LETTER OF ACCEPTANCE FROM THE WARSAW UNIVERSITY OF LIFE SCIENCE WULS – SGGW

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Research topic:

Energy Potential of Biogas Production in the EU and Ukraine

Detailed working plan of the scientific research

Duration	Topics
01.09.2024-30.09.2024	**Research on the potential of renewable energy of biogas** Presently, the production of energy from renewable resources is globally relevant. Given the constant demand for fuel resources, one of the priority areas and ways to overcome energy problems is the development of bioenergy and, in particular, the production and use of biogas, which is formed by appropriate technologies and is an effective way to supplement and replace traditional fuel and energy resources. Biogas is the general name for a mixture of combustible gases obtained as a result of the process of natural decomposition of various organic substances, i.e., methane fermentation. In the natural environment, the decomposition process takes a long time, but to obtain biogas in industrial conditions, it can be significantly accelerated, primarily by creating optimal conditions for the bacterial 'engines of change'. To ensure the efficient flow of the methane fermentation process, it is important to maintain an optimal temperature that will stimulate the activity of these bacterial cocktails. Depending on the type of substrate, it can range from +25 °C to +75 °C, so in winter (at low temperatures), the meta tank must be heated. There are more than 60 listed and patented technologies for biogas manufacturing. This is due to the fact that to ensure the maximum output of biogas for each type of feedstock, a different technology is applied. Biogas consists of a mixture of several gases. These are: methane (CH4) is the main source of energy, the share of which is equal to 60–70%, and its content is determined by the choice of source material (bio substrate); carbon dioxide (CO2) its share is from 25% to 40%;

	hydrogen (H2), ammonia (NH3), and hydrogen sulfide (H2S)—A total of 2–5%.
01.10. 2024-31.10. 2024	**Conceptual bases for the development of renewable energy sources** In recent years, renewable energy sources have become one of the main criteria of energy security throughout the world. The principal reasons for that are the prospected depletion of fossil fuels, rapid price increase of energy sources, uncertainty of stability of supply and reliability of procurement thereof. Moreover, the negative effect on environment is leading to grave consequences that concern the society in more ways that are be-coming explicit. In many countries, renewable energy utilization significantly augments current energy capacities, thus, delivering security and enhancing the social and economic situation. One further reason for increased utilization of renewable energy sources is that in or-der to ensure economic development, overall energy consumption has become higher since the normal functioning of industrial enterprises, thermal power stations, and transport activities need a constant flow of energy inputs. The main sources of energy are coal, natural gas; gasoline, kerosene (paraffin) and mazut (which are derived from petroleum). Meanwhile, vehicle engines, industrial facilities and thermal power stations bring about an increase of carbon dioxide emission (a greenhouse gas). The reduction of CO2 emissions by transitioning to the use of renewable energy sources and lowering the energy capacity of businesses is the primary means of combating climate change. Renewable and ecologically safe energy sources are recognized as being the most auspicious way to accomplish this goal.
01.11. 2024- 30.11.2024	**World experience of the system of production of renewable energy sources** The alternative and renewable energy sources have recently become one of the important criteria for energy security in the world. The main reason is the expected depletion of fossil fuels, the sharp rise in energy prices, uncertainty about the stability and reliability of their supply, impact on the environment, the effects of which are increasingly worrying the society. In the present context, the use of the renewable energy significantly increases the security of energy supply, improves the social and economic situation.
1.12. 2024- 31.12. 2024	**Conceptually - strategic framework for the development of the bioenergy product market** Obtaining biogas out of organic leftovers that come from the agricultural sector is considered to be an important vector of renewable energy development. Biogas can be used in different ways. It can be burned in heating installations, for example, or in its enriched form, it can be employed

