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## **BIOGAS IS IN UKRAINE: ECONOMIC AND TECHNOLOGICAL PERSPECTIVES**

*Economic pre-conditions of necessity of biogas industry development in Ukraine are considered in the article. The source of raw materials of biogas production in European Union and in our state is considered. An accent is done on the modern condition and prospects of development of biogas production technologies in the grounds of solid household waste.*

**Keywords:** *biogas, natural gas, landfills of solid household waste, power potential of biomass, conditional fuel.*

**Introduction.** It is believed that Ukraine's prospects for biofuels and economic benefits stand on such place: bioethanol, biodiesel and biogas. However, in Ukraine biogas can be the cheapest of all biofuels, because it requires a relatively substantial funds for the construction of facilities for its production and raw materials for production are cheapest.

Taking biogas from other biofuels, we can say that for its production raw materials from crop and livestock sectors can be used. Thus, in a plant-grower the output of raw material is almost independent on the productivity of cultures, as wastes are used, as well as in a stock-raising. But the output of raw material from a stock-raising depends on the population of animals. Therefore, we can predict that the development of biogas production will increase demand for raw material of stock-raising origin, that can result in the increase of population of animals in Ukraine, which is important for Ukraine [1].

Having regard to energydependence of our state and considerable volumes of import of gas, production and use of biogas acquires outstanding meaningfulness.

**Analysis of recent publications.** The number of home and foreign scientists works on the problems of production and consumptions of biogas, including A. Steinhauer, N. Board, G.M. Kaletnik, V.A. Dubrovin, M.O. Korchemnyy, G.G Geletukha, Y. Kernasyuk.

The common work of such scientists as G.Geletukha, P.P. Curls and J.B. Matveeva «Prospect of production and use of biogas in Ukraine» causes considerable interest, it combines the analysis of European and Ukrainian experience, as well as incentives and barriers on the way of development of biogas production in Ukraine and suggestions for its improvement.

A significant step in the development of biogas industry is made by an expert group, consisting of Ukrainian and foreign specialists in the field of bioenergy – the concept of the national project «Biogas Energy».

**The purpose** of the study is to analyze economic pre-conditions of necessity of development of biogas industry in Ukraine and research perspectives of biogas production from the different types of raw material and use of it as substitute of natural gas.

**Methodology of reseaches** includes the tools of economic researches, including monographic method (at the analysis of the last researches and publications), methods of analysis, statistical and graphic methods. The method of comparison, in particular, with the countries of EU, is important for research of this subjects, giving more complete picture of the situation in Ukraine and approximately outlines the prospects of our state in biogas industry.

**Research results.** If for Europe gradual transition from mineral to biofuel - is, first of all, environmental issues, for Ukraine it is, foremost, the question of economic politics and reduction of energy dependence.

Ukraine consumes the considerable amount of natural gas, but the gas produced in the country, provides necessities only on a third. Annually the country

produces about 18-20 billion cubic meters of natural gas, and the volumes of its consumption vary in a range from 45 to 60 billion cubic meters (table 1).

*Table 1*

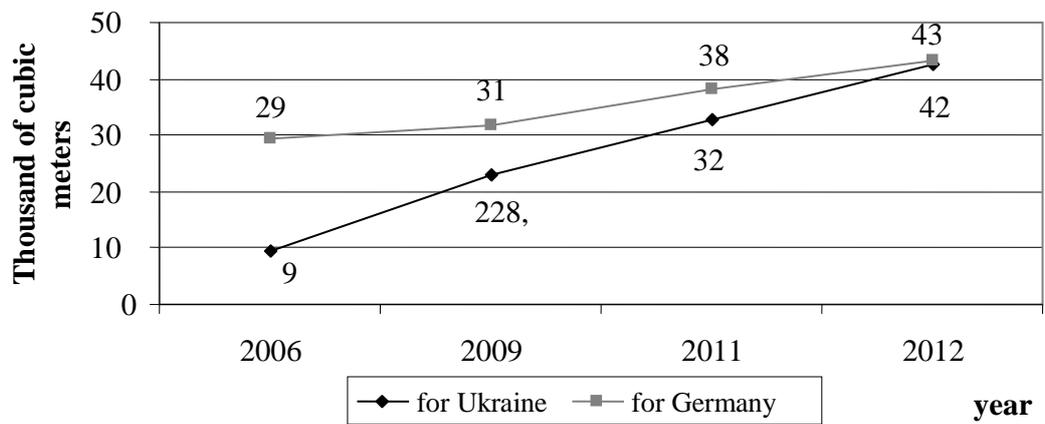
**Indicators of production and import of natural gas to Ukraine**

