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# BIOMASS PROSPECTS OF AZERBAIJAN

Babayeva Sevinc Sh.[1], Shikhkarimov Nazim N.[2]

*Azerbaijan State Oil and Industry University, Azadlıq avenue 16/21*

***Abstract*** *- A classification of biogas plants has been analyzed, the features of their functioning have been disclosed, a map of the processes of a biogas plant has been developed on the basis of a system and process approach. We have carried out research that proposed the optimal scheme of a biogas plant for effective functioning in the conditions of Azerbaijan.*

***Keywords*** *- biogas, methane, classification, process efficiency, installation scheme, systems approach.*

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## I. INTRODUCTION

As human society developed, so did industry and agriculture, and the need for energy increased. One of the global problems facing humanity today is the uninterrupted use of fuel resources. Traditional energy sources such as oil, natural gas and coal are depleted, polluting the environment and expensive. In contrast, alternative energy sources are environmentally friendly and inexhaustible. Therefore, demand for alternative energy continuously increases. Till the end of 2019, the world's renewable energy capacity increased by 2537 gigawatts (GW), 176 GW more than in 2018. [1- 2]. The “The world's renewable energy capacity” graph (Figure 1) illustrates renewable energy capacities of world countries from 2010 to 2019.

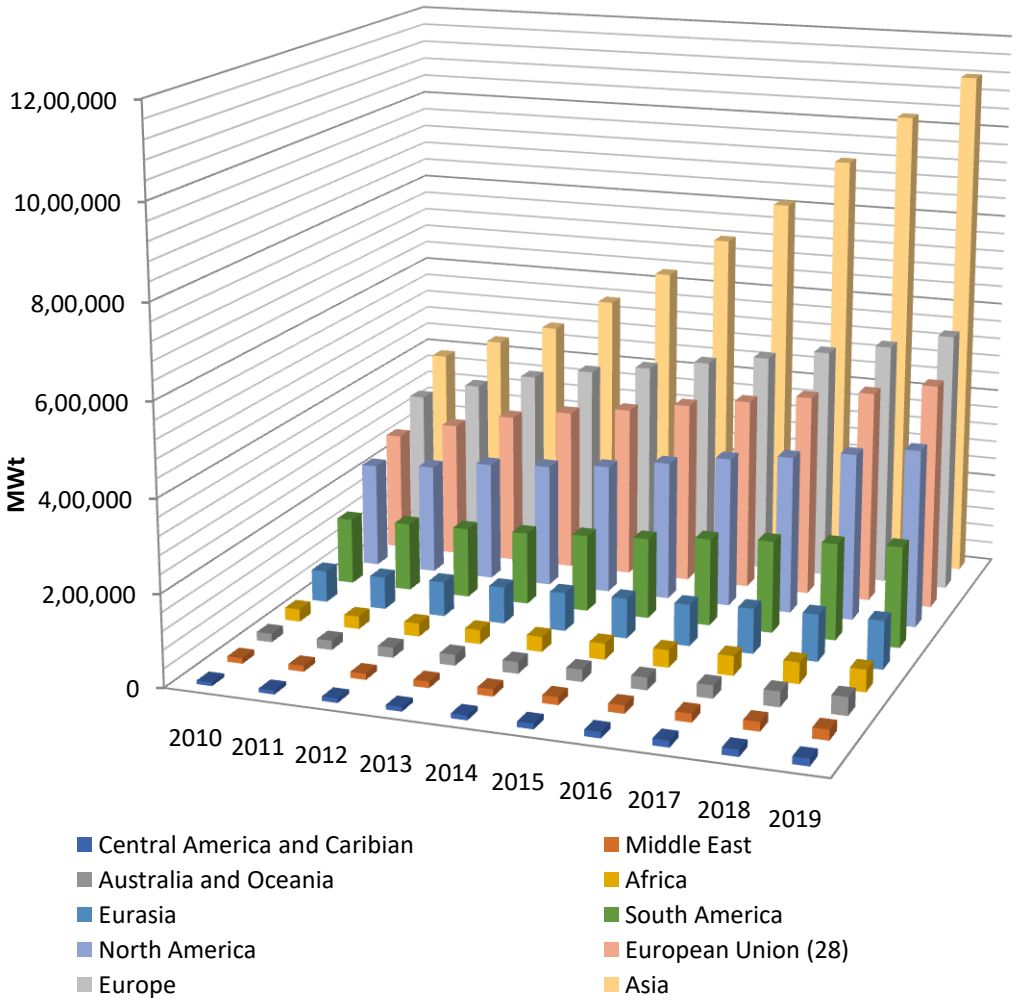


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***Figure 1. The world's renewable energy capacity***

