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Article

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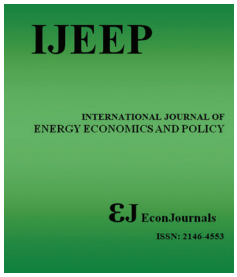

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World Practice of Using Biogas as Alternative Energy

Aslan B. Tasmaganbetov[1]*, Zhumabay Ataniyazov[1], Zhangul Basshieva[1], Abu U. Muhammedov[2], Anar Yessengeldina[3]

[1]K. Zhubanov Aktobe Regional State University, A. Moldagulova st.34, Aktobe, Kazakhstan, [2]University of International Business, Abay ave. 8a, Almaty, Kazakhstan, [3]Academy of Public Administration under the President of the Republic of Kazakhstan, Abay av. 33, Nur-Sultan, Kazakhstan.*Email: aslan.tas@inbox.ru

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ABSTRACT

The article evaluates the biogas as the alternative energy source useful for contributing to the future. Biogas has been found to offer one of the best alternatives due to its economic significance as well as the improved sustainable development through reduced greenhouse gas emissions. The work investigates the production of biogas as an alternative source of energy while outlining its significance in reducing the issues of power energy as well as environmental pollution. The authors analysed the level of bioenergy development in Kazakhstan and around the globe. They revealed that Brazil, China, USA, India and Germany are leaders of bioenergy production in the world. According to the authors, development of bioenergy in Kazakhstan is related to commissioning of new bioenergy stations and supporting sources of renewable energy by government mechanisms. In the case of Kazakhstan, the authors highlighted the fact that existing biogas plants are only used for processing municipal solid waste in urban landfills despite being a major producer of agricultural products.

Keywords: Alternative Energy Source, Bioenergy, Green Economics
JEL Classifications: Q42, Q50

1. INTRODUCTION

Population growth has contributed to challenges related to energy shortages with the need for higher standards of living. The high oil and natural gas demand have increased consumption levels. As a result, there is a need to investigate the new form of energy generation to allow the energy matrix diversification, which entails a dependence of about 90% on fossil fuel. Due to the long term economic as well as environmental concerns, there is a need to embrace an alternative source of energy.

Biogas energy stimulates and supports economic growth as well as development. Fossil fuels, oil as well as natural gas are depleting assets, thus the need to orient the energy source by searching alternatives (Krido et al., 2019). The world requires the source of energy that is economical and conserves the environment. As a result, the biogas form of energy should be embraced. The biogas form of energy is a type of energy that is produced naturally through organic waste (Rosenthal et al., 2018). The economic production of biogas is not as competitive as an alternative in the industrial countries. Therefore, the industrial use of such materials should be improved to achieve a practical approach in its adoption (Kumar and Vadhera, 2016). The scarcity of petroleum supply in many parts of the world reveals the need for technology on the biogas has raised global interest on the alternative source of energy. Biogas technology can solve the various problems associated with a lack of electricity and challenges if petroleum supply (Kwee et al., 2017). Power supply affects the economic progress of a country; thus, the need to emphasize on employing biogas technology within the economic capacity of a country (Ekpeni et al., 2017). Since waste generation is a consequence of the natural human

activities, converting it into biogas energy can result in health and environment as well as economic benefits.

Thus, the purpose of this article is to determine the role of using biogas as an alternative energy source in the world practice. To achieve this goal, the following tasks must be completed:

- Review the literature on the use of biogas as an alternative energy source
- Consider the potential of using biogas technologies for energy production
- Analyze the level of bioenergy development in Kazakhstan and around the globe.

2. LITERATURE REVIEW

Energy serves a significant part in the economic development of society. Despite the advancement in technology, meeting the energy need of society has been through traditional means. However, some practices are the source of significant environmental as well as economic issues.

According to Kazakhstani scientists, environmental and economic problems of energy supply should be considered in the context of energy security (Yessengeldin, 2018), prospects for the use of renewable energy sources (Bolyssov, 2019.) and the use of price instruments of state support for the renewable energy development (Tasmaganbetov, 2020).