<b>Indicators</b>	<b>Units</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>
Extraction of:					
natural gas	billion cubic meters	20,7	20,0	19,3	19,2
petroleum gas	million cubic meters	744,0	655,0	719,6	723
gas condensate	million tons	1,1	0,9	0,8	-
Imports of natural gas, including from:	million cubic meters	38,0	36,6	44,8	32,9
Russian Federation	million cubic meters	22,2	36,6	40,0	32,9
Kazakhstan	million cubic meters	5,0	-	1,5	-
Turkmenistan	million cubic meters	4,5	-	1,7	-
Uzbekistan	million cubic meters	6,2	-	1,5	-
The volume of natural gas consumed	million cubic meters	50,1	46,1	59,3	54,8
Transported through Ukraine (transit)	million cubic meters	95,2	98,6	104,2	84,3

*\* Source [2]*

The development of biogas technologies in Ukraine will allow in a prospect to substitute from 2.6 to 18 billion of m<sup>3</sup> of natural gas per year. Having regard to the dynamics of price on natural gas (Fig. 1), it will give an opportunity to save considerable financial resources.

The cost of biogas production in Ukraine is \$25-35 per 1000 cubic meters, for comparison, in 2012 our country pays Russia for import (taking into account the discounts) \$425. The economic benefits from substituting natural gas biogas is obvious.



**Figure 1. Dynamics of prices for natural gas for Ukraine and Germany**

*\* Is based on analytical data*

Raw materials for biogas production both in our country and abroad are extremely diverse. Thus, in 2011 in European Union 56.7% of biogas was produced on biogas plants that use agriculture waste as a raw material and specially grown plant material. About a third of biogas (31.3%) was received at landfills. The rest (12%) generated by the sewage treatment plant. Thus? different European countries have different specializations. Biogas from solid waste landfills play a major role in Great Britain, France, Italy and Spain, while biogas from agricultural waste and plant material dominates in Germany, the Netherlands, Czech Republic, Austria, Belgium, Denmark and Eastern Europe.

In Ukraine biogas potential assessed within 30-40 billion m<sup>3</sup>, or 10.98 million tons of conditional fuel, including 6.0 million tons that can be obtained from animals' and birds' manure, for 2.0 million tons - from beet cobs (sugar beets) and corn silage (at the productivity of 200 kg/ha), 0.77 million tons of fuel - using as raw material landfills of solid waste and 0.21 million tonnes – due to fermentation of sewage treatment plants sediment [4].

We will stop more detailed on landfills of solid household waste as raw material for biogas production. Projects on their use actively function in the USA and most European countries (Germany, Austria, Denmark, Sweden and Belgium).

Thus, in 2025 the U.S. plans to receive annually 29 billion kilowatt-hours of electricity using household waste and landfill gas. In Europe, a leader in energy

production from municipal solid waste is France, where about 130 plants work on utilization waste energy, generating 3.34 billion kilowatt-hours of electricity and 9.44 million Gcal of thermal energy per year.

In relation to Ukraine, according to experts, nearly 4% of the territory is occupied by various types of waste, and it is approximately 35 billion tons of waste. In addition, there is a big problem of their utilization in landfills. The total mass of solid waste, collected annually in Ukraine, is about 15 million tons. Most waste of household origin (90%) is transported to the landfill. Total number of landfills, suitable for biogas production, is estimated at 140, 90 of which are large and contain 30% of household waste of Ukraine (in regional centers and cities with a population of over 100,000 inhabitants) (Fig. 2).