## II. COMPARISON OF AZERBAIJAN AND THE WORLD'S BIOMASS POTENTIAL

As it is in the world, Azerbaijan has also a huge potential for renewable energy sources and there is political will for using it everywhere. The use of renewable energy sources leads to an increase in the level of reliability of power supply, reduction in total costs of electricity generation, savings natural resources, creating new jobs and positively affecting environmental protection. Currently, water, wind, sun, and biogas energy are used as alternative energy resources in Azerbaijan.

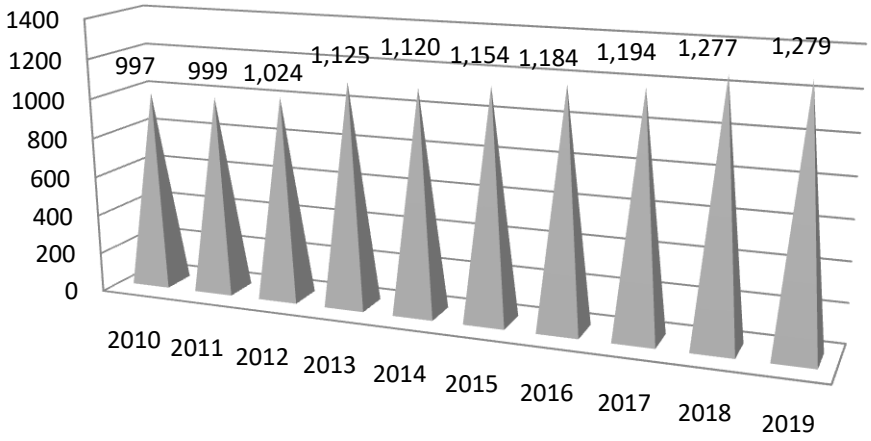


***Figure 2. The renewable energy capacity of Azerbaijan***

Biomass is also an alternative energy source. There are several energy sources of biomass in Azerbaijan: industrial waste, forestry and woodworking waste, agricultural crops, waste of organic compounds, waste of household and communal services, production waste territories contaminated with oil and oil products. According to research, most of the waste consists of biomass products in all sectors of the economy.

It is possible to obtain gas, liquid and solid biomass, which are used in the production of electricity from these biomass substances. Thus, more than 2.0 million tons in Azerbaijan, solid and industrial wastes were discharged annually into the neutralization zones. Recycling of solid and industrial wastes allows partially eliminating the difficulties with heating public buildings in Baku and large industrial cities of the country. Bioenergy is one of the alternative energy resources. Azerbaijan's and the world countries' bioenergy capacities from 2010 to 2019 are shown in figures3 and 4, respectively.

