

THE UTILIZATION OF BIOGAS IN SLOVAKIA

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ABSTRACT

Fossil fuels cover 95 % of primary energy needs in Slovakia, and more than 90% of primary energy sources are imported. At the same time, Slovakia has a great potential to use biomass from own forests and agriculture. The paper finds potential of biogas acquisition from the agricultural biomass /excremental and energetic farm crops/ in Slovakia for the energetic purpose.

1. INTRODUCTION

The idea, that rotting vegetable matter gives off a flammable gas, has been understood since the ancient Persians. In modern times, the first sewage plant was built in Bombay in 1859; an idea that was brought to the UK in 1895, when the gas produced was used to light street lamps.

Biogas is a combustible mixture of gases (fig.1). It consists mainly of methane (CH₄) and carbon dioxide (CO₂) and is formed from the anaerobic bacterial and decomposition of organic compounds i.e. without oxygen. The gases formed are the waste products of the respiration of these decomposer micro-organisms and the composition of the gases depends on the substance that is being decomposed. If the material consists of mainly carbohydrates, such as glucose and other simple sugars and high-molecular compounds (polymers) such as cellulose and hemicelluloses, the methane production is low. However, if the fat content is high, the methane production is likewise high. Methane and whatever additional hydrogen, there may be makes up the combustible part of biogas [5].

Gas	%
Methane (CH ₄)	55 – 70
Carbon dioxide (CO ₂)	30 – 45
Hydrogen sulphide (H ₂ S)	} 1 – 2
Hydrogen (H ₂)	
Ammonia (NH ₃)	
Carbon monoxide (CO)	trace
Nitrogen (N ₂)	trace
Oxygen (O ₂)	trace

Figure 1 - Composition of biogas.[1]

Methane is a colourless and odourless gas with a boiling point of -162°C. Methane is also the main constituent (77-90%) of natural gas. Biogas is produced naturally in swamps, bogs, rice paddies and in the sediment at the bottom of lakes and oceans where anaerobic conditions prevail at a certain depth.

A biogas plant has a cyclical system. The basis of the system is biomass, in other words slurry, manure, organic waste and fuel crops such as corn. The biomass is fermented in the plant to create biogas. It can be used for a number of different applications, primarily the generation of heat and power on-site or feeding an existing natural gas network. The residue of the fermentation process can be reused as high-quality farmland fertiliser to help grow plants. Biogas process is shown on (fig.2).[3]

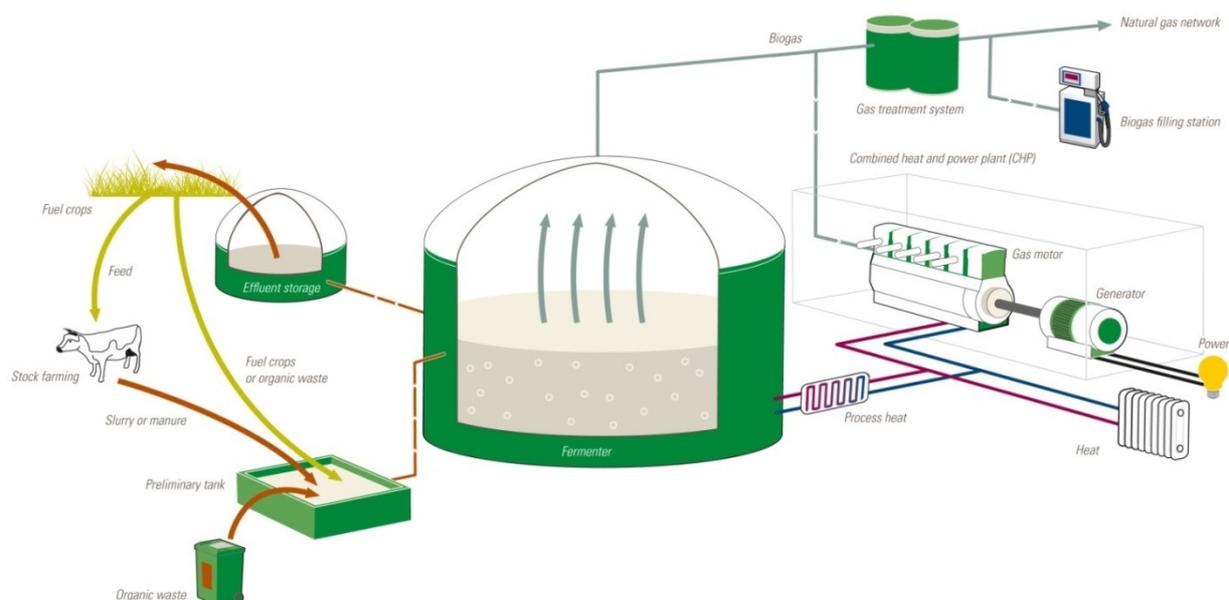


Figure 2 – Biogas process.[2]

2. BIOGAS IN SLOVAKIA

The utilization of biogas in Slovakia is completely negligible. There are only 5 biogas plants, which use agricultural biomass. An overview of biogas stations operating in Slovakia is presented in Table 1. The interest in using biomass for energy production has been growing over recent years, along with realisation of the environmental effect caused by use of fossil fuels. Biogas plants are most efficient on larger farms, where the animals can provide the plant with sufficient amounts of manure. Biogas plants may also be advantageous in light of the local environmental problems often caused by large, concentrated populations of farm animals. Based on the type of waste used, biogas plants in Slovakia can be divided into the following groups:

- **Agricultural biogas plants.** These technologies make use mainly of materials from agricultural production. Among these waste materials, by products from animal production such as manure is most utilized.
- **Industrial biogas stations.** These stations use wastes produced mainly from various industrial production. Most of these wastes are from agro-food chemistry (residue from alcohol production, waste oil, slaughterhouse waste, waste from differing food chemistry or pharmaceutical fermentation production).
- **Communal biogas stations.** These stations have been built primarily as municipal properties. They provide for community waste management, where the biggest share is generated by separation of the biological component of community waste, such as waste from restaurants and dining halls, and green waste from lawn maintenance [3].

