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Potentials and status of biogas as energy source in the Republic of Serbia

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ABSTRACT

Biogas is a sustainable and renewable energy source that can provide green energy, a better environment and new jobs. The aim of this paper is to present potentials for biogas production in the Republic of Serbia from different sources (agricultural crops directly provided for energy, livestock residues, municipal solid waste, slaughterhouse waste and wastewater from milk processing industry) and to analyze the current situation in this sector in Serbia. The barriers that limit the wider production of biogas are considered. Results have shown that there is a great potential for biogas production in Serbia. The yearly potentials were calculated as follows: biogas production potential from agricultural crops directly cultivated for energy is 0.85 Mega tons of oil equivalent (Mtoe); potential from livestock residues amounts to 94.13 ktoe; potential from municipal solid waste (MSW) is 49.72 ktoe; potential from slaughterhouse waste is 9.94 ktoe and potential from milk processing industry is 3.21 ktoe. The analysis of incentives, barriers and status of biogas technologies presented in this paper represents a contribution for the further improvement and analysis of the biogas sector in the Republic of Serbia.

Contents

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1. Introduction

Energy sector has an important economic role as the largest economic sector in the Republic of Serbia and contributes to more than 10% to Gross Domestic Product (GDP). Total consumption of primary energy in Serbia was 16.19 Mtoe in 2011 [1] out of which domestic production accounted for 62% and imports for 38%. Domestic production of primary energy includes exploitation and use of domestic resources of coal, crude oil, natural gas and renewable energy sources (hydro-potential, fuel wood, pellets, briquettes, geothermal energy, etc.).

Climate change, mainly caused by increased greenhouse emissions and reduction of fossil fuel reserves, initiated a number of measures on the global level. One of them is the increased use of renewable energy sources (RESs). The European Union Directive 2009/28/EC [2] defines detailed objectives in that area. The Republic of Serbia, as a candidate for membership in EU, is obliged to follow policy of the European Union and to implement concrete measures to support production and the use of renewable energy for the production of "green" energy.

Two priorities regarding the renewable energy sources exist in the Republic of Serbia [3]:

1. Establishing a long-term stable and supportive regulatory framework for RES.
2. Development and construction of new energy infrastructure facilities (power, thermo-power plants and energy networks) for RES.

Biogas is a renewable energy source that is generated from biomass under anaerobic conditions. Common sources for biogas production are agricultural crops, livestock residues, municipal solid waste, and organic waste and wastewater from different sectors. Biogas contains a high percentage of methane (50–75%) and biogas technology has great potential to reduce methane emissions to the environment. Serbia has relatively good conditions for biogas production, especially in agricultural sector, ensuring that this production does not influence the price of food on the market. The official register of biogas production potentials from different materials and industries does not exist in Serbia. Also, there is no adequate estimation of the potential for biogas production from agricultural land that is directly used for production of energy, taking into account the impacts on food prices and the loss of biodiversity. The Republic of Serbia also does not have reliable estimation on potential for biogas production from waste streams (municipal solid waste and waste streams from industrial systems-meat industry and milk industry), which contain significant amounts of organic matter that can be used as a substrate for biogas production. The review of biogas production potentials in this work represents a contribution to the analysis of the possibility of biogas production from different sources in Serbia. Through an integrated approach in analyzing the potential for biogas production from the most important resources, as well as by analyzing of existing economic and administrative barriers for use of biogas, it is intended to lay the groundwork that would serve to identify the real economic and sustainable potentials of production and application of biogas in the Republic of Serbia.

By signing the Treaty establishing the Energy Community of Southeast Europe and EU, Serbia has accepted the obligation to apply all the directives related to the renewable energy sources. Also, Serbia has accepted the obligation to increase the share of renewable energy sources in gross final energy consumption from 21.1% in 2009 to 27% in 2020. The share of electricity produced from hydro potential in the gross final energy consumption amounted to 9.6% in 2009, while the share of heat produced from biomass in gross final energy consumption amounted to 11.5%. Expected gross final energy consumption in 2020 is 10,330 ktoe [4]. In order to reach the mentioned target, the Republic of Serbia has prepared National Renewable Energy Action Plan (NREAP) up to 2020 [4]. According to the NREAP, the Republic of Serbia would produce 30 MW of energy from biogas plants till 2020. Biogas can be an important energy source in Serbia and contribute to the improvement of the energy sector, environment protection, job creation and rural development.

The aim of this paper is to present potentials for biogas production in the Republic of Serbia from different sources: agricultural crops directly provided for energy, livestock residues, municipal solid waste, slaughterhouse waste and wastewater from milk processing industry and to analyze the current situation in this sector considering the current barriers which limit the wider use of energy obtained from biogas in the country.

2. Review of different sources for biogas production in Serbia

Appropriate raw material for production of biogas must contain organic material that is suitable for anaerobic digestion. Such raw materials are agricultural biomass residues, livestock residues, municipal solid waste, animal waste and wastewater from food industry. Biogas production from different materials must be sustainable and should include energy, environmental and economic considerations. In the following sections, the review of different raw materials for the production of biogas and their availability in Serbia are discussed.

2.1. Agricultural crops

Agriculture is an important sector of the Serbian economy accounting to about 20% of the total employment and 8.3% of GDP. From 7.8 million ha of the total land area of Serbia, the area devoted to agriculture constitutes 5.1 million ha out of which 1.55 million ha are grassland, 3.35 million ha are cultivated. Every year over 0.2 million ha are left fallow [4].

Production of major crops in Serbia for the period 2007–2011 is shown in Fig. 1.

The largest part of crop residues comes from corn and wheat. These two cultures are dominant species in the field of crops. The amount of crop resides is about 12 million t/year. It is estimated that one-third of the total crop residues can be used for energy purposes. Application of biomass for energy production in the Republic of Serbia has already been investigated [5–9]. According to the Serbian Action plan for biomass for the period 2010–2012, potential in agricultural sector for energy production is over 1 Mtoe: crop residues 1.023 Mtoe and liquid manure for biogas