	in vehicle engines as a fuel. Moreover, cogeneration plants can produce electricity, which then can be sold on or used in the manufactories' own production. Biofuel production requires a biogas complex - an engineering and technical facility that processes organic waste into biomethane.
01.01.2025-31.01.2025	**Materials and methods of the scientific research** The main sources of data used in the study the annual reports "BP Statistical Review of World Energy 2022" on developments Renewable energy in Europe, State Agency for Energy Efficiency and Energy Saving of Ukraine and the Bioenergy Association of Ukraine. The EU and Ukraine legislation on supporting the development of renewable energy sources, in particular Directive (EU) 2019/790 of the European Parliament and of the Council of 17 April 2019, The Statistics for the European Green Deal, Certification system of sustainable biofuels and bioliquids production.
01.02.2025-28.02.2025	**Analysis and evaluation of biogas resources** Today, agricultural waste is considered a valuable secondary energy resource. Developed agricultural production has a strong potential for biogas production, which can be produced from a wide range of organic substrates of both animal and plant origin. The advantage of biomass is its renewability and relatively cheap cost compared to traditional fuels. The benefits of using the potential of biomass and household waste are quite significant. It is also important that modern biofuel plants are relatively compact and can employ different types of raw materials. This versatility allows them to be placed in close proximity to facilities that are planned to provide energy or heat from these resources.
1.03.25-31.03.25	**Research of the bioenergy market in the EU and Ukraine** Biogas production mainly depends on the availability of appropriate raw materials. Ukraine has a well-developed agriculture sector, the waste of which provides an excellent raw material base. However, biogas plants for biogas production must be installed and conditions created to ensure their operation. To assess the dynamics of biogas production in some EU countries and Ukraine, in this paper, data on the availability of biogas plants and their capacity were collected. In analyzing the dynamics of biogas production in certain EU countries and in Ukraine, one may notice a different range of biogas production opportunities. In Germany, for instance, this process has gained stable development and delivered high results, as evidenced by the indicators of installed capacity and their use for the development of biogas production. The development indicators of this industry in Poland are much lower, but they are characterized by stability and annual growth.

	At present, the number of biogas plants in Europe has exceeded 18,000. Among the leading countries are Germany, which has more than 11,000 biogas plants, and Italy, where there are about 1,700 plants. France has 837, the United Kingdom has 715, while Switzerland has 634 biogas plants.
01.04.2025-30.04.2025	**The EU legislation on supporting the development of renewable energy sources** Directive (EU) 2019/790 of the European Parliament and of the Council of 17 April 2019 establishes a common framework for the promotion of energy from renewable sources. It sets a binding Union overall target for the total share of energy from renewable sources in gross final energy consumption in the Union in 2030. The European Union has committed itself to reducing CO_2 emissions by at least 40% by 2030 (43% in the so-called ETS sector and 30% in non-ETS), obtaining at least 32% of energy from RES and achieving at least 32.5% savings in the energy efficiency sector compared to 1990. The European Commission has developed the assumptions of the "European Green Deal" - a project that is to completely transform the climate policy and economy of the Community. It assumes that by 2050 the European Union will be climate-neutral. It mainly concerns greenhouse gas emissions, but also waste management and other aspects of environmental protection. It also defines sustainability and greenhouse gas emissions reduction criteria for biofuels, bioliquids and biomass fuel.
01.05.2025-31.05.2025	**Renewable energy certification system according to EU requirements** The KZR INIG System is used to certify the sustainable production of biofuels, bioliquids and raw materials. The solutions and procedures offered by the System has gained recognition from the European Commission. Certified products serve the purpose of achieving renewable energy targets set in the EU policies. The aim of the System is to provide solutions that ensure the production of renewable energy in accordance with sustainability criteria.
01.06.2025-30.06.2025	**Ecological and economic substantiation for biogas production in the EU and Ukraine** Manufacturing and the further utilization of biogas is an efficient way of complementing or replacing primary energy resources. The benefits of using biogas are not only found in the production of alternative energy but also in that it is the solution to a myriad of environmental problems because, through proper disposal and processing of agricultural and household waste, biogas production can prevent methane emissions into the atmosphere.

	In addition to the impact on the environment in the form of reducing carbon emissions and disposal of livestock and crop waste, the development of the biogas market will reduce dependence on fossil fuels, hasten biotechnical and bioengineering development, and smooth peak loads in the grid by connecting additional cogeneration facilities.

To conduct research topic investigation by support of questioning

The monograph will be published on the basis of the research results.

Supervision: dr hab, Agata Malak-Rawlikowska, prof. WULS

Type of research: full-time

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