THE POTENTIAL OF LANDFILL GAS UTILIZATION FOR ENERGY PRODUCTION IN THE REGION OF SOUTH EAST EUROPE

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Overview

South East Europe (SEE) represents a geographical and historic region with certain countries being gradually accepted into the European Union (Golušin and Munitlak-Ivanović, 2009). SEE countries have been facing various common energy-related problems (Dominković et al., 2016). The countries of SEE are contractually obligated through a treaty with the EU to implement Directive 2001/77/EC and 2003/30/EC with the goal of increasing the utilization of renewable energy sources and reducing GHG emissions.

Due to their reduced dependence on fossil fuel resources, renewable energies are crucial contributors to the energy supply portfolio as they provide opportunities for reducing emissions of GHG as well as contribute to world energy supply security. Renewable energies, such as bioenergy, are gaining a lot of attention and importance within the European and worldwide energy policy frameworks, as they are reaching the technical maturity to meet a large percentage of the global energy demand (Burlando et al., 2009).Biomass for the production of bioenergy comes from various sources with waste being a significant contributor (Jose and Bhaskar, 2015). Biodegradable waste is converted into energy by anaerobic digestion and composting processes, which is a method each country can use to exploit the energy potential of this type of waste in order to ensure energy security and sustainable development (Bajić et al., 2015). This is why it is crucial to properly manage waste and use it for energy production.

Waste management is a major global problem that is especially severe in developing countries where increasing but poorly planned urbanization, as well as a lack of adequate resources lead to inadequate waste management practices (Gorsevski et al. 2012). Safe disposal of waste is one of the major environmental issues facing society today, and landfills represent the most economical and simple means of disposing waste globally and will likely remain the most widely used method despite a significant increase in the reduction, reuse and recycling of waste. Landfilling creates a certain sets of problems, such as leachate generation, GHG emissions and other environmental impacts. However, landfills can provide a potential source of methane as a fuel source with the introduction of gas recovery systems. Combustion of landfill gas for energy production reduces GHG emission mainly by preventing the release of methane into the atmosphere (Bolan et al., 2013). Therefore, the aim of this paper was to examine the current state of waste generation and management in the region of the SEE as well as potential of energy production on landfills.

Methods

This paper is based on literature review of waste management in the region of SEE. In order to summarize the available data on the issue, a comprehensive survey of available scientific literature was performed.

Results

Since waste generation and management are mostly associated with the economic status of a society, developing countries lack proper environmental legislation, financial management and administrative capacities due to their weak economy and other social factors, which ultimately results in poor waste management. Increasing amounts of untreated waste are mainly deposited in existing dumpsites and landfills which doesn't enable the exploitation of resources from waste, represents a huge loss of potential revenue and an environmental threat.

The available literature data shows the amounts of generated waste in each of the SEE countries.

Albania: Municipal solid waste generated in Albania in total is about 825,000 tons per year in 2012 or about 266 kg per capita per year, out of which the percentage of biodegradable matter was about 62.3%, and in 2013 the amount of generated waste was 1,039,455 tons (Alcani and Malca, 2015).

Bosnia and Herzegovina: According to the Agency for statistics of Bosnia and Herzegovina the estimated quantity of generated municipal waste in 2016 is 1,243,889 tons, which is 354 kg per capita per year, or 0,97 kg per capita per day. In the total amount of collected waste, mixed municipal waste accounts for 91.7%, separately collected waste 3.6%, waste from gardens and parks 2.8% and packaging waste for 1.9%.
Croatia: According to the waste management plan of the Republic of Croatia for the period 2017-2022 in 2014 the total amount of generated waste (municipal and industrial) was around 3.7 million tons which is a 10.5% increase since 2012, out of which only 3% was hazardous. Total amount of generated municipal waste in 2015 was 1,653,918 tons or 386 kg per capita.
Macedonia: Total amount of generated waste in FYR of Macedonia annualy is estimated at 26 million tons, while the total amount of municipal waste is 572,381 tons (Jordeva et al., 2013).
Montenegro: Report of the implementation of the National plan of waste management for 2013 in Montenegro states that the total generated amount of municipal waste is 243.941 tons.
Serbia: According to the data of the statistical office of the Republic of Serbia in 2016 total amount of generated waste was 47.1 million tons, out of which is 63.5 % non-hazardous waste. Largest generator of waste is the mining industry at 44.3%.
According to Eurostat statistics (http://ec.europa.eu/eurostat) the largest part of the generated waste is deposited into landfills in Montenegro, Macedonia and Serbia (97.3-98.8%), while this percentage is slightly lower in Albania (74.8%) and significantly lower in Croatia (51.1%) where a large percentage of waste is recycled (45.5%). Considering that waste management mainly consists of landfilling, and taking into account that landfills especially if not properly managed are environmental pollutants, it is necessary for the countries of the region to recognize the potential of landfills and develop strategies for their utilization for energy production.
In the paper by Bolan et al., 2013 potential estimated quantities of methane and electricity production from landfills in various countries are shown. The presented data shows that it is possible to produce significant amounts of biofuel and energy from landfills. It is for this reason, in addition to the fact that most waste in the region is deposited into landfills, that producing landfill gas would increase energy security as well as reduce the negative environmental impact.
Landfill gas with an average content of methane over 50% is an excellent fuel for specially designed gas engines due to its lower heat value of 5kWh/Nm^3. 1 Nm^3 of landfill gas produces 2 kWh of electricity and 2.15 kWh of heat. 1 ton of municipal waste over 20 years generates an average of 200 Nm^3 landfill gas, which is used as a starting calculation in order to calculate energy balance. A city of 150,000 inhabitants generates 50,000 tons of waste per year, which over 20 years equates to 200 million m^3 of landfill gas. If gas engines were to utilize even 50% of this gas , that is 5 million Nm^3 per year or 625 Nm^3 per hour. This amount of gas used as fuel would generate 9 million kWh of electricity and 12 million kWh of heat in addition to reducing methane emission by 300 Nm^3 per hour (Ugrinov et al., 2012).

Conclusions

Using landfill gas as an energy source is a possible solution for problems regarding waste management and environmental pollution in addition to being a way of generating energy. The main limitations for energy production in developing countries are the lack of a national landfill gas programs, funding, incentives, research and technological development in the fields of anaerobic digestion and energy generation out of landfill gas.