Achieving sustainable development entails ensuring the effective provision of renewable energy that is affordable (Santos-Ballardo et al., 2016). As a result, there is a need to upgrade from the existing biomass resources to biogas, which is more efficient energy. Biogas is a useful source of energy and has the potential for providing reliable energy as well as the preservation of the environment and maintaining economic growth. According to Divya et al. (2015), despite the significant potential of the biogas energy, it experiences high costs as well as a lack of resources for installation as well as maintenance technology. As a result, there is a need for the government as well as non-government organizations to facilitate the modernization of the biogas technology. The progress of biogas technology has an impact on the economic growth of the countries based on its successful implementation.

The basic energy services from biogas are essential for sustainable development. Mohammadi et al. (2019) showed a strong correlation on employment as well as income generation. Biogas allows access to energy services that are affordable energy services with improvement in the quality of life. The biogas technology also has the potential of improving waste management as it produces efficient energy, thus reducing the workload (Samuel, 2015). Besides, it creates employment opportunities for the members of the communities. Renewable feedstock resources in the form of animal manure, as well as crop residues, reveal the availability of material for biogas production. The readily available materials are effectively utilized economically for the production of biogas (Weatherford and Zhai, 2015). The resources used for biogas are, therefore, readily available with the technology helping divert the wastes into the biogas plant, thus harnessing clean energy (Jegannathan et al., 2019). The widespread of biogas technology has significant potential in reducing greenhouse emissions. As a result, it creates the possibility of active carbon trading in the market. Carbon trading has the potential of generating more revenue for the dissemination of biogas technologies.

3. USAGE POTENTIALITY OF BIOGAS TECHNOLOGIES FOR ENERGY PRODUCTION

The use of biogas as an alternative source of energy to traditional fuels such as firewood and kerosene is essential in developing countries. The biogas production has potential value in the households as it allows them to operate under optimal conditions (Ituen et al., 2018). From the firewood and kerosene equivalent of the produced biogas, biogas produced can be used to efficiently replace firewood and kerosene in household cooking and lighting (Silva et al., 2017). Substituting kerosene and firewood with biogas has the potential to improve economic growth while mitigating the greenhouse emission.

Biogas is a gas mixture that mainly consists of methane (CH_4) and carbon dioxide (CO_2), as well as water vapor and other gases in small volumes. An overview of the average composition of biogas is given in Table 1.

As it can be seen, biogas mainly consists of methane (50-75%) and carbon dioxide (25-45%). The volume of methane is mainly determined by the composition of the substrate used for the percentage of fat, protein and carbohydrates. In this case, the specific volumes of methane production of these groups of substances are reduced in the sequence named here. Reduced-to-weight fats allow to get more methane than carbohydrates.

The generation of waste is a natural consequence of human activities. The growth influences it in population and industrialization (Overend, 2017). As a result, biogas technology has the potential of reducing the open dumping as well as simple landfilling of solid wastes with a high degree of processing the waste materials.

Besides, it affects the economic growth of the country in terms of power supply, especially where there is the frequent scarcity of petroleum products (Decker et al., 2018). Biogas technology has resulted in increased interest with the need for developing renewable resources to serve as an alternative to the source of fuels.

The economics of this technology is based on the associated disposal costs as well as the biogas production (Peres et al.,

Table 1. Average consistency of biogas

No	Component	Concentration
1	Methane (CH_4)	50-75 % of formation
2	Carbon dioxide (CO_2)	25-45% of formation
3	Water (H_2O)	2-7% of formation (20-40 S)
4	Hydrogen sulfide (H_2S)	20-20 000 PPT
5	Nitrogen (N_2)	<2 % of formation
6	Oxygen (O_2)	<2 % of formation
7	Hydrogen (H_2)	<1 % of formation

Source: (Pestrikova and Lopatina, 2014)

2019). Biogas provides lower cost raw material for its production. Also, it is compatible with the biological systems, thus boosts the economic value with increased production. As an alternative source of energy, biogas helps alleviate the energy needs in countries that have a low amount of electricity, with the development of sustainable energy and resource systems.