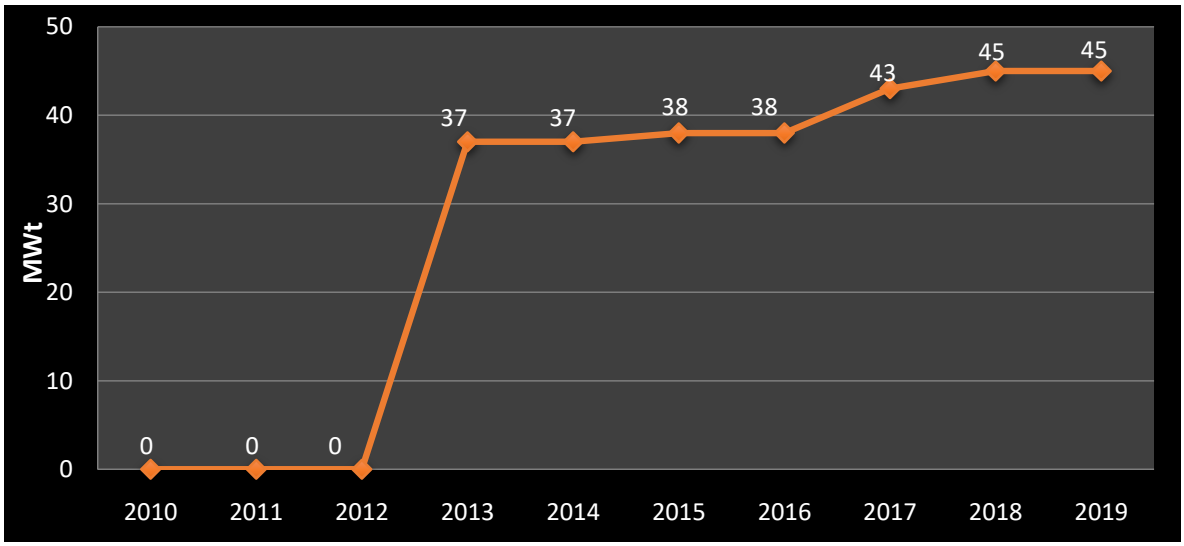


***Figure 3. Azerbaijan's bioenergy capacity***

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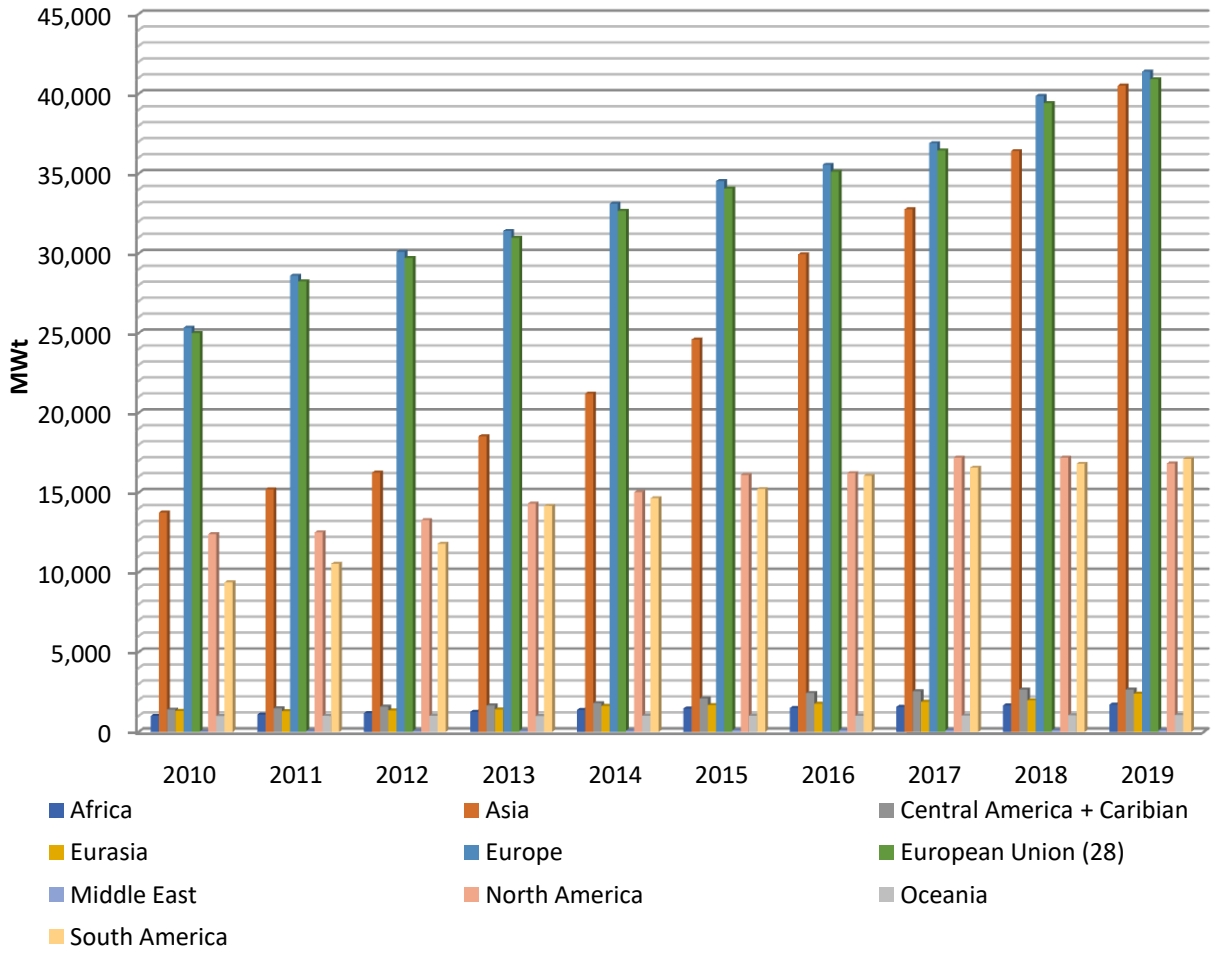


