal Ministry of the Environment, Nature Conservation and Nuclear Safety, German Bundestag, Germany
2. Council of Ministers of the Republic of Bulgaria, National Plan for Recovery and Sustainability of Bulgaria, version 1.05, 06.04.2022, <https://nextgeneration.bg/14>
3. Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources, Official Journal of the European Union 21.12.2018. [https://www.dker.bg/uploads/2022/god\\_doklad\\_30032022.pdf](https://www.dker.bg/uploads/2022/god_doklad_30032022.pdf)
4. Integrated national plan in the field of energy and climate of the Republic of Bulgaria 2021-2030, <https://www.me.government.bg>
5. Law on energy from renewable sources, in force from 03.05.2011, last amended. SG No. 42/07.06.2022.
6. Ministry of Energy, Comprehensive assessment of the potential for implementing highly efficient combined heat and power generation and efficient district heating and cooling systems in the Republic of Bulgaria, 2021
7. National Statistical Institute, Energy balances 2020, Published on: 17.03.2022 - 10:15, <https://nsi.bg/bg/content>
8. Nely Georgieva, Petko Tsankov, Ivan Binev, Krasimir Ivanov & Vasil Hristov, State of the energy market produced by animal biomass and prospects for development, ARTTE Vol. 10, No. 2, 2022 ISSN 1314-8788 (print), ISSN 1314-8796 (online), doi: 10.15547/artte.2022.02.002.
9. Ordinance No. 7 of July 19, 2017 on the issuance, transfer and cancellation of certificates of origin of electrical energy produced by highly efficient combined production of electrical and thermal energy, Pron. DV. No. 61 of July 28, 2017, amended and add. DV. No. 52 of June 22, 2018
10. Register of issued guarantees, SEDA <https://www.seea.government.bg/bg/registers>
11. Report on the activities of the Commission for Energy and Water Regulation for 2020, [https://www.dker.bg/uploads/2021/god\\_doklad\\_2020.pdf](https://www.dker.bg/uploads/2021/god_doklad_2020.pdf)
12. Statistical booklet 2020 ESO EAD, <https://www.eso.bg/fileObj.php?oid=3178>
13. Teodorita Al Seadi, Dominik Rutz, Heinz Prassl, Michael Köttner, Tobias Finsterwalder, Silke Volk, Rainer Janssen, Denitsa Dimitrova, Iva Cheriyska, Krasin Georgiev, Svetla Marinova, Nikola Kolev, Biogas manual developed under the BiG>East project (EIE /07/214/SI2.467620), 2009, ISBN 978-87-992962-1-7)
14. VDI 4630 Vergärung organischer Stoffe, Substratcharakterisierung, Probenahme, Stoffdatenerhebung, Gärversuche.
15. VDI 4631 Gütekriterien für Biogasanlagen.

**Nely Georgieva**

email: nely.georgieva@trakia-uni.bg



Nely Georgieva has a master's degree in mechanical engineering, PhD and she is an Associate Professor of Manufacturing technology at Trakia University- Stara Zagora, Faculty of Engineering and Technology - Yambol. She has more than twenty years' experience in the areas of education and administrative activities in higher education.

Her professional interests are in the range of the automated design of the technological processes, CAD-CAM organization of the manufacturing, Reverse engineering, renewable energy, biomass, biomass processing technologies, STEM engineering and education, E-learning and distance education, dual learning and training.

**Petko Tsankov**

E-mail: petko.tsankov@trakia-uni.bg



Graduated from higher education in Ukraine in 1984; Voroshilovgrad Mechanical Engineering Institute (now Lugansk); specialty Hydraulic machines and tools for hydro-pneumatic automation. He defended his thesis in 2012. PhD of Fluid Mechanics, topic "Modeling of flat aerostatic bearings". Since 2018, associate professor at Trakia University - Stara Zagora, Faculty of Engineering and Technology - Yambol.

His professional interests are in the range of the Ventilation systems, Gas flow in small gaps - aerostatic bearings Hydraulic and pneumatic machines and drive, Gas supply, Fluid mechanics, Aerodynamics of currents - experiment and modeling, renewable energy, biomass, biomass-processing technologies.

**Vasil Hristov**

E-mail: vasil.hristov@trakia-uni.bg



Vasil Hristov graduated in 2021 with a master's degree in "Heat and gas supply" and in the same year started working as an assistant in heat engineering at Trakia University - Stara Zagora, Faculty of Engineering and Technology – Yambol.

His professional interests are in the range of the CAD/CAM design, additive technologies, biotechnology, thermal process simulations, reverse engineering, resource-saving technologies.