4. LEVEL OF BIOENERGY DEVELOPMENT AROUND THE GLOBE AND IN KAZAKHSTAN

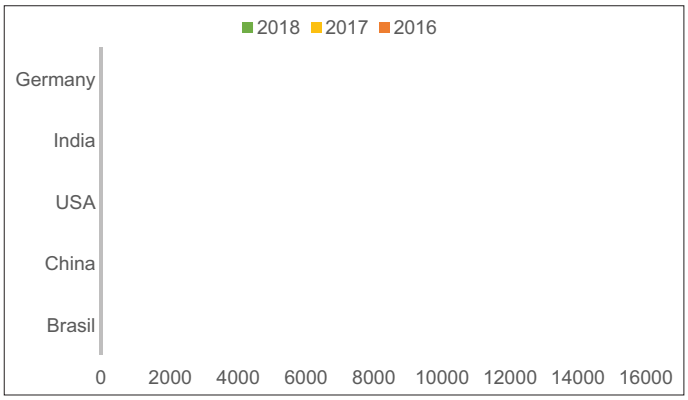
According to Renewable Energy Statistics (2019), bioenergy production in the world is increasing every year. In 2018, compared to 2016, the growth rate of bioenergy was 110.44% (Table 2).

According to Table 2, Brazil is the clear leader in bioenergy production in the world. However, China is leading in terms of growth in bioenergy production. The average annual rate of capacity growth in the period under review was 142.78%, which exceeds the global rate (110.44%) of bioenergy production. In Figure 1, China shows progressive growth while, other countries have slow pace in development of bioenergy production.

Active usage of bioenergy from agricultural raw materials in Brazil, China, USA, India and Germany is one of the priorities of national policies.

Kazakhstan is a major producer of agricultural products. Agricultural raw materials are organic waste which can be used as a primary resource for the production of biogas, electricity and heat. At the same time, no significant evaluation studies have been conducted, so it is difficult to assess the potential of bioenergy. Further development of this industry requires a comprehensive study of the potential of bioenergy in the Republic of Kazakhstan.

Figure 1: Bioenergy production of leading countries for the years 2016-2018



Source: Compiled by the authors collecting data from Renewable Energy Statistics (2019).

The first launch of a biogas plant in the Republic of Kazakhstan with a capacity of 0.5 MW took place in 2017 (Khaikina, 2017). This project in Kazakhstan was implemented in accordance with the "Concept of Transition to a Green Economy" (2013). The total cost of the project was 2 billion 200 million tenge. According to the technological process, the plant processes waste and releases 300 m^3 per day of methane-containing gas. A special feature of the technology is the production of heat and electricity by treating wasted water from the city's treatment facilities and extracting biogas from it. As a result, this technology significantly reduces pollution and improves the environment.

Over the past 3 years, the country's bioenergy has developed at an impressive pace. Thus, according to the Ministry of energy of the Republic of Kazakhstan (2019), electricity production at bioelectric power stations increased 248 times, and the total installed capacity for bioenergy production reached 2.42 MW (Table 3).

Over the past 3 years, there has been an annual increase in the volume of bioenergy compared to the previous year. The growth of these indicators is associated with the commissioning of new bio-electric power plants, as well as mechanisms of state support for renewable energy sources.

An important role in the development of bioenergy is played by LLP "settlement and financial center for support of renewable energy sources." This company was created in order to implement the mechanism of state support for renewable energy sources, based on the centralized purchase of electric energy produced by bioelectric power plants.

By the Law of the Republic of Kazakhstan (2009) "On support for the use of renewable energy sources," fixed tariffs and auction prices are applied for the purchase of electricity produced by bioelectric power plants.