***Figure 4. The world's bioenergy capacity***

In modern science, the production of biogas is of great importance for obtaining biofuels, heat, electrical energy, of fertilizers, to prevent emissions of methane into the atmosphere, and can also be used as an automotive fuel [1-2 ]. Some gases including methane has an effect on the greenhouse effect in 23 times stronger than $CO_2$, and stored in an atmosphere of 12 years, capturing methane is the best way to prevent short-term global warming.

Biogas plants can work as a treatment plant at farms, poultry farms, distilleries, sugar factories, meat processing plants and replace a veterinary and sanitary plant, i.e. carrion is disposed of in biogas instead of meat and bone meal production [1,3 - 8].

The leading place in the production of biogas use and by comparative indicators belongs to Denmark among industrialized countries - biogas occupies up to 18% of its total energy balance. In absolute terms (in terms of the number of medium and large installations), Germany takes the leading place - 8 million units. In Western Europe, slightly less than half of all poultry farms are heated with biogas [5]. Potential production in Russia biogas is to 72 billion cubic meters per year, while in Azerbaijan the production of biogas is more than 57 million cubic meters$^3$ per year. With the development of industrial and agriculture, in Azerbaijan, new opportunities are opening up for the production of thermal and electrical energy from biological resources. Biomass is a source of industrial fuel emissions, waste from wood processing, agriculture, agriculture, oil-contaminated soil. They are a source of energy. The republic produces 2 million tons of solid waste annually. In large cities, public buildings can be heated by utilization of solid wastes. Today, in Azerbaijan, more than 200 landfills are working for waste. Their total area is 900 hectares. Methane emissions from landfills in large cities, respectively: in Baku - 42.8 million m$^3$, in Ganja - 7.2 million m$^3$, Sumgait - 6.9 million m$^3$ and etc. [10]. In these cities, a small power plant can be built for power generation.

## III. OVERVIEW OF BIOGAS TECHNOLOGY

The advantages of biogas technology are: use of renewable, local plant and animal raw materials for energy production; the possibility of using still economically unused plants (or their parts); the possibility of recycling organic waste for energy production; decentralized power supply without many kilometers of communications; reduction of

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greenhouse gas emissions such as methane ($CH_4$), laughing gas ($N_2O$), carbon dioxide ($CO_2$) into the atmosphere; only that amount of $CO_2$ is released that was assimilated by plants during growth (closed cycle of $CO_2$), methane is not released into the atmosphere; improving the quality of fertilizer compared to untreated manure, reducing the intensity of odor and alkalinity when applied to the soil, faster absorption of nutrients by plants compared to untreated manure; during fermentation, the number of pathogenic microbes and weed germination are reduced; saving fertilizers and pesticides, the fermentation residue is an effective and environmentally friendly substitute for mineral fertilizers, the energy contained in one cubic meter of biogas is equivalent to the energy of 0.6 $m^3$ of natural combustible gas or 0.74 liters of oil, or 0.65 l of diesel fuel, or 0.48 liters of gasoline.

When using biogas, fuel oil, coal, electricity and other energy carriers are also saved. The introduction of biogas plants improves the ecological situation at livestock farms, poultry farms and adjacent territories, prevents harmful runoff into gullies, lakes, ravines, into small and large rivers, where, as a result, the habitat improves [9].

Obtaining biogas and its further use is a complex process, which is influenced by many factors, each of which is impossible to evaluate separatelyIn this case, a set of many elements is needed that are in essential relationships and connections with each other and form a certain integrity, unity. This is an integral set of elements interacting with each other, there are significant connections between the elements of the system, which, with natural necessity, determine the integration qualities of this system. To form a system, it is necessary to provide ordered connections, i.e. to create a specific organizational structure, consisting of interconnected objects and subjects of management, implementing the target function of the system.