Table 1 - The overview of biogas stations operated in present in Slovakia [2]

Biogas station	Main raw	Installed el. perform. kWe	Operated since
AGROS Ltd. Bátka	Swine manure, till 2000 also poultry dung	6x128	1995
PPD Brezov	Black cattle manure	50	1998
VPP SPU Ltd. Koliňany	Several substrates, mainly manure from farm animals	22	2001
PD Kapušany	Farm animal manure, cornsilage	120	2005
STIFI Hurbanovo	Cornsilage	300	2005

There were built some new biogas plant in Slovakia of recent years e.g **Veľké Uherce**- the station has an installed capacity of 0,999 MWe. The plant started to operate in 2011. **Ožďany I**- the station has an installed capacity of 0,99 MWe. The plant started to operate in 2012. **Ožďany II**- the station has an installed capacity of 0,99 MWe. The plant started to operate in 2012.

In Slovakia approximately 69 GWh/year of electricity are produced from biogas. In most of the cases the biogas is derived from sewage sludge (10 plants), and from agricultural biogas plants processing energy crops and manure (12 plants) as well as plant using waste from food industry.[3]

3. POTENTIAL OF BIOGAS IN SLOVAKIA

Nevertheless, there is still a high potential for biogas production in Slovakia, and it is nearly unused. Thus, the technical potential for energy produced by biogas in Slovakia has been calculated to be 4,190 GWh/year. In table 2 we can see the potential for biogas production from maize silage in different regions of Slovakia. Today, the biogas sector is best developed in Germany, Austria and Sweden, but countries including the UK, Italy and Slovakia also started to promote this energy source. Recently some biogas stations were constructed and few others are considered to be constructed but according to misty energy policy of the government in the area of renewable energy sources they represent only small share of biogas production [2],[4].

Table 2 - The potential for biogas production from maize silage in different regions of Slovakia [3]

Region	Maize silage (t/year)	Biogas yield [m3/t]	Biogas production [m3]
Bratislava county	32 146,26	200	6 429 252,83
Trnava county	203 331,47	200	40 666 293,98
Trencin county	24 498,53	200	4 899 706,65
Nitra county	257 743,91	200	51 548 781,47
Zilina county	670,73	200	134 146,00
Banska Bystrica county	40 307,88	200	8 061 576,12
Presov county	7 762,19	200	1 552 437,74
Kosice county	51 018,20	200	10 203 640,82
Slovakia Total	597 005,08	200	119 401 016,93

4. POTENTIAL OF BIOGAS IN EUROPE

In 2010, primary production of biogas in Europe was 10.9 Mtoe, an increase of 31% compared to 2009. In 2020 biogas could deliver more than a third of Europe’s natural gas production or around 10 % of the European consumption. Within the overall potential of biomass for energy in Europe biogas could reach 15 % to 25 % of total bioenergy, as compared to 7 % in 2007. Future biogas potential in the EU will also be determined by the contribution of energy crops. By 2030, up to 650 billion kWh of primary energy – with 370 kWh from biogas – could be generated from energy plants. Biogas potential of Europe is shown on (fig. 3) [4],[2].

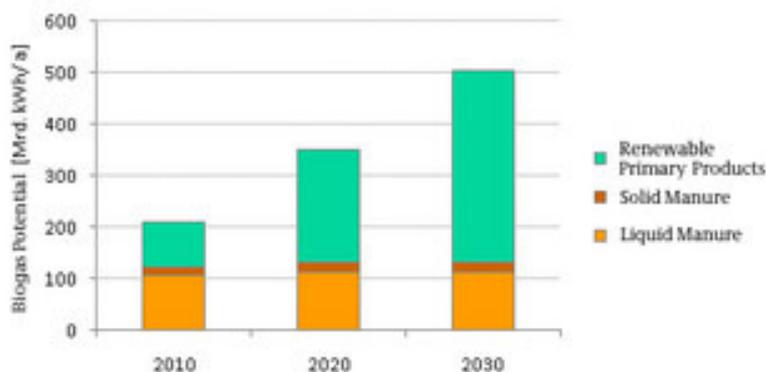


Figure 3 – Biogas potential of Europe [4]

5. CONCLUSION

Today, alternative energy sources receive great interest from the scientific community. Traditional fossil sources of energy are non-renewable. Consumption of electricity is increasing but resources of traditional fuels are decreasing. Therefore it is very important using renewable energy sources. Biogas is considered as a very good source of electricity and heat. Slovakia as an agricultural country has a big potential for biogas. Biogas will play an important role in Slovakia and Europe in the future.

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ACKNOWLEDGEMENT



This work was supported by the Agency of the Ministry of Education of the Slovak Republic for the Structural Funds of the EU under the project Development of Low Power Static Supply for Electric Systems (project number: 26220220029, priority axis 2 Support to research and development).