In accordance with the Decree of the Government of the Republic of Kazakhstan (2014) "on approval of fixed tariffs" fixed tariffs are approved for a period of 15 years for each type of renewable energy. When approving fixed tariffs for bioenergy, international obligations of the Republic of Kazakhstan to reduce greenhouse gas emissions were taken into account.

Table 2: Bioenergy production for the years 2016-2018 in the world Megawatts (MW)

Country	2016 (MW)	2017 (MW)	2018 (MW)	Growth rates for 2018 to 2016 (%)
World including	104788	109994	115731	110.44
Brasil	14187	14559	14782	104.19
China	9269	11234	13235	142.78
USA	12903	13073	12948	100.35
India	9009	9513	10253	113.81
Germany	8649	9003	9003	104.09

Source: Compiled by the authors collecting data from Renewable Energy Statistics (2019)

Table 3: Information on bioenergy production in the Republic of Kazakhstan

Indicators	Unit	2017	2018	2019	Growth rate from 2017 to 2019 (%)
Number of bioelectric power stations	Unit	1	1	6	600.00
The installed capacity for the generation of bioenergy	MW	0.3	0.3	2.42	806.67
Electricity generation	million KW	0.06	1.3	14.9	24833.33

Source: Compiled by the authors according to the Ministry of energy of the Republic of Kazakhstan (2019)

Table 4: Indexed tariffs and maximum auction price for bioenergy supply in the Republic of Kazakhstan for 2018-2020 (tenge/KW)

Tariff	2018	2019	2020
Fixed rate adjusted for inflation	40.24	42.69	44.99
Auction price	32.25	32.15	32.13
Changes (tenge)	+7.99	+10.54	+12.86
(%)	19.86	24.69	28.58

Source: Compiled by the authors according to the Decree of the Government of the Republic of Kazakhstan (2014), Calculation of indexation of fixed tariffs and indexed fixed tariffs (2020) and JSC "Kazakhstan operator of the electricity and capacity market" (2019)

According to the statistics Committee of the Ministry of National Economy of the Republic of Kazakhstan (2019), the value of the consumer price index used for indexing fixed tariffs by year is following:

- 2017 – 107.1%
- 2018 – 106.1%
- 2019 – 105.4%

The amount of indexed tariffs taking into account inflation and changes in the exchange rate of the national currency to convertible currencies, as well as the auction price for the supply of biogas in the Republic of Kazakhstan are shown in Table 4.

Table 4 shows that the established maximum auction prices for the supply of electricity produced by biogas facilities are much lower (from 19.586% to 28.58%) compared to the indexed tariff. This, in turn, will reduce the cost of the state budget allocated for the purchase of electricity at an inflated price from enterprises and individuals using alternative energy sources.

In general, it can be said that the existing biogas plants are not used for processing agricultural waste. For the Republic of Kazakhstan, modern municipal solid waste dumps are the main source of bioenergy production.

5. CONCLUSIONS AND RECOMMENDATIONS

Most people across the world depend on biogas resources for energy, with billions of people importing expensive fossil fuels. However, the use of such energies with increased dependency on imported fossil gas result in negative impacts on public health as well as adverse effects on the economy. As a result, biogas as an alternative source of energy is advocated for ensuring sustainable and affordable energy options. Biogas is required for the continued development of the fragile economy since it has potential in terms of its availability as well as the reduced environmental impact. World practice using biogas has an economic significance as it is cheap, robust, and easy to operate. The benefits of biogas have been linked with its sustainability as well as the economy that is realized at the international level.

It is recommended that the world practice of using biogas as alternative energy should entail co-digestion of the various organic feedstock that cope with the feedstock scarcity to improve the production of biogas. Effective co-digestion of the animal manure is essential for increasing the production of biogas while saving organic wastes through energy sales. Another recommendation entails government policy installation costs. Installation cost has been a barrier to biogas technology. As a result, there is a need to increase public awareness of the affordability of biogas technology. Effective and faster development of the biogas technology entails support in terms of strong finance as well as technical support from the government as well as other aid agencies.

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