Based on the analysis [3, 4, 7, 9, 10], it can be concluded that it is most important to increase the efficiency of biogas plants in the context of improving the technical indicators of the biogas production process, as backbone elements of the system. The rest must be considered when conducting research as restrictive.

The received organic raw materials contain a large number of materials of different physical and mechanical composition: animal manure, straw, foreign objects. Straw is a bedding material, rich in fiber and a poor raw material for methane production; in a bioreactor, it flakes from manure, floats to the surface and forms a layer that prevents gas release. In the process of obtaining biogas, it is necessary to pre-separate the viscous or loose, depending on the moisture content, manure from straw, chop the straw before entering the bioreactor, and, if necessary, purify it from impurities. Thorough grinding of organic materials supplied for processing, especially straw, increases the fermentation rate and shortens the processing time, mixers of various designs are used to ensure homogeneity and destruction of the gas-tight crust, the selection and substantiation of their optimal design and operating parameters is a reserve for increasing the amount of methane produced. Dispersion also improves homogeneity, and dispersed grinding increases the efficiency of the biogas plant.

For effective modeling, it is necessary to use the process and systems approach of the international system. The desired result is achieved more effectively when activities and associated resources are managed as a process.

Continuous improvement includes improvement in small steps and breakthroughs, periodic assessments of compliance with established excellence criteria to identify areas for potential improvement, and continuous improvement in the efficiency of all processes.

The well-functioning of the system must define and manage numerous interrelated processes that use resources and are managed to transform inputs into outputs, while often the output of one process forms the direct input of the next.

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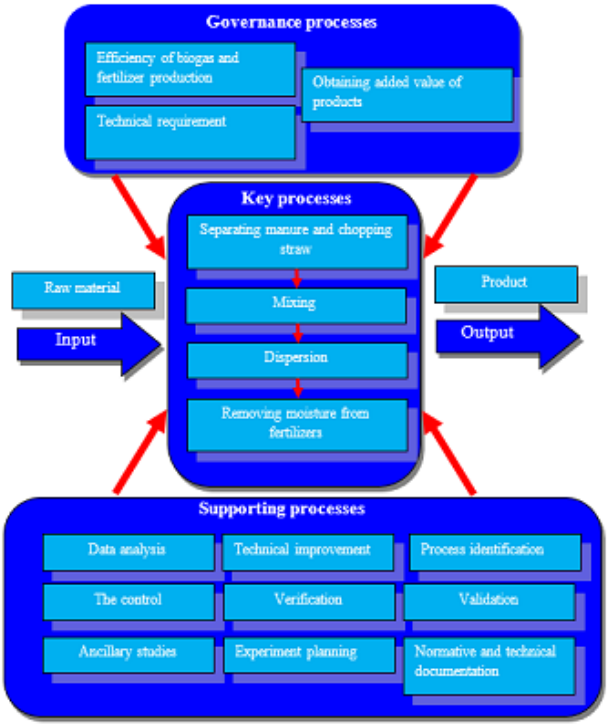


***Figure 5. Map of biogas plant processes***

Figure 5 demonstrates a map of biogas plant processes. Control processes are aimed at its organization, purpose and technical requirements. The quality of the process lies in the receipt by the product of added value, reflecting economic efficiency. The processes are aimed at maintaining, monitoring, adjusting and preventing possible deviations from regulatory requirements.

The description of the process should take into account the components necessary for its proper functioning: define the boundaries of the process; establish the requirements for it; identify input and output streams; determine the main indicators. The development of equipment for biogas plants is associated with the use of a large amount of information; the development of methods for the design of large and complex systems requires the use of system analysis.

The main goal of the approach to the process is continuous improvement, which is based on the development of a new structure of models, focus on meeting consumer needs, analysis of data on the functioning of the system, maintaining a long-term stable state of the system as a whole and its elements [9].

## IV. RESULT

Thus, the natural-geographical status and favorable climatic conditions of Azerbaijan not only positively affect the agricultural sector, but also contribute to the improvement of the bioindustry. Biogas can be produced by using annual waste from agriculture and animal husbandry as a biomass resource, which can reduce the consumption of traditional energy sources and minimize environmental pollution. These key factors are useful when designing small biogas plants, especially in mountainous rural areas of Azerbaijan.

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