**Figure 2. Landfills of Ukraine, the most perspective for biogas energy (collecting area > 200 000 inhabitants)**

*\* Source [5]*

Power potential of biogas from household waste and sewage treatment plants is therefore real. It is about 0,2 to 0,3 million tons of conditional fuel per year on 90 largest landfills.

The successful implementation of bioenergy projects from landfill biogas prerequisite is a presence of consumer power (especially heat) near landfills. It is

therefore within the power projects such consumers (eg, greenhouses for growing flowers) are created quite often. Another option is to create energy projects to produce only electricity, but such projects are less profitable - heat is still produced, but not consumed.

Biogas produced at the landfill can be transported over a distance. This is done usually by means of plastic pipes. According to local experts STU "Biomass" (Kyiv), biogas landfill should be transported over a distance of about 3 km from the landfill. Today in Ukraine there is a number of facilities for the production of biogas from solid waste, including landfills in Yalta, Alushta, Lviv, Mariupol, Kremenchug, Lugansk, Kiev, in Bortnytska aeration station (Table 2).

*Table 2*

**Existing systems for collecting and utilization of biogas at landfills**

Landfill	Ammount of solid waste, million tons	Landfill area, ha	The period of landfill operation	Beginning of biogas collection	Utilization technology
Alushta	1	3,2	1960	2008	FP* HOFGAS-Ready 500
Yalta	1,3	5	1973-2010	2008	FP HOFGAS-Ready 800
Lviv	4	26	1957	2009	FP HOFGAS-Ready 2000
Mariupol	2,5	14	1967-2009	2010	FP HOFGAS-Ready 800
Kremenchug	2,8	15	1965	n/f	FP Haase
Lugansk	2	11,6	1979-2010	2011	FP Biogas Ltd, UK, 600 m <sup>3</sup> /h
Zaporozhya	3,2	11	1952	2011	FP Haase
Vinnitsa	3	10	1980	2012	FP Haase
Kyiv	10	36	1986	2012	ISE TEDOM 5x189 kWt

\* flare plant

*\* Source [3]*

Project on the Kyiv landfill №5, realized by a company LNK, is the most successful Ukrainian biogas project. The line of five biogas engines of company TEDOM with the set power 177 kWt each. works on this landfill.

**Conclusions.** Biogas is certainly a perspective direction of reducing energy dependence of our country. The development of biogas technologies will form an alternative gas-fuel resource, will help to create new workplaces and develop the local economy. Among other sources of raw materials for biogas production landfills of solid household waste are in a special place, they can leave off to be a source of pollution of atmosphere and territories, and, last but not least, be able to make a profit. In Ukraine there are about 140 landfills, suitable for biogas production, their use will be an important step of decision of number of economic, environmental and social problems.

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### ***Анотація***

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#### ***Біогаз в Україні: економічні і технологічні перспективи***

*В статті розглянуто економічні передумови необхідності розвитку біогазової галузі в Україні. Розглянуто сировинну базу виробництва біогазу в Європейському Союзі та в нашій державі. Зроблено акцент на сучасному стані та перспективах розвитку технологій виробництва біогазу на полігонах твердих побутових відходів.*

***Ключові слова:*** біогаз, природний газ, полігони твердих побутових відходів, енергетичний потенціал біомаси, умовне паливо.

### ***Аннотация***

***Скорук О.П., Токарчук Д.М.***

#### ***Биогаз в Украине: экономические и технологические перспективы***

*В статье рассмотрены экономические предпосылки необходимости развития биогазовой отрасли в Украине. Рассмотрена сырьевая база производства биогаза в Европейском Союзе и в нашем государстве. Сделан акцент на современном состоянии и перспективах развития технологий производства биогаза на полигонах твердых бытовых отходов.*

***Ключевые слова:*** биогаз, природный газ, полигоны твердых бытовых отходов, энергетический потенциал биомассы, условное топливо.